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Satellites & Space-Related Systems
Defense: Radar, Missiles & Electronic Warfare
Engineering and Signal Processing
Acoustics, Underwater Sound & Sonar
Systems Engineering & Project Management

www.ATIcourses.com
Technical and Training Professionals:

For over 34 years, the Applied Technology Institute (ATI) continues to earn the trust of and provide solutions to technical professionals and training departments.

In October 2018, Eric Honour and Jim Jenkins were pleased to announce the merger of Honourcode with ATI. Eric Honour will stay on as Technical Director of the Systems Engineering courses. Eric and all of his fine instructors will continue to teach both open enrollment and on-site courses for ATI. ATI will now be handling the contracting and logistics for all training in 2019 and beyond.


ATI continues to offer more leading courses in:

• Systems Engineering & Project Management
• Satellites, Satellite Communications, & Space-Related Systems
• Defense: Radar, Missiles, & Electronic Warfare
• Engineering & Signal Processing
• Acoustics, Underwater Sound & Sonar

This catalog includes upcoming open enrollment dates for many of our courses. More courses are available for on-site delivery. These courses can be found on our website: ATIcourses.com.

Our team of specialists are available to address your training with open enrollment registrations or to send proposals when an on-site will better fit your requirements. You can save significantly with an on-site course for a group of 10 or more.

Contact us for a free proposal. We’re experienced and here to help.

Regards,

P.S. Connect with me (Jim Jenkins) on LinkedIn. I have more than 5740 connections including many technical experts & instructors. Easily expand your LinkedIn network now by connecting with me.

Eric Honour                                        Jim Jenkins
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What You Will Learn

You will benefit by enhancing your understanding of:

1. Role of C4ISR in the modern military and how to measure its effectiveness.
2. Theory and operations of command, control and communications (C3) systems.
3. Physics of materials signatures, sensors, and detection mechanisms.
4. Technologies and systems used to collect, fuse, and disseminate information.
   • DoD vision for networking a system of systems to support Joint Vision 2020.

Summary

This three day course delivers a thorough overview promoting an understanding and building a successful C4ISR architecture. Through technological innovation, modern warfare is conducted at longer ranges and with greater precision than ever before. Overall mission effectiveness increasingly depends upon systems and services external to a weapon system. Those systems and services fall in the domain of "C4ISR." This course presents a comprehensive view of C4ISR systems from Global Hawk to JSTARS and the associated architectures. It begins with fundamental scientific principles, shows how those principles are exploited in various technologies, describes current systems that take the technology into the theater of war, and concludes with a look at the vision of the future "network-centric" battlespace.

Instructor

Dr. Clayton Stewart has over 30 years of experience performing across the spectrum of research direction, line management, program management, system engineering, engineering education, flight operations, and research and development. He has had extensive involvement at all levels as Technical Director, Principal Investigator, Operations Manager, Director of Research, Program Manager, Associate Professor, Chief Scientist, Systems Analyst, Member of the Technical Staff, and Aircrew Member. He has performed engineering and operations analysis on a large variety of C4ISR systems such as Global Hawk, JSTARS, U-2, JTIDS, and Have Quick.

Course Outline


3. ISR. Fundamentals, Ops, and Examples: Target Signatures, Receiver Operating Curves (ROC), Current and Future Systems, Passive Sensors, Signals Intercept, Direction Finding, IR, Multi-/Hyper-Spectral characteristics and effectiveness, Radar: Ground Moving Target Indicator (GMTI), Synthetic Aperture Radar (SAR), Inverse SAR, Clutter and Noise considerations. Intelligence Tasking Processing Exploitation Dissemination (TPED), Signals Intelligence (SIGINT), Imagery Intelligence (IMINT) Sensors Tracking/Measurement Association: Kalman Filters, Multiple Hypothesis Tracking, Platforms and Sensors –Space Based Radar (SBR), Satellite Constellations, Persistent Coverage, ISR satellite constellations, Unmanned Aerial Vehicles (UAV), Manned Platforms, Maritime Domain Awareness (MDA).


Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805

May 14-16, 2019
Columbia, Maryland
$2090  (8:30am - 4:30pm)
Register 3 or More & Receive $1000 Off The Course Tuition.
**What You Will Learn**

- Objectives and concepts of cybersecurity.
- Techniques and tactics of cyber attackers.
- Foundational elements needed to secure a system.
- Tradeoffs between cryptographic techniques and applications.
- Value and limitations of firewalls, intrusion detection and prevention systems.
- Architectures to control and constrain adversary behavior.
- Current capabilities for trustworthy computing and their applications.
- Cloud and database security challenges.
- Current standards and protocols for secure communication and authentication.

**Instructor**

Julie Tarr has over 30 years of experience developing, analyzing, testing, and deploying cybersecurity solutions for government computing environments. Ms. Tarr's experience includes cryptographic systems, cross domain solutions, intrusion detection, security protocols, cyber deception, and security architectures. Ms. Tarr is currently the Program Manager for Cyber Defensive Systems at the Johns Hopkins University Applied Physics Lab. Before joining JHU/APL, she was the head of the Network Security Section of the Center for High Assurance Computing Systems at the Naval Research Lab. Ms. Tarr teaches cybersecurity at the graduate level for the JHU Whiting School of Engineering.

**Summary**

This three-day course provides an overview of cybersecurity principles and mechanisms and highlights the challenges of protecting computing systems from determined adversaries. The course provides an understanding of the foundational elements of information security. It also gives the student an awareness of the current threat environment and architectures, mechanisms and technologies used to contain, constrain, and control adversarial actions.

Real world examples are provided to help understand the capabilities of cyber adversaries and the impact of their activities.

The course is valuable to scientists, engineers and operators who are entering the field or as a review for employees who want a comprehensive overview. A complete set of notes and references will be provided to all attendees.

**Course Outline**

5. Access Control. Control of access to computing resources and data. Access control models including DAC, MAC, RBAC, and ABAC.
Electronic Protection and Electronic Attack
With In-Depth Discussions of Modern Technology and Operational Techniques

February 5-7, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each Off The Course Tuition.

Summary
This three-day course addresses the key elements of electronic attack (EA) and electronic protection (EP). This includes EA/ECM principles, philosophies, and strategies; basic radar systems and waveforms; the radar range equation and how to manipulate it to derive basic noise and deception jamming equations; electronic attack techniques and waveform generation; electronic protection techniques; threat system analyses; applications to communication and infra-red countermeasures concepts; expendables including lethal systems; and testing and evaluation methods and limitations.

Instructor
Dr. Clayton Stewart has over 30 years of experience performing across the spectrum of research direction, line management, program management, system engineering, engineering education, flight operations, and research and development. He has had extensive involvement at all levels as Technical Director, Principal Investigator, Operations Manager, Director of Research, Program Manager, Associate Professor, Chief Scientist, Systems Analyst, Member of the Technical Staff, and Aircrew Member. He served as an Electronic Warfare Officer and Electronic Warfare Engineer in the US Air Force.

What You Will Learn
• ES, EW, and ELINT receiver architectures and techniques.
• Radar range equation, sensitivity, detection, Pd and Pfa.
• Direction finding and location.
• Electronic attack techniques.
• Fundamental ECM principles.
• Basic jamming equations and J/S.
• Interactions between electronic attack and electronic protection.

From this course you will obtain knowledge and understanding of the fundamentals and principals of electronic attack and electronic protection.

Course Outline
1. EW Basic Concepts and Terminology. Signals and the electromagnetic environment; electromagnetic propagation; antennas used for EW and radar; solid state power electronics; radar systems Radar Basics … Need to understand what to Jam.

2. Basic Radar Systems. Types of radars Modern Radar Trends, Pulse Environment / Pulse Density, Modern Radars, Weapons, the Signal Environment & Integrated Weapon Systems, Target Acquisition and Guidance Techniques / Technologies; Doppler processing; threat radars; radar cross section (RCS); stealth; radar and EW link equations; integrated air defense systems.

3. Radar and Communications Systems. Russian and Chinese radar systems; communication systems; communications electronic protection (EP); signals intelligence (SIGINT).

4. EW Receiver Types and Characteristics. Electronic warfare support; types of EW receivers; radar warning receivers (RWR); EW receiver characteristics.

5. EW Processing and Electronic Attack (EA). EW receiver characteristics; EW signal processing; emitter location techniques; Electronic Attack (EA): Denial EA (Noise), Deception EA (False Targets); Basic Noise Jamming Equations, Noise Techniques, Search Radar Jamming Process, Noise EA Analysis Examples.


Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
Electronic Warfare Receivers with Digital Signal Processing

May 20-23, 2019
Columbia, Maryland
$2290 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each
Off The Course Tuition.

Instructor
Dr. Clayton Stewart has over 30 years of experience performing across the spectrum of research direction, line management, program management, system engineering, engineering education, flight operations, and research and development. He has had extensive involvement at all levels as Technical Director, Principal Investigator, Operations Manager, Director of Research, Program Manager, Associate Professor, Chief Scientist, Systems Analyst, Member of the Technical Staff, and Aircrew Member.

Dr. Stewart is currently Visiting Professor, Department of Electronic & Electrical Engineering, University College London, and is consultant on international SAT engagement with clients including DARPA, NSF, and JHU Applied Physics Lab. From 1994 to 2007, Dr. Stewart worked for SAIC as Corporate Vice President / Manager of the Reconnaissance / Surveillance Operation. Business areas include R&D of UAV systems/technology, advanced communications systems, manned flight simulator systems, data warehousing, and sensor product processing and exploitation, including international R&D in UK and Taiwan. From 1990 to 1994 Dr. Stewart served as an Associate Professor of ECE and Associate Director (to Dr. Harry Van Trees), Center of Excellence in Command, Control, Communications, & Intelligence at George Mason University.

Dr. Stewart held positions in industry from 1984 to 1990 with Sperry Corp., ARCO Power Technologies, Inc. and Program Manager of the Artificial Ionospheric Mirror Radar project under joint Air Force/DARPA sponsorship.

Dr. Stewart left the US Air Force after 20 years as a Lt Colonel. During his final tour (1982-84), he worked with Air Force Studies & Analyses in the Pentagon. He developed and taught undergraduate EE courses and also served as Director of Faculty Research and Continuing Education.

Dr. Stewart graduated in 1973 from the University of Redlands with a BS in Engineering Science. He then received his MSEE in 1975 and his PhD from the Air Force Institute of Technology.

Dr. Stewart held positions in industry from 1984 to 1990 with Sperry Corp., ARCO Power Technologies, Inc. and Program Manager of the Artificial Ionospheric Mirror Radar project under joint Air Force/DARPA sponsorship.

Dr. Stewart left the US Air Force after 20 years as a Lt Colonel. During his final tour (1982-84), he worked with Air Force Studies & Analyses in the Pentagon. He developed and taught undergraduate EE courses and also served as Director of Faculty Research and Continuing Education.

Dr. Stewart graduated in 1973 from the University of Redlands with a BS in Engineering Science. He then received his MSEE in 1975 and his PhD from the Air Force Institute of Technology.

Summary
This four-day course addresses digital signal processing theory, methods, techniques and algorithms with practical applications to ELINT. Directed primarily to ELINT/EW engineers and scientists responsible for ELINT digital signal processing system software and hardware design, installation, operation and evaluation. It is also appropriate for those having management or technical responsibility.

Course Outline
Module.
• Electronic Warfare Overview focusing on ELINT/ESM
• Signals and the Electromagnetic Environment
• Antenna and Receiver Parameters: Sensitivity, Dynamic Range, Noise Figure, Inst. BW
• Detection Fundamentals - Pd, Pf, SNR, Effective BW
• Receiver Architectures: Crystal Video, IFM, Channelized, Superheterodyne (Narrowband / Wideband), Compressive (Microscan) and Acousto–Optic (Bragg Cell), DRFM
• Receiver Architecture Advantages / Disadvantages
• Radar Warning Receivers
• Architectures for Direction Finding
• DF and Location Techniques: Amp. Comparison/TDOA/Interferometer
• Signal Analysis
Module.
• Introduction - Digital Processing
• Basic DSP Operations, Sampling Theory, Quantization: Nyquist (Low-pass, Band-pass), Aliasing, Fourier, Z-Transform
• Quadrature Demodulation: Direct Digital Down-Conversion
• Digital Receiver “Components”: Signal Conditioning, (Pre-ADC) and Anti-Aliasing, Analog-to-Digital Converters (ADC), Demodulators, CORDICs, Differentiators, Interpolators, Decimators, Equalizers, Detection and Measurement Blocks, Filters (IIR and FIR), Multi-Rate Filters and DSP, Clocks, Timing, Synchronization, Embedded Processors
• Channelized Architectures
• Digital Receiver Advantages and Technology Trends
• Digital Receiver Architecture Examples
Module.
• Measurement Basics - Error Definitions, Metrics, Averaging
• Statistics and Confidence Levels for System Assessment
• Error Sources & Statistical Distributions of Interest to System Designers
• Parameter Errors due to Noise — Thermal, Phase & Quantization Noise impacts on key parameters — Noise Modeling and SNR Estimation
• Simultaneous Signal Interference
• A/D Performance, Parameters and Error Sources
• Freq, Phase, Amp Errors due to Quantization
• Combining Errors, Error Sources, Error Propagation and Sample Error Budget
• Performance Assessment Methods
• Receiver Equalization and Characterization

What You Will Learn
• EW/ELINT receiver techniques and technologies.
• Digital Signal Processing Techniques.
• Application of DSP techniques to digital receiver development.
• Key digital receiver functions and components.
• Fundamental performance analysis and error estimating.

From this course you will obtain the knowledge and understanding of digital signal processing concepts and theories for digital receivers and their applications to EW/ELINT/ESM systems while balancing theory with practice.
What You Will Learn

- Concepts and strategies of Electromagnetic Spectrum Warfare.
- Important EW calculations (including J/S ratio, Burn-through range, Intercept range, etc.)
- EW impact of improved capabilities of new radar and communications threat systems.
- New EW systems and strategies required to counter modern threats.
- Capabilities and applications of digital RF memories.
- Capabilities of modern IR weapons and countermeasures.
- Capabilities of radar decoys.
Summary
A thick swarm of radionavigation satellites – at least 128 of them! -- will soon be orbiting our home planet. They will be owned and operated by six different sovereign nations hoping to capitalize on the technical and financial success of America’s highly successful GPS. In this comprehensive four-day short course Tom Logsdon will describe in detail how these various international navigation systems work and he will review the many practical benefits they are providing to civilian and military users scattered around the globe. He will also describe the salient features of each navigation system, describe its signal structure, and explain how you can use it most effectively in practical situations.

Instructor
Tom Logsdon has worked on the GPS radionavigation satellites and their constellation for more than 20 years. He helped design the Transit Navigation System and the GPS and he acted as a consultant to the European Galileo Spaceborne Navigation System. His key assignments have included constellation selection trades, military and civilian applications, force multiplier effects, survivability enhancements and spacecraft autonomy studies.

Over the past 30 years Logsdon has taught more than 300 short courses. He has also made two dozen television appearances, helped design an exhibit for the Smithsonian Institution, and written and published 1.7 million words, including 29 non fiction books. These include Understanding the Navstar, Orbital Mechanics, and The Navstar Global Positioning System.

The instructor’s vast experience and his ability to explain difficult topics in simple terms made this course a real joy to attend . . . Marvelous presentation style.”

Alessandro B. - ITA Flight Test Center, Italy

“Outstanding knowledge!! Outstanding presentation!! His curiosity was evident whenever students asked questions. Very energetic speaker … Very down to earth.”

Dale W. - Central Intelligence Agency

“I really enjoyed this class. It was a very special opportunity to be taught by an amazing person. He put a lot of effort into making the class material’s easy to learn, fun, and entertaining while covering a great deal of technical material.”

Matt C. - Jet Propulsion Laboratory

“Brilliant!” Mr. Logsdon’s depth of knowledge, historical perspectives, and delivery were all outstanding.”

Douglas Wright - Patterson Air Force Base

“Tom Logsdon is obviously a world-class expert on the GPS. Superb presentation style. Excellent historical background. This course would be useful and attractive to all of my fellow Europeans.”

Paul S. Tokes - Aerospace, Finland

“Charts are amazing!”

Bassem N. - Jet Propulsion Laboratory

Course Outline


7. India’s IRNSS and Japan’s QZSS. The regional constellation being launched by India. Seven geosynchronous satellites dancing across the sky. Rubidium atomic clocks and corner cube reflectors. Figure-8 ground traces. Japan’s unique quasi-zenith constellation. Providing navigation, audio, video, and data services. Local-area coverage characteristics. Awesome summary charts.

Link 16 Intermediate with Network Enabled Weapons

February 11-13, 2019  
Columbia, Maryland  
$2090 (8:30am - 4:30pm)

Register 3 or More & Receive $1000 Each Off The Course Tuition.

Summary
The Link 16 Intermediate Course covers the most important topics effecting Link 16. The course includes 21 instructional modules and is one of our most popular courses. The Link 16 Network Enabled Weapons course not only explains this new capability in great detail, it offers insight into where it may lead when coupled with Link 16 Enhanced Throughput, Concurrent Multi-Netting, and Concurrent Contention Receive. The course contains hundreds of graphics and animations designed specifically to help the student visualize how the capability is delivered in the joint battlespace.

Instructor
Patrick Pierson a retired U.S. Navy (USN) Joint Interface Control Officer (JICO), is the Managing Director of NCS. Patrick has more than 30 years of operational Tactical Data Link (TDL) experience, and has developed more than 75 TDL training courses which have been delivered to thousands of students around the globe. He is also responsible for the design of the Multi-TDL Planning System, OPTASK Link Generator, Network Design Tool, INDE Processing Program, Improved TSDF Calculator, JFAR, JCM, JAR Generator, and the Link 16 Pulse Planning System. Prior to his retirement, Patrick served as the Theatre JICO for the Commander US Naval Forces Europe and Commander US Naval Forces Sixth Fleet, and was part of the JICO teams for Operation Iraqi Freedom, Operation Allied Force, and dozens of Joint and Coalition exercises.

Course Outline
- Introduction to Link 16
- Link 16 Documentation
- System Characteristics
- Time Division Multiple Access
- Network Participation Groups
- J-Series Messages
- Waveform Generation
- Time Slot Components
- Message Packing and Pulses
- Link 16 Networks / Nets
- Network Access Modes
- Terminal Synchronization
- Link 16 Network Time
- Network Roles
- Terminal Navigation
- Network Relays
- Network Communications Security
- Link 16 Pulse Deconfliction
- Terminal RF Modes
- Time Slot Duty Factor
- Link 16 Terminals
- Introduction to Link 16 NEW
- NEW Message to NPG Mapping
  - J11 Messages (Background Data)
  - J11.0 Weapon Response / Status Message
  - J11.1 Weapon Directive Message
  - J11.2 Weapon Coordination Message
  - J11.X Message Acknowledgement
- Weapon In-Flight Track Query / Response / Report
- Bomb-Hit Indication Report
- Target Updates / Retargeting / Mission Supplement
  - J11.X Loiter / Abort Messages
  - Weapon Handoff
  - Contact Reports
  - J11.X Ping / EMCON / 3rd Party Communications

Applicability
This course is suitable for personnel with little or no experience and is designed to take the student to a very high level of comprehension in a short period of time.
Summary
This three-day course treats in a consistent manner the various key factors that must be taken into account when deciding on the form of missile defense for any nation. It first takes the technical factors of performance, cost, schedule and risk and determines which system out of a set of candidate systems provides the best solution based on a given set of easily understood criteria. These technical solutions are then modified, in a controlled and transparent manner, by such modifiers as political factors, national requirements and other less tangible factors. All factors are presented with both historical background trends for contextual appreciation and with known values that can be either statistical State-of-Art values or user input values as needed. Engineering formulation of equations and data is provided sparingly where necessary for technical background and for sensitivity analyses. Attendees will receive Mr. Mantle's AIAA book The Missile Defense Equation: Factors for Decision Making.

Instructor
Peter Mantle with over 40 years of experience in engineering and program management, has served in industry and government in UK, Canada and the US. In The Pentagon, he was the US Navy's liaison executive to the Strategic Defense Initiative in 1983. He was Chairman of NATO's studies on air & missile defense 1990-2000. He was the Chairman of US Delegation to NATO's Industrial Advisory group 2003-2007. He has lectured in Europe, India and the US and has authored many articles on missile defense and other topics.

Course Outline


4. How Long will it Take? Acquisition Policies in US, NATO and European nations and their Key Milestones.Review of Milestones I,II,III and A,B,C from 1969 to present day.. Overview of DoDD 5000.1 and DoDi 5000.2. Statistical data on Program elapsed times from Program Start to FSD, to LRIP and to IOC. Comparison statistics of US, European and Israel programs. Transition from RDT&E to Acquisition. Increasing development times of systems and possible improvements. International cooperation and OTS.


What You Will Learn
- Key drivers in missile defense for any nation.
- Integration of technical, political & programmatic considerations.
- Trade-off technical, cost, schedule and risk. Handling of less precise decision making.

Testimonials ...
"Making Decisions in Missile Defense was an excellent course and posed questions and ideas I had not thought of before . . . .!"

"The class was definitely food for thought"

"The alternative approaches presented will be beneficial in the acquisition process . . . .!"
Missile Design, Development & Systems

March 11-14, 2019
Columbia, Maryland

$2295 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each
Off The Course Tuition.

Summary
This four-day course is recommended for those who wish to broaden their understanding of missiles.

Conceptual design methods are presented for the major subsystems and for predicting performance, cost, risk, and launch platform integration. Examples are shown of subsystem and system development test activities. Configuration sizing examples include rocket-powered, ramjet-powered, and turbo-jet powered missiles as well as guided bombs. The course presents typical characteristics of missiles, historical development of subsystems, enabling technologies, and the state-of-the-art. Over seventy videos illustrate missile development activities and performance. Each attendee will design, build, and fly a small air powered rocket based on the analysis and prediction methods of the course. This course is based on the instructor’s 880 page AIAA textbook *Missile Design and System Engineering*, which includes free software.

Instructor
Eugene L. Fleeman has 50+ years of government, industry, academia, and consulting experience in the design and development of missile systems. Formerly a manager of missile programs at the US Air Force Research Laboratory, Rockwell International, Boeing, and Georgia Tech, he is an international lecturer on missiles and the author of 200+ publications, including three textbooks. Since the year 1999 his short course has been held over 100 times in fifteen countries and five continents.

What You Will Learn
- Drivers in design, development, and system engineering.
- Configuration sizing methods for aerodynamics, propulsion, weight, and flight trajectory.
- Integration with aircraft, ground, and ship platforms.
- Robustness, lethality, guidance, navigation, flight control, observables, survivability, safety, reliability, and cost.
- Missile sizing examples.
- Development of missile system, subsystems, and technology.

Who Should Attend
The course is oriented toward the needs of missile engineers, systems engineers, analysts, marketing personnel, program managers, university professors, and others working in the area of missile systems and technology development. Attendees will gain an understanding of missile design, missile technologies, launch platform integration, missile system measures of merit, and the missile system development process.

Course Outline

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
What You Will Learn

- Modeling flight dynamics with tensors.
- Kinematics and dynamics of 6 DoF aerospace vehicles.
- Integration of missile subsystems: aerodynamics, propulsion, actuators, autopilots, guidance, seekers and navigation.
- Running missile 6 DoF simulations in C++.
- How to build your own 6 DoF simulations.

Knowing how to assess and construct high fidelity simulations has become essential for any aerospace project.
Modern Missile Analysis
Propulsion, Guidance, Control, Seekers, and Technology

February 25-28, 2019
Columbia, Maryland
$2290 (8:30am - 4:00pm)
Register 3 or More & Receive $1000 Each
Off The Course Tuition.

Summary
This four-day course presents a broad introduction to major missile subsystems and their integrated performance, explained in practical terms, but including relevant analytical methods. While emphasis is on today's homing missiles and future trends, the course includes a historical perspective of relevant older missiles. Both endoatmospheric and exoatmospheric missiles (missiles that operate in the atmosphere and in space) are addressed. Missile propulsion, guidance, control, and seekers are covered, and their roles and interactions in integrated missile operation are explained. The types and applications of missile simulation and testing are presented. Comparisons of autopilot designs, guidance approaches, seeker alternatives, and instrumentation for various purposes are presented. The course is recommended for analysts, engineers, and technical managers who want to broaden their understanding of modern missiles and missile systems. The analytical descriptions require some technical background, but practical explanations can be appreciated by all students. U.S. citizenship is required for this course.

Instructor
Dr. Walter R. Dyer is a graduate of UCLA, with a Ph.D. degree in Control Systems Engineering and Applied Mathematics. He has over thirty years of industry, government and academic experience in the analysis and design of tactical and strategic missiles. His experience includes Standard Missile, Stinger, AMRAAM, HARM, MX, Small ICBM, and ballistic missile defense. He is currently a Senior Staff Member at the Johns Hopkins University Applied Physics Laboratory and was formerly the Chief Technologist at the Missile Defense Agency in Washington, DC. He has authored numerous industry and government reports and published prominent papers on missile technology. He has also taught university courses in engineering at both the graduate and undergraduate levels.

What You Will Learn
You will gain an understanding of the design and analysis of homing missiles and the integrated performance of their subsystems.

- Missile propulsion and control in the atmosphere and in space.
- Clear explanation of homing guidance.
- Types of missile seekers and how they work.
- Missile testing and simulation.

Course Outline
Multi-Target Tracking and Multi-Sensor Data Fusion

February 26-28, 2019
Columbia, Maryland
March 4-6, 2019
Denver, Colorado

$2090  (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each Off The Course Tuition.

Summary

The objective of this three-day course is to introduce engineers, scientists, managers and military operations personnel to the fields of target tracking and data fusion, and to the key technologies which are available today for application to this field. The course is designed to be rigorous where appropriate, while remaining accessible to students without a specific scientific background in this field. The course will start from the fundamentals and move to more advanced concepts. This course will identify and characterize the principle components of typical tracking systems. A variety of techniques for addressing different aspects of the data fusion problem will be described. Real world examples will be used to emphasize the applicability of some of the algorithms. Specific illustrative examples will be used to show the tradeoffs and systems issues between the application of different techniques.

Instructor

Stan Silberman is a member of the Senior Technical Staff at the Johns Hopkins University Applied Physics Laboratory. He has over 30 years of experience in tracking, sensor fusion, and radar systems analysis and design for the Navy, Marine Corps, Air Force, and FAA. Recent work has included the integration of a new radar into an existing multisensor system and in the integration, using a multiple hypothesis approach, of shipboard radar and ESM sensors. Previous experience has included analysis and design of multiradar fusion systems, integration of shipboard sensors including radar, IR and ESM, integration of radar, IFF, and time-difference-of-arrival sensors with GPS data sources.

What You Will Learn

• State Estimation Techniques – Kalman Filter, constant-gain filters.
• Non-linear filtering – When is it needed? Extended Kalman Filter.
• Techniques for angle-only tracking.
• Tracking algorithms, their advantages and limitations, including:
  - Nearest Neighbor.
  - Probabilistic Data Association.
  - Multiple Hypothesis Tracking.
• How to handle maneuvering targets.
• Track initiation – recursive and batch approaches.
• Architectures for sensor fusion.
• Sensor alignment – Why do we need it and how do we do it?
• Attribute Fusion, including Bayesian methods, Dempster-Shafer, Fuzzy Logic.

Course Outline

1. Introduction.
2. The Kalman Filter.
3. Other Linear Filters.
4. Non-Linear Filters.
5. Angle-Only Tracking.
7. Maneuvering Targets: Multiple Model Approaches.
10. Using Measured Range Rate (Doppler).
13. Multiple Hypothesis Approaches.
15. Multiple Sensors.
17. Fusion of Data From Multiple Radars.
18. Fusion of Data From Multiple Angle-Only Sensors.
21. Fusion of Target Type and Attribute Data.
22. Performance Metrics.
Naval Weapons Principles
Underlying Physics of Today’s Sensor and Weapons

Summary
This four-day course is designed for students who have a college level knowledge of mathematics and basic physics to gain the “big picture” as related to basic sensor and weapons theory. As in all disciplines knowing the vocabulary is fundamental for further exploration, this course strives to provide the physical explanation behind the vocabulary such that students have a working vernacular of naval weapons. This course is a fundamental course and is not designed for experts in the Navy’s combat systems.

Instructors
Craig Payne is currently a principal investigator at the Johns Hopkins Applied Physics Laboratory. His expertise in the “detect to engage” process with emphasis in sensor systems, (sonar, radar and electro-optics), development of fire control solutions for systems, guidance methods, fuzing techniques, and weapon effects on targets. He is a retired U.S. Naval Officer from the Surface Warfare community and has extensive experience naval operations. As a Master Instructor at the U.S. Naval Academy he designed, taught and literally wrote the book for the course called Principles of Naval Weapons. This course is provided to all U.S. Naval Academy Midshipmen, 62 colleges and Universities that offer the NROTC program and taught abroad at various national service schools.

Dr. Menachem Levitas has 36 years of experience in direct radar and weapon systems analysis, design, and development. Throughout his tenure he has provided technical support for shipboard and airborne radar programs in many different areas including system concept definition, electronic protection, active arrays, signal and data processing, requirement analyses, and radar phenomenology. He is a recipient of the AEGIS Excellence Award. He has supported many radar programs including the Air Force’s Ultra Reliable Radar (URR), the Atmospheric Surveillance Technology (AST), the USMC’s Ground/Air Task Oriented Radar (GATOR), the 3D Long Range Expeditionary Radar (3DLRR), and others. He was the chief scientist of Technology Service Corporation’s Washington Operations.

Course Outline
1. Introduction to Combat Systems: Discussion of combat system attributes.
2. Introduction to Radar: Fundamentals, examples, sub-systems and issues.
3. The Physics of Radar: Electromagnetic radiations, frequency, transmission and reception, waveforms, PRF, minimum range, range resolution and bandwidth, scattering, target cross-section, reflectivities, scattering statistics, polarimetric scattering, propagation in the Earth troposphere.
4. Radar Theory: The radar range equation, signal and noise, detection threshold, noise in receiving systems, detection principles, measurement accuracies.
5. The Radar Sub-systems: Transmitter, antenna, receiver and signal processor (Pulse Compression and Doppler filtering principles, automatic detection with adaptive detection threshold, the CFAR mechanism, sidelobe blanking angle estimation), the radar control program and data processor (SAR/ISAR are addressed as antenna excitations).
6. Workshop: Hands-on exercises relative to Antenna basics; and range radar analysis with and without detailed losses and the pattern propagation factor.
8. Electronically Scanned Antennas: Fundamental concepts, directivity and gain, elements and arrays, near and far field radiation, element factor and array factor, illumination function and Fourier transform relations, beamwidth approximations, array tapers and sidelobes, electrical dimension and errors, array bandwidth, steering mechanisms, grating lobes, phase monopoles, beam broadening, examples.
9. Solid State Active Phased Arrays: What are solid state active arrays (SSAA), what advantages do they provide, emerging requirements that call for SSAA (or AESA), SSAA issues at T/R module, array, and system levels.
10. Radar Tracking: Functional block diagram, what is radar tracking, fir track initiation and range, track update, track maintenance, algorithmic alternatives (association via single or multiple hypotheses, tracking filters options), role of electronically steered arrays in radar tracking.
11. Current Challenges and Advancements: Key radar challenges, key advances (transmitter, antenna, signal stability, digitization and digital processing, waveforms, algorithms).
16. SONAR Figure of Merit. Target Strength, Noise, Reverberation, Scattering, Detection Threshold, Directivity Index, Passive and Active Sonar Equations.
19. Guidance: Guidance laws and logic to include pursuit, constant bearing, proportional navigation and kappa-gamma, Seeker design.
22. Warhead Damage Predictions. Quantifying Damage, Circular Error Probable, Blast Warheads, Diffraction and Drag loading on targets, fragmentation Warheads, Shaped Charges, Special Purpose Warheads.

In this course you will obtain the knowledge and ability to perform basic sensor and weapon calculations, identify tradeoffs, interact meaningfully with colleagues, evaluate systems, and understand the literature.

What You Will Learn
Scientific and engineering principles behind systems such as radar, sonar, electro-optics, guidance systems, explosives and ballistics. Specifically:
• Analyze weapon systems in their environment, examining elements of the “detect to engage sequence” from sensing to target damage mechanisms.
• Apply the concept of energy propagation and interaction from source to distant objects via various media for detection or destruction.
• Evaluate the factors that affect a weapon system’s sensor resolution and signal-to-noise ratio. Including the characteristics of a multiple element system and/or array.
• Knowledge to make reasonable assumptions and formulate first-order approximations of weapons systems’ performance.
• Assess the design and operational tradeoffs on weapon systems’ performance from a high level.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
Summary

Dr. Menchem Levitas has forty years of experience in science and engineering, thirty six of which have consisted of direct radar and weapon systems analysis, design, and development. Throughout his tenure he has provided technical support for many shipboard and airborne radar programs in many different areas including system concept definition, electronic protection, active arrays, signal and data processing, requirement analyses, and radar phenomenology. He is a recipient of the AEGIS Excellence Award for the development of a novel radar cross-band calibration technique in support of wide-band operations for high range resolution. He has developed innovative techniques in many areas e.g., active array self-calibration and failure-compensation, array multi-beam-forming, electronic protection, synthetic wide-band, knowledge-based adaptive processing, waveforms and waveform processing, and high fidelity, real-time, littoral propagation modeling. He has supported many AESA programs including the Air Force’s Ultra Reliable Radar (URR), the Atmospheric Surveillance Technology (AST), the USMC’s Ground/Air Task Oriented Radar (G/ATOR), the 3D Long Range Expeditionary Radar (3DLRR), and others. Prior to his retirement in 2013 he had been the chief scientist of Technology Service Corporation’s Washington Operations.

Radar 101

Fundamentals of Radar

February 20, 2019

Laurel, Maryland

$850 (8:30am - 4:00pm)

"Register 3 or More & Receive $50 Off The Course Tuition."

Radar 201

Advances in Modern Radar

February 21, 2019

Laurel, Maryland

$850 (8:30am - 4:00pm)

"Register 3 or More & Receive $50 Off The Course Tuition."

Course Outline

1. Introduction. The general nature of radar: composition, block diagrams, photos, types and functions of radar, typical characteristics.


3. The Radar Range Equation. Development from basic principles. The concepts of peak and average power, signal and noise bandwidth and the matched filter concept, antenna aperture and gain, system noise temperature, and signal detectability.


5. The sub-systems of Radar. Transmitter (pulse oscillator vs. MOPA, tube vs. solid state, bottled vs. distributed architecture), antenna (pattern, gain, sidelobes, bandwidth), receiver (homodyne vs. super heterodyne), signal processor (functions, front and back-end), and system controller/tracker. Types, issues, architectures, tradeoffs considerations.


Course Outline

1. Introduction. Radar's development, the metamorphosis of the last few decades: analog and digital technology evolution, theory and algorithms, increased digitization: multi-functionality, adaptivity to the environment, higher detection sensitivity, higher resolution, increased performance in clutter.


Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
Radar Systems Design & Engineering
Radar Performance Calculations

Summary
This four-day course covers radar functionality, architecture, and performance. Fundamental radar issues such as transmitter stability, antenna pattern, clutter, jamming, propagation, target cross section, dynamic range, receiver noise, receiver architecture, waveforms, processing, and target detection are treated in detail within the unified context of the radar range equation, and examined within the contexts of surface and airborne radar platforms and their respective applications. Advanced topics such as pulse compression, electronically steered arrays, and active phased arrays are covered, together with the related issues of failure compensation and auto-calibration. The pattern propagation factor; Mutual coupling in a phased array radar; and airborne radar programs in many different areas including system concept definition, electronic protection, active arrays, signal and data algorithms, and phenomenology. He is a recipient of the AEGIS Excellence Award. He has supported many radar programs including the Air Force’s Ultra Reliable Radar (URR), the Atmospheric Surveillance Technology (AST), the USMC’s Ground/Air Task Oriented Radar (GATOR), the 3D Long Range Expeditionary Radar (DLRDR), and others. He was the chief scientist of Technology Service Corporation’s Washington Operations.

Instructors
Dr. Menachem Levitas has 36 years of experience in radar and weapon systems analysis, design, and development. Throughout his tenure he has consulted for a variety of military, aerospace, and airborne radar programs in many different areas including system concept definition, electronic protection, active arrays, signal and data algorithms, and radar phenomenology. He is a recipient of the AEGIS Excellence Award. He has supported many radar programs including the Air Force’s Ultra Reliable Radar (URR), the Atmospheric Surveillance Technology (AST), the USMC’s Ground/Air Task Oriented Radar (GATOR), the 3D Long Range Expeditionary Radar (DLRDR), and others. He was the chief scientist of Technology Service Corporation’s Washington Operations.

Course Outline
1. Introduction. Radar systems examples. Radar ranging principles, frequencies, architecture, measurements, displays, and parameters. Radar range equation; radar waveforms; antenna patterns, types, and parameters. Radar cross section; stealth, fluctuating targets; stochastic models; detection of fluctuating targets.
2. Noise in Receiving Systems and Detection Principles. Noise sources; statistical properties. Radar range equation; false alarm and detection probability; and pulse integration schemes. Radar cross section; stealth, fluctuating targets; stochastic models; detection of fluctuating targets.
3. CW Radar, Doppler, and Receiver Architecture. Basic properties; CW and high PRF relationships; dynamic range; stability; isolation; frequency requirements; antenna requirements; and device/subheterodyne receivers; in-phase and quadrature receivers; signal spectrum; spectral broadening; matched filtering; Doppler filtering; Spectral modulation; CW ranging; and measurement accuracy.
4. Transmitters and Propagation. The pattern propagation factor; interference (multipath); and diffraction; refraction; standard refractivity; the 4/3 Earth approximation; sub-refractivity; super refractivity; trapping; propagation ducts; littoral propagation; and Doppler ambiguities.
5. Radar Clutter and Detection in Clutter. Volume, surface, and discrete clutter, deleterious clutter effects on radar performance, clutter characteristics, effects of platform velocity, distributed sea clutter and sea spikes, terrain clutter, grazing angle vs. depression angle characterization, volume clutter, birds, Constant False Alarm Rate (CFAR) thresholding, editing CFAR, and clutter Maps.
6. Clutter Filtering Principles. Signal-to-clutter ratio; signal and clutter range techniques; principles of filtering; transmitter stability and filtering; pulse Doppler and MTI; MTD; blind speeds and blind ranges; staggered MTI; analog and digital filtering; notch shaping; gains and losses. Performance measures; clutter attenuation, improvement factor, subclutter visibility, and cancellation ratio. Improvement factor limitation sources; stability noise sources; composite errors; types of MTI.
7. Radar Waveforms. The time-bandwidth concept. Pulse compression; Performance measures; Code families; Matched and mismatched filters. Optimal codes and code families: multiple constraints. Performance in the time and frequency domains; Matched filters and their applications; Orthogonal and quasi-orthogonal codes; Multiple-Input-Multiple-Output (MIMO) radar; MIMO waveforms and MIMO antenna patterns.
8. Electronically Scanned Radar Systems. Fundamental concepts; diversity and gain; elements and arrays near and far field radiation, element factor and array factor, illumination function and Fourier transform relations, beamwidth approximations, array layers and sidelobes, electrical dimension and errors, array bandwidth, steering mechanisms, grating lobes, phase monopulse, beam broadening, examples.
9. Active Phased Array Radar Systems. What are solid state active arrays (SSAA)? What advantages do they provide, emerging requirements that call for SSAA (or AESA), SSAA issues at IF module, array, and system levels, digital arrays, future direction.
10. Multiple Simultaneous Beams. Why multiple beams, independently steered beams and clustered beams, organization of clustered beams and their implications, quantization lobes in clustered beams arrangements and design options to mitigate them.
11. Auto-Calibration Techniques in Active Phased Array Radars. Motivation; the mutual coupling in a phased array radar; external calibration reference approach; the mutual coupling approach; architectural.
Part 4: Applications
13. Surface Radar. Principal functions and characteristics, nearness and extent of clutter, effects of anomalous propagation, the stressing factors of dynamic range, signal stability, time, and coverage requirements, transportation requirements and their implications, sensitivity time control in classical radar, the increasing role of bird/angel clutter and its effects on radar design, trim mode initiation and the scan-back mechanism, antenna pattern techniques used to obtain partial relief.
14. Airborne Radar. Frequency selection; Platform motion effects; iso-ranges and iso-Dopplers; antenna pattern effects; clutter; reflection point; altitude limit. The role of medium and high PRF’s in location, using multiple targets, real and synthetic aperture, Doppler ambiguities; velocity search modes, TACAC and DPCA.
15. Synthetic Aperture Radar. Principles of high resolution, radar vs. optical imaging, real vs. synthetic aperture, real beam limitations, simultaneous vs. sequential operation, derivations of focused array resolution, unfocused arrays, motion compensation, range-gate drifting, synthetic aperture modes; real-beam mapping, strip mapping, and spotlighting, waveform restrictions, processing through an array of subarrays.
16. Multiple Target Tracking. Definition of Basic terms. Track Initiation: Methodology for initiating new targets; Recursive and batch algorithms; Sizing of gates for track initiation. M out of N processing. State Estimation: Basic techniques; least squares; Kalman filter. Adaptive filtering and multiple model methods. Use of suboptimal filters such as table look-up and constant gain. Correlation & Association: Correlation tests and gates; Association algorithms; Probabilistic data association and multiple hypothesis algorithms.

What You Will Learn
• What are radar subsystems.
• How to calculate radar performance.
• Key functions, issues, and requirements.
• How different requirements make radars different.
• Operating in different modes & environments.
• ESA and AESA radars: what are these technologies, how they work, what drives them, and what new issues they bring.
• Issues unique to multifunction, phased array, radars.
• State-of-the-art waveforms and waveform processing.
• How airborne radars differ from surface radars.
• Today's requirements, technologies & designs.

June 17-20, 2019
Columbia, Maryland

$2290 (8:am - 4:pm)
Register 3 or More & Receive $100 Off Each Off The Course Tuition.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
February 11-14, 2019  
Columbia, Maryland  
$2290 (8:30am - 4:00pm)  
"Register 3 or More & Receive $100 Off Each Off The Course Tuition."

Summary
This four-day course provides an overview of rockets and missiles, including a fourth day covering advanced selection and design processes. The course provides a wide practical knowledge in rocket and missile issues and technologies. The seminar is designed for engineers, supporting disciplines, decision makers and managers of current and future projects needing a more complete understanding of the complex issues of rocket and missile technology. The seminar provides a foundation for understanding the issues that must be decided in the design, use, regulation, selection and development of rocket systems of the future. You will learn a wide spectrum of problems, solutions and choices in the technology of rockets and missile used for both military and civil purposes. The seminar is taught to the point-of-view of a decision maker needing the technical knowledge to make better informed choices in the multi-discipline world of rockets and missiles. The class provides what you need to know about how rockets and missiles work, why they are built the way they are, what they are used for and how they differ from use to use. You will learn how rockets and missiles differ when used as weapons, as launch vehicles, and in spacecraft or satellites. The objective is to give the decision maker all the tools needed to understand the available choices, and to manage or work with other technical experts of different specialized disciplines.

Instructor
Daniel J. Moser has been an engineer, innovator, and entrepreneur in the aerospace industry for over 35 years. He has extensive experience in designing and developing launch vehicles, liquid rocket propulsion systems, ablative-cooled thrust chambers / nozzles, filament-wound composite vessels (liquid propellant tanks, high-pressure gas storage vessels, solid rocket motorcases, and crash-worthy external aircraft fuel tanks), wings, control surfaces, fuselages, radomes, spars, missile tail fins, bulkheads, reentry heat shields, and landing gear. Mr. Moser has a B.S. in Physics, and M.E. in Mechanical Engineering, University of Utah.

What You Will Learn
• Fundamentals of rocket and missile systems, functions and disciplines.  
• The full spectrum of rocket systems, uses and technologies.  
• Optimum Selection and Design strategies.  
• Fundamentals and uses of solid, liquid and hybrid rocket systems.  
• Differences between weapons systems and those built for commerce.

Course Outline
1. Introduction to Rockets and Missiles. The student is introduced to the historic and practical uses of rocket systems.  
2. Classifications of Rockets and Missiles. The classifications and terminology of all types of rocket systems are defined.  
3. Rocket Propulsion made Simple. The chemistry and physics of all rockets and rocket nozzles operate to achieve thrust is explained. Rocket performance modeling is introduced.  
4. Rocket Flight Environments. The flight environments of rockets, such as acceleration, heating, shock, and vibration, are explored.  
5. Aerodynamics and Winds. The effect of winds, atmospheric density and velocity on lift, drag, and dynamic pressure is explained. Rocket shape, stability and venting are discussed.  
6. Performance Analysis and Staging. The use of performance modeling and loss factors, are defined. Staging theory for multi-stage rockets are explained.  
7. Mass Properties and Propellant Selection. The relative importance of specific impulse, bulk density, bulk temperature, storability, ignition properties, stability, toxicity, operability, material compatibility, and ululage. Monopropellant and solid gas propellants are introduced.  
8. Introduction to Solid Rocket Motors. The historical and technological aspects of Solid Rocket Motors. Solid rocket materials, propellants, thrust-profiles, construction, cost advantages and special applications.  
10. Liquid Rocket Engines. Pressure and pump-fed liquid rocket engines are explained, including injectors, cooling, chamber construction, pump cycles, ignition and thrust vector control.  
11. Introducing the Liquid Rocket Stage. Liquid rocket stages are introduced, including tank systems, pressurization, cryogenics, and other structures.  
12. Thrust Vector Control. Thrust Vector control hardware and alternatives are explained.  
15. Rockets in Spacecraft Propulsion. The differences between systems on spacecraft, satellites and transfer stages, operating in microgravity.  
16. Launch Sites and Operations. The role and purpose of launch sites, and the choices available for a launch operations infrastructure.  
17. Useful Orbits & Trajectories Made Simple. A simplified presentation of orbital mechanics, for the understanding rocket propulsion in orbital trajectories and maneuvers.  
19. Reliability of Rocket Systems. Reliability, and strategies to improve reliability, are discussed, including random and systematic failures, reliability environments, quality, robustness, and redundancy.  
20. Reusable Launch Vehicle Theory. Why Reusable Launch Vehicles have had difficulty replacing expendable launch vehicles.  
21. Rocket Propulsion Principles and Cases. Cost estimation methods modeling systems as a science, including why costs are so high. Strategies from the Soyuz Case illustrate alternatives and to cost reduction. Integrated modeling and incentives are introduced.  
22. Chemical Rocket Propulsion Alternatives. Alternatives to chemical rocket propulsion includes air breathing, nuclear, thermal, cannons, and tethers.  
24. The Future of Rockets and Missiles. The direction of rocket technology science, usage and regulations is conducted.  
25. Opportunities to Select and/or Design Optimum Launch Vehicles. This fourth day will help you understand optimization processes for both the design and selection of Launch Vehicles.  
27. Optimizing the Selection Trade Study Process. Standard vs. optimum processes are explained.  
28. Integrating Available Information on Alternatives. All Launch Vehicle characteristics must be accurately determined.  
29. The Goals and Incentives of Launch Vehicle Design. Setting goals and incentives is a success project. Goals and incentives of the past explain future successes and failures.  
30. Optimum Launch Vehicle Design Strategies. Optimum design strategies are explained to the extent that the student will understand what works and what fails. These strategies are borely understood throughout the Aerospace community, leading to many bad assumptions.  
31. Understanding Why Good Designs Succeed. The strategies from Soyuz, Delta, Space-X, and beyond, are wrapped.
This 4-day course presents fundamental design rules and implementation considerations that have been, and continue to be, employed in the successful development and deployment of sensor-based systems for use by tactical ISR and related applications. The material presented applies to a variety of remote sensing systems that focus on adaptable sensor capabilities, multiple sensor elements, and scalable system integration.

Key performance parameters associated with sensor systems are derived, and their evaluation is presented in detail. Sensor functions, such as target detection & acquisition, discrimination, designation, and tracking, are each addressed in detail -- including how these functions are integrated to realize an effective sensing system. Technical capabilities associated with underlying performance and various math models are presented, compared, and evaluated, thereby providing tools useful in conducting effective and comprehensive trade studies.

This course is of significant value to those working remote sensing, tiered-sensor systems, wireless sensor networks (WSN), and similar. Experience and technical backgrounds best suited include: engineers, computer & physical scientists, and system decision-makers that work with remote sensor solutions. Detailed derivations are provided via the distributed course notes, as well as examples of computer-based tools used to evaluate design performance. Key performance issues, and design implementations are provided by distributed Python code.

Instructor

Timothy D. Cole is a leading authority on sensor systems with 30 years of experience during which he successfully designed, developed, and deployed sensing systems used for military, space-based, and biomedical applications. While at The Johns Hopkins University (JHU) Applied Physics Laboratory, he design & delivered the ground processing facility for the GEOSAT-1 Ku-band altimeter, developed novel signal processing for laser radars, and was the lead designer/developer of the Near-Earth Rendezvous (NEAR) laser radar. In recognition of accomplishing the foregoing tasks, Tim was awarded the NASA Achievement Award. He also collaborated and co-developed a multi-meridian photorefractor with JHU Wilmer Eye Institute. Tim also worked exoatmospheric sensor solutions for long-wave infrared missions. And while at Northrop Grumman, Tim was nominated and selected as a Technical Fellow based on successes associated with numerous sensor research and ISR-focused programs. He now works as the calibration lead for NASA’s ICESat-2 laser altimeter.

March 25-28, 2019
Columbia, Maryland
$2290 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off! Each Off The Course Tuition.

Summary


7. Case studies: DARPA NEST & ANSCD programs (WSN, tiered-sensors), swarm systems, laser vibrometry programs (Radiant Outlaw, FFT), CEC

Course Outline

What You Will Learn

• Terminology associated with sensor system technologies.
• Mathematical tools associated with the statistical nature behind sensor system design and capability.
• How to derive and modify key sensor design equations.
• How to formulate effective system trade studies.
• Understanding sensor technologies: capability, strengths & weaknesses.
• How to manage distributed sensor assets and successful support timely exfiltration of vital data products.
• How to ensure seamless integration sensors to situational analyses and common operating (COP) architectures.
• Considerations as: power management, security, effective operation & upgrading, current and coming standards.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
Wireless Communications & Spread Spectrum Design

Summary

This three-day course is designed for wireless communication engineers involved with spread spectrum systems, and managers who wish to enhance their understanding of the wireless techniques that are being used in all types of communication systems and products. It provides an overall look at many types and advantages of spread spectrum systems that are designed in wireless systems today. Cognitive adaptive systems are discussed. This course covers an intuitive approach that provides a real feel for the technology, with applications that apply to both the government and commercial sectors. Students will receive a copy of the instructor’s textbook, Transceiver and System Design for Digital Communications.

Instructor

Scott R. Bullock. P.E., MSEE, specializes in Wireless Communications including Spread Spectrum Systems and Broadband Communication Systems, Networking, Software Defined Radios and Cognitive Radios and Systems for both government and commercial uses. He holds 18 patents and 22 trade secrets in communications and has published several articles in various trade magazines. He was active in establishing the data link standard for GPS SCAT-I landing systems, the first handheld spread spectrum PCS cell phone, and developed spread spectrum landing systems for the government. He is the author of two books, Transceiver and System Design for Digital Communications & Broadband Communications and Home Networking, Scitech Publishing, www.scitechpub.com. He has taught seminars for several years to all the major communication companies, an adjunct professor at two colleges, and was a guest lecturer for Polytechnic University on "Direct Sequence Spread Spectrum and Multiple Access Technologies." He has held several high level engineering positions including VP, Senior Director, Director of R&D, Engineering Fellow, and Consulting Engineer.

What You Will Learn

- How to perform link budgets for types of spread spectrum communications?
- How to evaluate different digital modulation/demodulation techniques?
- What additional techniques are used to enhance digital Comm links including: multiple access, OFDM, error detection/correction, FEC, Turbo codes?
- What is multipath and how to reduce multipath and jammers including adaptive processes?
- What types of satellite communications and satellites are being used and design techniques?
- What types of networks & Comms are being used for commercial/military: ad hoc, mesh, WIFI, WiMAX, 3&4G, JTRS, SCA, SDR, Link 16, cognitive radios & networks?
- What is a Global Positioning System?
- How to solve a 3 dimension Direction Finding?
- From this course you will obtain the knowledge and ability to evaluate and develop the system design for wireless communication digital transceivers including spread spectrum systems.

February 19-21, 2019
Columbia, Maryland

Course Outline

$2295 (8:30am - 4:30pm)

*Register 3 or More & Receive $1000 each Off The Course Tuition.*

1. Transceiver Design. db power, link budgets, system design tradeoffs, S/N, Eb/No, Pe, BER, link margin, tracking noise, process gain, effects and advantages of using spread spectrum techniques.

2. Transmitter Design. Spread spectrum transmitters, PSK, MSK, QAM, CP-PSK, FH, OFDM, PN-codes, TDMA/CDMA/FDMA. antennas, T/R, LOs, upconverters, sidestand elimination, PAS, VSWR.

3. Receiver Design. Dynamic range, image rejection, limiters, MDS, superheterodyne receivers, importance of LNAs, 3rd order intercept, intermods, spurious signals, two tone dynamic range, TSS, phase noise, mixers, filters, A/D converters, aliasing anti-aliasing filters, digital signal processors DSPs.

4. Automatic Gain Control Design & Phase Lock Loop Comparison. AGCs, linearizer, detector, loop filter, integrator, using control theory and feedback systems to analyze AGCs, PLL and AGC comparison.

5. Demodulation. Demodulation and despreading techniques for spread spectrum systems, pulsed matched filters, sliding correlators, pulse position modulation, CDMA, coherent demod, spread spectrum recovery, squaring loops, Costas and modified Costas loops, symbol synch, eye pattern, inter-symbol interference, phase detection, Shannon’s limit.

6. Basic Probability and Pulse Theory. Simple approach to probability, gaussian process, quantization error, Pe, BER, probability of detection vs probability of false alarm, error detection CRC, error correction, FEC, RS & Turbo codes, LDPC, Interleaving, Viterbi, multi-h, PPM, m-sequence codes.

7. Cognitive adaptive systems. Dynamic spectrum access, adaptive power gain control using closed loop feedback systems, integrated solutions of Navigational data and closed loop RSSI measurements, adaptive modulation, digital adaptive filters, adaptive cosite filters, use of AESAs for beamsteering, nullsteering, beam spotting, sidelobe detection, communications using multipath, MIMO, and a combined cognitive system approach.

8. Improving the System Against Jammers. Burst jammers, digital filters, GSOs, adaptive filters, ALEs, quadrature method to eliminate unwanted sidebands, orthogonal methods to reduce jammers, types of intercept receivers.


10. Satellite Communications. ADPCM, FSS, geosynchronous / geostationary orbits, types of antennas, equivalent temperature analysis, G/T multiple access, propagation delay, types of satellites.


12. DF & Interferometer Analysis. Positioning and direction finding using interferometers, direction cosines, three dimensional approach, antenna position matrix, coordinate conversion for moving.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805

Vol. 130 – 21
Antenna and Array Fundamentals
Basic concepts in antennas, antenna arrays, and antenna systems

Course Outline

1. Basic Concepts In Antenna Theory. Beam patterns, radiation resistance, polarization, gain/directivity, aperture size, reciprocity, and matching techniques.

2. RF Field Locations. Reactive near-field, radiating near-field (Fresnel region), far-field (Fraunhofer region) and the Friis transmission formula.

3. Types of Antennas. Dipole, loop, patch, horn, dish, and helical antennas are discussed, compared, and contrasted from a performance/applications standpoint.


5. Antenna Arrays and Array Factors. (e.g., uniform, binomial, and Tschebyscheff arrays).

6. Scanning From Broadside. Sidelobe levels, null locations, and beam broadening. The end-fire condition. Problems such as grating lobes, beam squint, quantization errors, and scan blindness.

7. Beam Steering. Phase shifters and true-time delay devices. Some commonly used components and delay devices (e.g., the Rotman lens) are compared.

8. Measurement Techniques Used In Anechoic Chambers. Pattern measurements, polarization patterns, gain comparison test, spinning dipole (for CP measurements). Items of concern relative to anechoic chambers such as the quality of the absorbent material, quiet zone, and measurement errors. Compact, outdoor, and near-field ranges.

9. Software Simulation Concepts. Discussion and distinction between: Finite Difference Time Domain (FDTD), the method of moments (MoM), and the Finite Element Method (FEM.) Some commercial codes that use these techniques.

10. Throughput And Data Rates. Various antennas are examined to quantify suitability for data transmission.

11. Special Topics. The class can be tailored to meet the desired needs of the students.

12. Questions and Answers.

What You Will Learn

• Basic antenna concepts that pertain to all antennas and antenna arrays.

• The appropriate antenna for your application.

• Factors that affect antenna array designs and antenna systems.

• Measurement techniques commonly used in anechoic chambers.

This course is invaluable to engineers seeking to work with experts in the field and for those desiring a deeper understanding of antenna concepts. At its completion, you will have a solid understanding of the appropriate antenna for your application and the technical difficulties you can expect to encounter as your design is brought from the conceptual stage to a working prototype.

Summary

This three-day course teaches the basics of antenna and antenna array theory. Fundamental concepts such as beam patterns, radiation resistance, polarization, gain/directivity, aperture size, reciprocity, and matching techniques are presented. Different types of antennas such as dipole, loop, patch, horn, dish, and helical antennas are discussed and compared and contrasted from a performance-applications standpoint. The locations of the reactive near-field, radiating near-field (Fresnel region), and far-field (Fraunhofer region) are described and the Friis transmission formula is presented with worked examples. Propagation effects are presented. Antenna arrays are discussed, and array factors for different types of distributions (e.g., uniform, binomial, and Tschebyscheff arrays) are analyzed giving insight to sidelobe levels, null locations, and beam broadening (as the array scans from broadside.) The end-fire condition is discussed. Beam steering is described using phase shifters and true-time delay devices. Problems such as grating lobes, beam squint, quantization errors, and scan blindness are presented. Antenna systems (transmit/receive) with active amplifiers are introduced. Finally, measurement techniques commonly used in anechoic chambers are outlined. A comprehensive set of course notes is included.

Instructor

Dr. Steven Weiss is a senior design engineer with the Army Research Lab. He has a Bachelor’s degree in Electrical Engineering from the Rochester Institute of Technology with Master’s and Doctoral Degrees from The George Washington University. He has numerous publications in the IEEE on antenna theory. He teaches both introductory and advanced, graduate level courses at Johns Hopkins University on antenna systems. He is active in the IEEE. In his job at the Army Research Lab, he is actively involved with all stages of antenna development from initial design, to first prototype, to measurements. He is a licensed Professional Engineer in both Maryland and Delaware.
He was a contributing editor of technical papers and articles on measurement system design, operations, and test process improvements. He published 100 scientists, managers and educators from various industrial and university settings. He has delivered this course as the highest expression of systems design and the knowledge-based measurement system concept for mechanical engineering test and evaluation. This work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. 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He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed work is surely founded on the Unified Approach to the Engineering of Measurement Systems.

This three day short course is for engineers, scientists, analysts, and managers who must answer those questions and use those systems to make and understand experimental test measurements on a daily basis. The course will teach you the engineering principles underlying design and operation of effective computer-driven measurement systems that provide demonstrably valid test data on purpose, the first time, and on your tight test budget and schedule.

These fundamental & underlying engineering principles governing the design and operation of effective systems for test measurements are explained using real-world examples. Understanding these critical design and data validation principles, not taught in American universities, allows you to field effective measurement systems with both today’s and tomorrow’s hardware and software.

The result, in your laboratory, will be skilled people running more effective testing programs, generating demonstrably valid and unambiguous data on time, lowered design verification risk, cost and cycle time, and delighted customers. Attendees receive both an 800+ page workbook and the instructor’s book, (Prentice Hall).

### Instructor

Charles Wright, founder of the Measurements Engineering Department at a major satellite manufacturer, has three+ decades of successful experience in the design and operation of advanced multichannel, computer-driven measurement systems for mechanical engineering test and evaluation. This work is surely founded on the Unified Approach to the Engineering of Measurement Systems. He developed the knowledge-based measurement system concept as the highest expression of systems design and operational performance. He has delivered this course all over the United States and Canada to engineers, scientists, managers and educators from various industrial and university settings. He published 100 technical papers and articles on measurement system design, operations, and test process improvements. He was a contributing editor of Personal Engineering and Instrumentation News.
Summary
This three-day course will be of use to design engineers, structural engineers, and materials engineers in the selection of composite materials, design, analysis, processing and fabrication of composite structures. Will include worked numerical examples, physical material samples for classroom examination and references for later application.

Instructors
Dr. Jack Roberts
ASME Fellow, specializes in structural analysis & design, composite materials, biomedical & biomechanics and proposal writing. Dr. Roberts is a previous member of the Principal Professional Staff at the Johns Hopkins University Applied Physics Laboratory, where he has performed hand structural analysis and finite element modeling on composite structures for Aerospace, Naval, Space and biomedical applications. Dr. Roberts has a Ph.D. in mechanical Engineering from Rensselaer Polytechnic Institute and has his own consulting business. Dr. Roberts has over 120 publications, presentations and proceedings, 16 patents, 3 book chapters and numerous conference papers.

Mr. Paul Biemann is a materials and process engineer and a member of the Principal Professional Staff at the Johns Hopkins Applied Physics Laboratory, with over 36 years experience in design, manufacturing and characterization of composite materials and engineering polymers. His has worked on composite components for spacecraft, biomedical applications and for undersea deployment. He has an extensive background in composite cure and assembly techniques, polymer molding and casting, tooling and mold fabrication, adhesive bonding, and test equipment and methods. He holds the degree of BS in Materials Engineering from Rensselaer Polytechnic Institute. Mr. Biemann has 37 published papers and two book chapters. He also holds 17 US patents.

What You Will Learn
• What are composite materials?
• How to process composite materials and how that affects your design.
• What are anisotropic materials?
• What is laminate analysis?
• What are the failure theories used for composites?
• What is a laminate code and what does it do?
• How is a laminate code used to design a composite structure?
• What is an orthotropic material?
• How to break a structure down into simple plates and shells for preliminary analysis.
• What design equations can be used for orthotropic materials?
• What are the applications of these equations to plates and shells under in-plane or out-of-plane loads?

From this course you will obtain the knowledge and ability to perform basic composite materials selection, separate structures into basic plates and shells for initial preliminary design, perform design and analysis with composite materials, identify tradeoffs, understand the use of special equations for orthotropic materials under in-plane and out-of-plane loads for plates and shells, interact meaningfully with colleagues, and understand the literature.

Course Outline
Day 1 – Composites: What are they and how do you use them?
1. Composite Materials. What are they? Why use them?
2. Past Examples of Composite Applications. From ancient building materials to aerospace structural solutions.

Day 2 – How to design and analyze composite material structures.
8. Use of “The Laminator”. Material properties, strengths, ply angles, ply thicknesses, mechanical loads (forces and moments), thermal loads, moisture loads.
9. Preliminary Design and Analysis. For preliminary analysis many structures can be broken-down into series of flat rectangular plates or shells.
10. Composite Orthotropic Plate Bending and Buckling. Closed-form and approximate equations for bending and buckling of flat rectangular orthotropic plates due to uniform out-of-plane pressure or in-plane compressive loads.
11. Sandwich Plate Bending and Buckling. Equations for honeycomb core sandwich plates using composite face sheets.
12. Cylindrical Shell Bending and Buckling. Equations for torsion, bending, buckling, or internal/external pressurization of composite cylindrical shells. Shells under multiple loads.

Day 3- Applications.
13. Buckling and Bending of Orthotropic Plates.
14. EMI Shielding of Composites.
17. Composite Bone Implant Design and analysis.
What You Will Learn

- How to identify, prevent, and fix common EMI/EMC problems in military systems.
- Simple models and "rules of thumb" and to help you arrive at quick design decisions (NO heavy math).
- EMI/EMC troubleshooting tips and techniques.
- EMI/EMC documentation requirements (Control Plans, Test Plans, and Test Reports).

Summary

Systems EMC (Electromagnetic Compatibility) involves the control of EMI (Electromagnetic Interference) at the systems, facility, and platform levels (e.g. outside the box.) This three-day course provides a comprehensive treatment of EMI/EMC problems in military systems. These include both the box level requirements of MIL-STD-461 and the systems level requirements of MIL-STD-464. The emphasis is on prevention through good EMI/EMC design techniques - grounding, shielding, cable management, and power interface design. Troubleshooting techniques are also addressed in an addendum. Please note - this class does NOT address circuit boards issues. Each student will receive a copy of the EDN Magazine Designer's Guide to EMC by Daryl Gerke and William Kimmel, along with a complete set of lecture notes.

Instructor

Daryl Gerke, PE, has worked in the electronics field for over 40 years. He received his BSEE from the University of Nebraska. His experience ranges includes design and systems engineering with industry leaders like Collins Radio, Sperry Defense Systems, Tektronix, and Intel. Since 1987, he has been involved exclusively with EMI/EMC as a founding partner of Kimmel Gerke Associates, Ltd. Daryl has qualified numerous systems to industrial, commercial, military, medical, vehicular, and related EMI/EMC requirements.

Course Outline

1. Introduction. Interference sources, paths, and receptors. Identifying key EMI threats - power disturbances, radio frequency interference, electrostatic discharge, self-compatibility. Key EMI concepts - Frequency and impedance, Frequency and time, Frequency and dimensions. Unintentional antennas related to dimensions.


8. EMC Troubleshooting Addendum. Trouble shooting vs Design & Test. Using the "Differential Diagnosis" Methodology Diagnostic and Isolation Techniques - RFI, power, ESD, emissions.
Summary
This 3-day hands-on course will immerse the participant in the design and implementation of both hardware and software subsystems for the design of Internet-of-Things systems. Adriano and Raspberry Pi platforms will be provided. Participants need only a general knowledge of hardware and software systems to benefit from this course.

A system-engineering framework will be used to highlight the need for and use of a proven structured life-cycle approach in IOT product development. Requirements generation, design, testing, debugging, integration, manufacturing and supply chain challenges will be covered. Both commercial and DOD process variations will be highlighted.

A matrix of current life-cycle tools for both hardware-software IOT development and systems engineering will be provided. The importance and application of digital twins, simulation, emulation, prototyping and model-based design-verification will be emphasized. Data analysis, machine learning, edge and cloud-based computing/partitioning and the potential use of algorithm synthesis and artificial intelligence (AI) will be included. Finally, daily exercises and case studies will be used to tie all the concepts, methodologies and tool usage together.

At the end of this course, participants will have hands-on experience with both the hardware and software design of IOT systems. Additionally, participants will understand how the systems engineering approach can be used to manage the complexity of IOT projects as well as handle risk, perform powers-connectivity-data processing tradeoffs, incorporate reliability and security to deliver a prototype system. Material will also be present that focus on supply chain issues for full production systems.


Instructor
John E. Blyler, BS (Engineering Physics), MS (EE), Affiliate and Founding Advisor of Systems Engineering at Portland State Univ., lecture and course developer for certificate IoT and Systems Engineering programs at UC-Irvine. Co-author of numerous textbooks for Wiley, Elsevier, IEEE and SAE. John is an experienced physicist, engineer, affiliate professor, author and writer who continues to speak at major conferences and before the camera. He has spent many years leading hardware-software integration teams in commercial, industrial, and DOD electronic semiconductor industries. Finally, he has served as editor-in-chief for a variety for technical semiconductor and embedded trade journal publications.

Course Outline
1. IOT Hardware and Software Development: Basics, example systems, evaluating constraints, cost estimates, power sources, sensors and actuator fundamental, microcontrollers vs. microprocessor, hw-sw design tradeoffs, connectivity, bandwidth restrictions, networking basics and protocols, online design-networking software tools, basics of C and Python, using IDEs, debugging embedded systems, learn to use Arduino and Raspberry Pi, understand embedded OSs like Raspbian Linux, WiFi and cellular connections, API interfaces, full system operation.

2. Data Design: Incorporating legacy systems, data processing constraints in field-factory, edge/gateway processing vs. cloud, decision points, machine learning and AI overviews, understand privacy requirements, identify and resolve security issues.

3. Connectivity: Wired and wireless systems, cellular, network basics, resiliency design, conducting trade-off studies.

4. Applied Systems Engineering (tailored to IOT Development): System architecting and analysis, requirements engineering, hardware-software partitioning, system design and integration, hardware testing, software debugging, reliability-resiliency-failure analysis, risk management, prototyping vs. manufacturing, logistics, organizational structures.


6. Lifecycle Tools Overview: Simulation, emulation, prototyping, QFD, N2, ACH, Extendsim, software IDE – scripts – languages – debugging, hardware and software integration platforms, and more. In-class exercises, integrated case studies, templates and online resources.

What You Will Learn
• Why the intersection of Morse’s Law, Metcalf’s Communication Law and the Learning Curve predicts the future of the IoT.
• How to transform system objectives and service requirements into IoT and IIoT specifications and design elements.
• Conduct hardware-software trade-off studies to decrease risks during implementation.
• Develop and integrate actual IoT hardware-software systems using Arduino and Raspberry Pi platforms.
• Write and debug simple code for Arduino and Raspberry Pi.
• Selection of specific hardware and software tools associated with each phase of the IoT product lifecycle.
• Identify security issues and their impact on your design.

April 30 - May 2, 2019
San Jose, California
May 7-9, 2019
Columbia, Maryland
$2295 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each Off The Course Tuition.

Online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
### Summary

This three-day course introduces Kalman filtering and other advanced state estimation algorithms in a practical way so that students can design and apply state estimation algorithms to real-world problems. The course presents enough theoretical background to justify the algorithms and to provide a solid foundation for implementation and advanced research. The course begins with a first-principles derivation of the Kalman filter, and proceeds to cover state-of-the-art nonlinear estimators. After taking this course, students will be able to design Kalman filters, H-infinity filters, and nonlinear filters, such as unscented Kalman filters and particle filters. Students will be able to evaluate the tradeoffs between different types of estimators, verify the correct operation of their estimators, and debug their estimators to alleviate poor performance. The estimation algorithms will be demonstrated in class with a wide variety of freely available MATLAB programs that can provide a template for the students’ own problem-specific implementations. Each student will receive a copy of Dr. Simon’s text, *Optimal State Estimation*.

### Instructor

**Dr. Dan Simon** has been a professor at Cleveland State University since 1999 and is also the owner of Innovatia Software, an independent consulting firm. He had 14 years of industrial experience in the aerospace, automotive, biomedical, process control, and software engineering fields before entering academia. He has applied Kalman filtering and other state estimation techniques to a variety of areas, including motor control, neural network and fuzzy system optimization, missile guidance, communication networks, fault diagnosis, vehicle navigation, robotics, prosthetics, and financial forecasting. He has over 100 publications in refereed journals and conference proceedings, including many on the topic of Kalman filtering. He has written three graduate-level text books.

### Course Outline


### What You Will Learn

- How can I write a system model in a form that is amenable to state estimation?
- What are different ways to simulate a system?
- How can I design a Kalman filter?
- How can I modify the algorithm if the Kalman filter assumptions are not satisfied?
- How can I design a filter for a nonlinear system?
- How can I design a filter that is robust to model uncertainty?
- What are some other types of estimators that may perform better than a Kalman filter?
- What are the tradeoffs between Kalman, H-infinity, unscented, and particle filters?
Instructor
Steve Brenner has worked in environmental simulation and reliability testing for over 30 years, always involved with the latest techniques for verifying equipment integrity through testing. He has independently consulted in reliability testing since 1996. His client base includes American and European companies with mechanical and electronic products in almost every industry. Steve’s experience includes the entire range of climatic and dynamic testing, including ESS, HALT, HASS and long term reliability testing.

Summary
This four-day class provides understanding of the purpose of each test, the equipment required to perform each test, and the methodology to correctly apply the specified test environments. Vibration and Shock methods will be covered together with instrumentation, equipment, control systems and fixture design. Climatic tests will be discussed individually: requirements, origination, equipment required, test methodology, understanding of results.

The course emphasizes topics you will use immediately. Suppliers to the military services protectively install commercial-off-the-shelf (COTS) equipment in our flight and land vehicles and in shipboard locations where vibration and shock can be severe. We laboratory test the protected equipment (1) to assure twenty years equipment survival and possible combat, also (2) to meet commercial test standards, IEC documents, military standards such as STANAG or MIL-STD-810G, etc. Few, if any, engineering schools cover the essentials about such protection or such testing.

What You Will Learn
When you visit an environmental test laboratory, perhaps to witness a test, or plan or review a test program, you will have a good understanding of the requirements and execution of the 810G dynamics and climatics tests. You will be able to ask meaningful questions and understand the responses of test laboratory personnel.

Course Outline
1. Introduction to Military Standard testing - Dynamics.
   • Introduction to classical sinusoidal vibration.
   • Resonance effects.
   • Acceleration and force measurement.
   • Electrohydraulic shaker systems.
   • Electrodynamic shaker systems.
   • Sine vibration testing.
   • Random vibration testing.
   • Attaching test articles to shakers (fixture design, fabrication and usage).
   • Shock testing.
2. Climatics.
   • Temperature testing.
   • Temperature shock.
   • Humidity.
   • Altitude.
   • Rapid decompression/explosives.
   • Combined environments.
   • Solar radiation.
   • Salt fog.
   • Sand & Dust.
   • Rain.
   • Immersion.
   • Explosive atmosphere.
   • Icing.
   • Fungus.
   • Acceleration.
   • Freeze/thaw (new in 810G).
3. Climatics and Dynamics Labs demonstrations.
4. Reporting On And Certifying Test Results.
**Summary**

This four-day course covers signal processing systems for radar, sonar, communications, speech, imaging and other applications based on state-of-the-art computer algorithms. These algorithms include important tasks such as data simulation, parameter estimation, filtering, interpolation, detection, spectral analysis, beamforming, classification, and tracking. Until now these algorithms could only be learned by reading the latest technical journals. This course will take the mystery out of these designs by introducing the algorithms with a minimum of mathematics and illustrating the key ideas via numerous examples using MATLAB.

Designed for engineers, scientists, and other professionals who wish to study the practice of statistical signal processing without the headaches, this course will make extensive use of hands-on MATLAB implementations and demonstrations. Attendees will receive a suite of software source code and are encouraged to bring their own laptops to follow along with the demonstrations.

Each participant will receive two books *Fundamentals of Statistical Signal Processing: Vol. 1* and *Vol. 2* by instructor Dr. Kay. A complete set of notes and a suite of MATLAB m-files will be distributed in source format for direct use or modification by the user.

**Course Outline**

1. **MATLAB Basics.** M-files, logical flow, graphing, debugging, special characters, array manipulation, vectorizing computations, useful toolboxes.
2. **Computer Data Generation.** Signals, Gaussian noise, nonGaussian noise, colored and white noise, AR/ARMA time series, real vs. complex data, linear models, complex envelopes and demodulation.
3. **Parameter Estimation.** Maximum likelihood, best linear unbiased, linear and nonlinear least squares, recursive and sequential least squares, minimum mean square error, maximum a posteriori, general linear model, performance evaluation via Taylor series and computer simulation methods.
4. **Filtering/Interpolation/Extrapolation.** Wiener, linear Kalman approaches, time series methods.
5. **Detection.** Matched filters, generalized matched filters, estimator-correlators, energy detectors, detection of abrupt changes, min probability of error receivers, communication receivers, nonGaussian approaches, likelihood and generalized likelihood detectors, receiver operating characteristics, CFAR receivers, performance evaluation by computer simulation.
6. **Spectral Analysis.** Periodogram, Blackman-Tukey, autoregressive and other high resolution methods, eigenanalysis methods for sinusoids in noise.
7. **Array Processing.** Beamforming, narrowband vs. wideband considerations, space-time processing, interference suppression.
8. **Signal Processing Systems.** Image processing, active sonar receiver, passive sonar receiver, adaptive noise canceler, time difference of arrival localization, channel identification and tracking, adaptive beamforming, data analysis.
9. **Case Studies.** Fault detection in bearings, acoustic imaging, active sonar detection, passive sonar detection, infrared surveillance, radar Doppler estimation, speaker separation, stock market data analysis.

**Instructor**

**Dr. Steven Kay** is a Professor of Electrical Engineering at the University of Rhode Island and the President of Signal Processing Systems, a consulting firm to industry and the government. He has over 25 years of research and development experience in designing optimal statistical signal processing algorithms for radar, sonar, speech, image, communications, vibration, and financial data analysis. Much of his work has been published in over 100 technical papers and the three textbooks, *Modern Spectral Estimation: Theory and Application*, *Fundamentals of Statistical Signal Processing: Estimation Theory*, and *Fundamentals of Statistical Signal Processing: Detection Theory*. Dr. Kay is a Fellow of the IEEE.

**What You Will Learn**

- To translate system requirements into algorithms that work.
- To simulate and assess performance of key algorithms.
- To tradeoff algorithm performance for computational complexity.
- The limitations to signal processing performance.
- To recognize and avoid common pitfalls and traps in algorithmic development.
- To generalize and solve practical problems using the provided suite of MATLAB code.

February 4-7, 2019
Columbia, Maryland

$2495 (8:30am - 4:00pm)

“Register 3 or More & Receive $100 off each Off The Course Tuition.”

Register online at [www.ATIcourses.com](http://www.ATIcourses.com) or call ATI at 888.501.2100 or 410.956.8805

Vol. 130 – 29
Random Vibration & Shock Testing - Fundamentals
for Land, Sea, Air, Space Vehicles & Electronics Manufacture

February 19-21, 2019
San Jose, California
$3200 (8:00am - 4:00pm)
Register 3 or More & Receive $1000 Each Off The Course Tuition.

Summary
This three-day course is primarily designed for test personnel who conduct, supervise or “contract out” vibration and shock tests. It also benefits design, quality and reliability specialists who interface with vibration and shock test activities.

Each student receives the instructor’s, minimal-mathematics, minimal-theory hardbound text Random Vibration & Shock Testing, Measurement, Analysis & Calibration. This 444 page, 4-color book also includes a CD-ROM with video clips and animations.

Instructor
Steve Brenner has been working in the field of environmental simulation and reliability testing for over 30 years.

Beginning in the late sixties with reliability and design verification testing on the Lunar Module, the Space Shuttle in the eighties, to semiconductor manufacturing equipment in the nineties, Mr. Brenner has always been involved with the latest techniques for verifying equipment integrity through testing.

Mr. Brenner began his career as an Environmental test engineer with Grumman Aerospace Corporation in New York, worked as design verification and reliability engineer for the Air Force, an Environmental Test Engineer for Lockheed Missiles and Space company, and spent 18 years with Kaiser Electronics in San Jose, where he managed the Environmental Test Lab and was involved with the design of hardware intended for severe environments.

What You Will Learn
• How to plan, conduct and evaluate vibration and shock tests and screens.
• How to attack vibration and noise problems.
• How to make vibration isolation, damping and absorbers work for vibration and noise control.
• How noise is generated and radiated, and how it can be reduced.

From this course you will gain the ability to understand and communicate meaningfully with test personnel, perform basic engineering calculations, and evaluate tradeoffs between test equipment and procedures.

Course Outline
2. Instrumentation. How to select and correctly use displacement, velocity and especially acceleration and force sensors and microphones. Minimizing mechanical and electrical errors. Sensor and system dynamic calibration.
3. Extension of SDoF. to understand multi-resonant continuous systems encountered in land, sea, air and space vehicle structures and cargo, as well as in electronic products.
4. Types of shakers. Tradeoffs between mechanical, electrohydraulic (servohydraulic), electrodynamic (electromagnetic) and piezoelectric shakers and systems. Limitations. Diagnostics.
8. Environmental Stress Screening. (ESS) of electronics production. Extensions to highly accelerated stress screening (HASS) and to highly accelerated life testing (HALT).
9. Assisting Designers. To improve their designs by (a) substituting materials of greater damping or (b) adding damping or (c) avoiding “stacking” of resonances.
11. Intense Noise. (acoustic) testing of launch vehicles and spacecraft.
14. Attaching DUT via vibration and shock test fixtures. Large DUTs may require head expanders and/or slip plates.
Statistics 101 / 201

STATISTICS 101
Fundamentals of Statistics with Excel Examples
June 10-11, 2019
Columbia, Maryland
$1595 (8:30am - 4:30pm)
“Register 3 or More & Receive $100 off each Off The Course Tuition.”

STATISTICS 201
Statistical Data Analysis with Excel Examples
June 12-13, 2019
Columbia, Maryland
$1590 (8:30am - 4:30pm)
“Register 3 or More & Receive $100 off each Off The Course Tuition.”

Dr. Alan D. Stuart, Associate Professor Emeritus of Acoustics, Penn State, has over forty years experience in the field of sound and vibration. He has degrees in mechanical engineering, electrical engineering, and engineering acoustics. For over thirty years he has taught courses on the Fundamentals of Acoustics, Structural Acoustics, Applied Acoustics, Noise Control Engineering, and Sonar Engineering on both the graduate and undergraduate levels as well as at government and industrial organizations throughout the country.

ATTEND ONE COURSE OR THE OTHER OR BOTH!
IF YOU ATTEND BOTH, THE TUITION FOR FOUR DAYS OF TRAINING IS $2295 PER PERSON.

Summary
This two-day course provides an introductory overview of basic statistics and statistical analysis with examples presented in Excel. Participants will be furnished with the textbook Statistical Analysis with Excel for Dummies (4thEd), by Joseph Schmuller.

Course Outline
- Introduction to Excel Statistical Tools
- Measures of Central Tendency and of Dispersion
- Probability Concepts
- Discretel Random Variables
- Binomial Distributions (Pass-Fail Statistics)
- Continuous RV’s; Uniform & Triangular Distribution
- Basics of Normal Distribution
- Central Limit Theorem & Student t- Distribution
- Confidence Level and Interval
- Sample Size for Mean Estimation
- Chi-Square Distribution and Goodness-of-Fit
- Functions of Random Variables (Propagation of Errors)
- Uncertainty of Measurements
- Probability and System Reliability:
  - Exponential Distribution and Reliability
  - Gamma Distribution and Reliability
  - Poisson Distribution and Process
  - Weibull Distribution and Time to Failure
- Percentiles and Probability Plots of Data
- Hypotheses Testing and OC Curves
- Topics of interest to the class

Summary
This two-day course presents applications of multivariant statistical data analysis with Excel examples. Participants should be familiar with the topics presented in the Statistics 101 course. Since two-days is insufficient time to properly present all the topics listed below, participants will prioritize the order in which the topics are to be presented.

Course Outline
- Two-Sample Comparisons (t-test)
- Failure Mechanics Example
- Comparing Two Variances
- Analysis of Variance (ANOVA)
- Regression Analysis and Correlation
- Residuals Analysis
- Acceptance Sampling and AQL Tables
- Introduction to Multivariate Data
- Random Data Vectors and Matrices
- Relevant Matrix Algebra
- Multiple Linear Regression Analysis
- Normal Bivariate Example: Rayleigh Distribution
- Sample Mean, Covariance, and Correlation
- Circular Error Probability (CEP)
- Principal Component Analysis (PCA)
- Independent Component Analysis (ICA)
- Topics presented in order of participant interest

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805

Vol. 130 – 31
Software Defined Radio – Practical Applications
A beginners guide to Software Defined Radio development with GNURadio

Summary
This three-day course will provide the foundational skills required to develop software defined radios using the GNURadio framework. This course consists of both lecture material and worked SDR software examples. The course begins with a background in SDR technologies and communications theory. The course then covers programming in the Linux environment common to GNURadio. Introductory GNURadio is presented to demonstrate the utilization of the stock framework. Then the class will cover how to develop and debug custom signal processing blocks in the context of a work SDR modem. Finally, the advanced features of GNURadio will be covered such as RPC, data tagging, and burst (event) processing. This class will present SDR development best practices developed through the development of over a dozen SDR systems. Such practices include approaches to quality assurance coding, process monitoring, and proper system segmentation architectures.

Each student will receive a complete set of lecture notes as well as a complete SDR development environment preloaded with the worked examples of GNURadio applications.

Instructor
Dr. Mark Plett has 15 years experience developing Communications Systems. He has worked at several telecommunications start-ups as well as the DoD, and Microsoft. Most recently, Dr. Plett works at the Johns Hopkins Applied Physics Lab (APL) directing the Wireless Cyber Capabilities Group. Dr. Plett has spent the last 7 years developing software-defined radios for a variety of DoD applications. He is active in the open source SDR community and has contributed source code to the GNURadio project. Dr. Plett received his Masters in Electrical Engineering from the University of Maryland in 1999 and his Ph.D. in Electro-physics from the University of Maryland in 2007. Dr. Plett is a licensed Professional Engineer in the State of Maryland.

What You Will Learn
• What applications utilize SDR.
• Common SDR architectures.
• Basic communications theory (spectrum access, modulation).
• Basic algorithms utilized in SDR (carrier recovery, timing recovery).
• Modem structure.
• Linux software development and debugging.
• SDR development in GNURadio Companion.
• Custom signal processing in GNURadio.
• Worked examples of SDR Modems in GNURadio.
• Advanced GNURadio features (stream tags, message passing, control port).

Course Outline
4. The Linux Programming Environment. Introduction to the Linux operating system. Architecture of the Linux operating system (Kernel and User spaces) Features of the Linux OS useful to development such as Package managers, command line utilities, and BASH. Worked examples of useful commands and BASH scripting to provide an introduction to software development in Linux. How software is compiled and executed with worked examples of static and shared libraries.
9. Advanced GNURadio features. Overview of advanced GNURadio features. Worked examples of system logging. Worked examples of message passing and burst processing with PDUs. Worked examples of metadata passing using stream tags. Worked example of burst processing using metadata enabled tagged-streams. Worked example of external process monitoring using GNURadio control port. Worked example of hardware accelerated signal processing using the VOLK optimized kernel library.
10. Open source SDR projects. Discussion and simple demonstration of available open-source SDR projects. Scanner utilities such as GQRX, SDR#, and Baudline. SDR modems projects such as ADS-B, AIS, Airprobe and OpenRTS.

March 12-14, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
Register 3 or More & Receive $1000 Off The Course Tuition.
A 4-Day Practical Workshop
Planned and Controlled Methods are Essential to Successful Systems.

Participants in this course practice the skills by designing and building interoperating robots that solve a larger problem. Small groups build actual interoperating robots to solve a larger problem. Create these interesting and challenging robotic systems while practicing:

- Requirements development from a stakeholder description.
- System architecting, including quantified, stakeholder-oriented trade-offs.
- Implementation in software and hardware.
- System integration, verification and validation.

Summary
Systems engineering is a simple flow of concepts, frequently neglected in the press of day-to-day work, that reduces risk step by step. In this workshop, you will learn the latest systems principles, processes, products, and methods. This is a practical course, in which students apply the methods to build real, interacting systems during the workshop. You can use the results now in your work.

This workshop provides an in-depth look at the latest principles for systems engineering in context of standard development cycles, with realistic practice on how to apply them. The focus is on the underlying thought patterns, to help the participant understand why rather than just teach what to do.

Instructor
Dr. Scott Workinger has led innovative technology development efforts in complex, risk-laden environments for 30 years in the fields of manufacturing (automotive, glass, optical fiber), engineering and construction (nuclear, pulp & paper), and information technology (expert systems, operations analysis, CAD, collaboration technology). He currently teaches courses on program management and engineering and consults on strategic management and technology issues. Scott has a B.S in Engineering Physics from Lehigh University, an M.S. in Systems Engineering from the University of Arizona, and a Ph.D. in Civil and Environment Engineering from Stanford University.

Who Should Attend
- A leader or a key member of a complex system development team.
- Concerned about the team’s technical success.
- Interested in how to fit your system into its system environment.
- Looking for practical methods to use in your team.

Course Outline

2. Systems Engineering Model. An underlying process model, based on ISO-15288 and the INCOSE Handbook, that ties together all the concepts and methods. Overview of the systems engineering model; process descriptions from Stakeholder Requirements Definition through Requirements Definition, System Architecting, System Integration, Verification, Validation, Operation, Maintenance, and Disposal.

3. A System Challenge Application. Practical application of the systems engineering model against an interesting and entertaining system development designing and building interoperating robots. (See side box.)

4. Operational Definition. How to focus on and agree on the need for a system. Defining the problem in stakeholder terms, from an operational view. Encompassing interoperability and larger-system aspects. Quantifying the need for later trade-offs.

5. Requirements Definition. Requirements as the primary method of measurement and control for systems development. How to translate a need into effective requirements; types of requirements and their limitations; definition of requirements by analyzing the mission and environments, documenting good technical requirements; functional, object-oriented, and model-based SE (MBSE) methods for requirements documentation; informal requirements in Agile and Lean.

6. System Architecting. Designing a system using the best MBSE methods known today. System architecting processes; alternate sources for solutions; how to allocate requirements to the system components; how to develop, analyze, and test alternatives; how to trade-off results and make decisions. Architecting concepts and methods, the elements of an architecture; simulation and modeling methods; interfaces and interface control; patterns and their power in architecting; architectural frameworks such as DoDAF and UPDM. Creating product-level requirements on the system components.

7. Product Design and Implementation. The role of SE during the design of product-level components; protecting the objectivity; summary of preliminary and detailed design stages; production planning and management; unit-level test methods; the system responsibility for unit-level acceptance.

8. System Integration and Test. Building in quality during the development, and then checking it frequently. The relationship between systems engineering and systems testing. Purpose of system integration in contrast to test; planning for I&T integration management. Verification and validation at multiple levels, and how they affect system quality.

9. Project Technical Leadership. How to successfully manage the technical aspects of the system development; virtual, collaborative teams; design reviews; technical performance measurement (TPM); technical baselines and configuration management. Integrated Product Team (IPT) methodology; technical teamwork and leadership. Technical planning, monitoring, and control. Risk management, requirements management. Trends in SE management, how complexity and Systems of Systems (SoS) are affecting SE. Small case studies.
April 16-18, 2019
Columbia, Maryland
May 21-23, 2019
Orlando, Florida
$2090 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each
Off The Course Tuition.

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Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805

Course Outline

1. Test & Evaluation Overview: An overview of test and evaluation (T&E) principles and methods for simple products and complex systems. Defining specific test processes, including test, evaluation, verification, validation, developmental testing (DT&E or “alpha”), and operational testing (OT&E or “beta”). Cost-effective T&E, and the cost of quality. Nine basic principles of testing.


3. Developing Test Requirements: Requirements as the primary method to control product development. Types of requirements, including traditional, model-based and agile requirements. How to develop a requirements verification matrix (RVM); verification methods (Inspection, Analysis, Demonstration, Test). Test requirements differences for prototypes, first articles, production and support.

4. Designing a Test and Evaluation Program: Three stages: test strategy, test planning, test procedures. Creating a T&E strategy in context of the stakeholder needs. An effective outline of T&E strategy topics, such as US DoD “Test and Evaluation Master Plan (TEMP)” Converting the strategy to a T&E plan: defining specific verification events in terms of requirements tested, time frame, equipment/skills needed, duration, and goals. Identification of test enabling products early enough to affect the development program. Modeling and simulation for test planning.

5. Designing Tests and Evaluations: The test procedure as a control for each verification event. Identifying the issues and goals in each verification event. Determining the requirements to include, and what not to include. “Black box” input/output analysis, choosing what to measure, and identification of observability issues. Logical sequencing of the test procedure based on product/system states, input controls, and observable measurements. Analyzing expected variation in test data, statistical design of tests, sampling principles, selecting useful statistical methods, design of experiments, common statistical errors.

6. Integration Testing: Manage the intricate aspects of system integration testing: level of integration planning; managing system integration problems; work-arounds. Development test concepts: five types of integration test planning; preferred order of events; component testing.

7. Test Conduct: How to perform testing; differences in testing for prototypes, first article qualification, recurring production acceptance, support; rules for test conduct. Test records; test readiness certification, test constraints, test article configuration; troubleshooting and anomaly handling; measures of success and indicators of difficulty; test tools. Test failure analysis.

8. Robotic Test Challenge: A hands-on class exercise in small groups. Part A analyzes a system concept and requirements, developing an RVM and specific test procedures. Part B creates an effective test program and test procedures for the product system. Part C builds the robotic systems per assembly instructions. Part D implements the test program to evaluate the final robots. Continuing Education: This course qualifies for 2.1 CEUs or 21 PDUs.

Who Should Attend
● Test Engineers ● Design Engineers (any engineering discipline) ● Systems Engineers ● Project Engineers ● Technical Team Leaders ● System Support Leaders ● Technical and Management Staff ● Project Managers.

Instructor
Mr. William “Bill” Fournier, ESEP is Senior Software Systems Engineering with 38 years of experience. Mr. Fournier taught DoD Systems Engineering full time at SMC/DAU as a Professor of Engineering Management. Mr. Fournier has taught Systems Engineering at least part time for more than the last 25 years. Mr. Fournier holds a MBS and a BS Industrial Engineering / Operations Research and is DOORS trained. Bill is level III in four DAWIA career fields. He is a contributor to DAU / DSMC, Major Defense Contractor internal Systems Engineering Courses and Process, and INCOSE publications. Bill is a Verification SME.

What You Will Learn
• The roles of T&E in development and support.
• Nine basic principles of testing.
• A useful life-cycle model for T&E.
• How to analyze product/system requirements into test requirements that satisfy stakeholders.
• T&E development: strategy, plan, procedures.
• Test design and analysis; statistical methods.
• System integration testing and how it differs from product/system final testing Test methods, test control, test results.

Summary
Test and evaluation (T&E) provide the means to ensure that a product performs in the intended way and with the intended results. Testing starts very early in a product system development, however, because test planning is dependent on good requirements.

This course teaches the details of test and evaluation from product concept through operations, with a view toward application in large system development. The course is highly practical, helping students to understand not only what must be done, but why it is necessary. Students learn about a stakeholder view of test and evaluation, the use of requirements as the primary staypoint for verification, planning a test program in terms of strategy, plans, and procedures, the statistical analysis of a test prior to performing the test, the differences between integration testing and final testing, and how to conduct tests at different phases of product/system development, production and support.

Practice the skills on a realistic product system. Design a test program for a typical product system. Build the robotic system. Implement the test program. Analyze the results.

The Robotic Test Challenge Exercise gives students the opportunity to practice the skills taught in the course from end to end during development and support of actual operating robots. The exercise happens in four segments throughout the course, encompassing a total of six hours in highly practical learning.

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Who Should Attend
● Test Engineers ● Design Engineers (any engineering discipline) ● Systems Engineers ● Project Engineers ● Technical Team Leaders ● System Support Leaders ● Technical and Management Staff ● Project Managers.
March 26-28, 2019  
Dallas, Texas  

June 4-6, 2019  
Columbia, Maryland  

$2090  
(8:30am - 4:30pm)  
Register 3 or More & Receive $100 per Off The Course Tuition.

Course Outline
1. Introduction. What is the CSEP and what are the requirements to obtain it? Terms and definitions. Basis of the examination. Study plans and sample examination questions and how to use them. Plan for the course. Introduction to the INCOSE Handbook. Self-assessment quiz. Filling out the CSEP application.


3. Technical Processes. The processes that take a system from concept in the eye to operation, maintenance and disposal. Stakeholder requirements and technical requirements, including concept of operations, requirements analysis, requirements definition, requirements management. Architectural design, including functional analysis and allocation, system architecture synthesis. Implementation, integration, verification, transition, validation, operation, maintenance and disposal of a system.


5. Enterprise & Agreement Processes. How to define the need for a system, from the viewpoint of stakeholders and the enterprise. Acquisition and supply processes, including defining the need. Managing the environment, investment, and resources. Enterprise environment management. Investment management including life cycle cost analysis. Life cycle processes management standard processes, and process improvement. Resource management and quality management.

6. Specialty Engineering Activities. Unique technical disciplines used in the systems engineering processes: integrated logistics support, electromagnetic and environmental analysis, human systems integration, mass properties, modeling & simulation including the system modeling language (SysML), safety & hazards analysis, sustainment and training needs.


The INCOSE Certified Systems Engineering Professional (CSEP) rating is a coveted milestone in the career of a systems engineer, demonstrating knowledge, education and experience that are of high value to systems organizations. This two-day course provides you with the detailed knowledge and practice that you need to pass the CSEP examination.
### Course Outline

1. **Effective Workplace Communication.** Interpersonal, Spoken & E-mail Strategies & Best Practices in effective communication to get your meaning across. Participants address communication pitfalls and cross-generational / cross-cultural trends.

2. **Sexual Harassment Prevention—Creating an Inclusive & Respectful Workplace.** Disrespectful behaviors have negative effects on teams and organizations reducing morale and increasing employee Turnover, Stress, & EEO complaints. Organizations must foster an inclusive, respectful workplace.

3. **Thomas-Kilmann Conflict Mode Instrument (TKI)—Conflict Management Assessment.** A conflict management style self-assessment (30-question assessment) identifies your conflict management style. TKI is easily learned and flexible to apply to a variety of individual and team learning needs – communication, teamwork, conflict resolution, decision-making, and others.

4. **Trust, Credibility & Team Building.** High-trust organizations outperform low-trust organizations by 300%. Distrust in the organization increases 3-fold the time it takes to get things done. Supervisors with the highest credibility are best able to implement their goals for their staff.

5. **Emotional Intelligence/EQ - Social & Self-Management Skills.** Some employees are intelligent, technically capable, and perform the duties their job demands … yet wreak havoc on teams because of their lack of social skills—IQ alone is not enough.

6. **Coaching, Delegation & Performance Management.** Practical management and delegation guidelines are provided as well as techniques insights for enhancing employee collaboration and output.

7. **Creativity/Innovation & Critical Thinking.** EVERYONE is creative and capable of generating innovations. Teams need members to see, think, learn, and act in new ways to keep abreast of change.

8. **Implementing Strategic Plans & Goals.** Supervisors ensure strategic plans are executed efficiently & effectively. Set short- and long-term goals, identify potential obstacles, and prioritize plans, timelines, and tasks for success.

9. **Negotiation, Influencing & Leading Change & Re-Negotiation & Influence.** Are core skills for effective supervision and leadership. Supervisors bringing change must influence others. Change resilience training helps supervisors and managers implement workplace change more effectively.

10. **Cultural Competency, Diversity & Inclusion.** Celebrating diversity is one thing; cultural competency is altogether different. Developing cultural competency includes examining our own worldview and biases, and developing the willingness to learn and be educated from a different point of view.

11. **BONUS TOPIC: Recognizing and Overcoming Unconscious Bias in Self & Others.** Unconscious/implicit Biases are the filters or stereotypes, both favorable and unfavorable, that structure our understanding, actions, and decisions without our awareness or intentional control. Explore the roots of unconscious bias and identify how bias operates in the workplace.

### What You Will Learn

- **Skills & Techniques for Effective Supervision & Management.**
- **Current trends & Best Practices in Employee Engagement & Motivation.**
- **How to assess your Conflict Management Style & its Impact.**
- **Coaching & Mentoring Strategies.**
- **Impact of Unconscious/Implicit Bias on Building High-Performing Teams.**
- **Creating & Maintaining A Respectful & Inclusive Workplace.**
- **Strategies For Leading & Implementing Change.**
- **After Action Planning.**

### Summary

This innovative four-day Supervisor/Leadership program uses Case Studies, DVDs, workplace scenarios, and self-assessments to provide essential foundational skills and enabling tools for supervisory success in today’s demanding workplace. 11 competencies are addressed through interactive exercises providing practical strategies you can implement at work.

This fast-paced training program provides step-by-step strategies and best practices for addressing bias and 10 other competencies for workplace success. These skills and insights are crucial to your ongoing success and support of workplace inclusion and employee engagement.

### Instructor

**Charles (Skip) Pettit, M.Ed., AGS** has been a training consultant and trainer for more than 25 years. In 1993, he formed the International Training Consortium, a talent-packed group of more than 100 of the top trainers and consultants in the US. He serves as its President today. Mr. Pettit it is a nationally recognized trainer, consultant and educator and a graduate & former instructor of Defense Equal Opportunity Management Institute (DEOMI). His extensive work with the federal government (NOAA/NOS, NSF, NRC, USDA, EPA, NIH, NRC, DOJ, and other organizations) makes him a master facilitator of this course. He is a Subject Matter Expert in Team Building, Diversity & Inclusion/Unconscious Bias, Performance Management, Employee Engagement, Supervision and Leadership. Mr. Pettit develops, coordinates, executes, and evaluates managerial training and development programs.

Register online at [www.ATIcourses.com](http://www.ATIcourses.com) or call ATI at 888.501.2100 or 410.956.8805.

Register 3 or More & Receive $100 Each Off The Course Tuition.

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**March 4-7, 2019**  
**Columbia, Maryland**  
**$2290** (8:30am - 4:30pm)
Instructor

Paul Martin, ESEP, CTT+, is a practicing Systems Engineer with over 35 years of experience. He has been everything from a Product Engineer for General Electric Products Division to a Software Systems Engineer for a multi-million dollar Navy program. He developed the INCOSE SEP Exam Preparation Course back in 2009 and has taught the material to several hundred students. For the course Paul developed a unique comprehensive Process Flow diagram that contextualize all 31 Organizational, Project and Technical processes that are outlined in the INCOSE SE Handbook. Many of Paul’s students have commented on the effectiveness of the diagram. Paul has a unique and passionate style that keeps students interest at a high level.

Testimonials ...

“I took a CSEP prep course from Paul last May and, after putting it off, finally took the exam in December and passed. Just wanted to let you know. Your prep course and materials were very helpful. I felt well-prepared for the exam, but it was still harder than expected. I felt that the wording on some of the questions was confusing. But I passed, and that’s what matters”

“This course takes a very complex topic and gives it structure and cohesion in order to impart knowledge as well as suggest best practices: two thumbs up!

I found the tests particularly useful in pinpointing my areas of deficiency. In my prep for the CSEP test, I studied and took the test iteratively, gradually cementing my command of the subject.”

“Course content was very well organized and had complete coverage of required material.”

“He obviously has had a long working career in SE and knows the material. Kept the focus on what is needed to pass the CSEP exam.”

“Just wanted to let you know I successfully passed the CSEP exam today. Thanks again for your help. You are an excellent instructor, and I appreciate your examples and explanations.

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“Just wanted to let you know I successfully passed the CSEP exam today. Thanks again for your help. You are an excellent instructor, and I appreciate your examples and explanations.”

Summary

An online course consisting of 7 modules with over 20 hours of teaching. Once registered you’ll be provided admittance to the class web portal, which you will have access to 24/7. This online class can be taken at your own pace (with unlimited replays) and at your own most convenient times. The course covers the entire INCOSE SE Handbook Version 4.0. Includes study guides, a comprehensive Process Flow diagram, practice quizzes and exams.

Take control of your career and get your INCOSE Systems Engineer Professional (SEP) certification now! This class provides 16 Professional Development Units (PDUs) and 24 PDU if you complete quizzes and the 120 Question Practice Exam. The quizzes prepare you to take INCOSE SEP exam. We are confident that our testing materials will prepare you to pass the INCOSE SEP exam the first time.
Model Based Systems Engineering
Creating and Using Models for More Effective Systems Engineering

May 6-9, 2019
Columbia, Maryland
$2290 (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 each Off The Course Tuition."

Summary
This 4-day course provides an introduction to Model-Based Systems Engineering (MBSE): the practice of using a system model to streamline the process of requirements analysis, architecture, and design. Lectures on proven, state-of-the-art techniques will be reinforced with lessons learned and case studies from the instructor’s own experiences applying MBSE of major DoD acquisition programs, along with in-class, live demonstrations using a popular system modeling tool (Cameo Systems Modeler™ by No Magic, Inc.) to create an example model. Students will be provided with a temporary, fully-functional tool license with which they can get hands-on experience working tutorial exercises that reinforce the lecture material.

The course is valuable to systems engineers, program managers, and anyone else interested in understanding what is required to create a system model, how to use it to support systems engineering activities on a program, and the benefits that can be realized.

Instructor
Sean McGervey, is a Systems Engineer at the Johns Hopkins University Applied Physics Laboratory, where he has been the Architecture Lead on a Major Defense Acquisition Program (ACAT-1) for the US Navy and most recently is leading several efforts within the Systems Engineering Transformation initiative of the US Navy’s Strategic Systems Programs. Sean founded the JHU/APL MBSE Community of Practice to foster MBSE collaboration and innovation, and currently teaches three courses in MBSE at the laboratory. Prior to joining APL, Sean worked in the Systems Engineering Department at Northrop Grumman Mission Systems in Baltimore, Maryland for 15 years. While there, Sean applied MBSE on multiple ACAT-1 programs and founded the Northrop Grumman Corporate Model-Based Engineering (MBE) Community of Practice. Sean is an OMG Certified Systems Modeling Professional at the Model Builder: Advanced level and has been active in INCOSE’s MBSE Initiative.

Course Outline
1. MBSE Overview. What MBSE is and isn’t, practical benefits of MBSE.
2. Introduction to the Systems Modeling Language (SysML). Language notation and diagrams, element types and relationships.
3. Tool Introduction and Methodology. Introduction. How to use a typical modeling tool, methodology for developing a model.
4. Organizing Your Model. Best practices for model organization, packages, model libraries.
7. System Requirements Elicitation. System use cases, functional requirements derivation.
12. Advanced Topics in MBSE. Creating extensions to SysML, domain-specific modeling, model validation.

What You Will Learn
• Practical, proven techniques for creating models using industry standard SysML, and how to use those models to support systems engineering.
• How to use one of the most popular system modeling tools to create, verify, and validate system models.
• Preparing for a formal design review using the model as its centerpiece.
• Linking the SysML model to external analytical models.
Requirements Development & Management
Building Requirements that Effectively Communicate and Guide

April 8-10, 2019
Greenbelt, Maryland

June 11-13, 2019
Minneapolis, Minnesota

$2090  (8:30am - 4:30pm)
Register 3 or More & Receive $100 Each
Off The Course Tuition.

Course Outline

1. Requirements Overview.
   • What are requirements and how do they fit in to system development?
   • Context of system development models.
   • Role of requirements.
   • Importance of requirements.
   • Requirements cycles for contracted, R&D, and commercial development.

2. Stakeholder Requirements. Defining the system at its highest level, in terms of the stakeholder needs. The basic steps in understanding a new system.
   • Problem definition with the stakeholders.
   • System boundaries and life cycle.
   • System environment.
   • Define the need in operational terms.
   • What to do with the operational descriptions.
   • Quantify the need to allow effective trade offs.
   • Application of SysML diagrams for operational definition.

3. Defining Requirements. How to convert operational descriptions into technical requirements.
   • Five types of requirements and the characteristics of each type: functional, performance, interface, constraint, and verification requirements.
   • Create functional and performance requirements using mission analysis as an engineering technique.
   • Interface requirements as a definition of system boundaries; how to create them.
   • Constraint requirements on the system, its environment, and its development.
   • Verification requirements as the basis for system proof, including the Requirements Verification Matrix (RVM).
   • Requirements document types – specifications, use cases, agile, SCRUM.
   • Formal requirements writing rules from the INCOSE Requirements Writing Guide.

4. Requirements Analysis. Methods to validate requirements to ensure that systems requirements are complete, coherent, and cohesive.
   • Working with requirements interactions.
   • Diagramming techniques to evaluate sets of requirements.
   • Useful SysML diagrams: use case, activity, state machine diagrams. Strengths and weakness of each diagram.

5. Requirements Allocation. Requirements as engineering tools during the system architecting and design phases.
   • Overview of system architecture and how requirements are used to define components.
   • Allocation methods with examples – direct allocation, apportionment, derivation.
   • Application of allocation methods to different types of high-level requirements.
   • Architectural design using requirements.

6. Requirements Management. Using a requirements database to allow requirements to guide the design.
   • Requirements management methods: when to do what tasks.
   • Feedback to the system development so that requirements act as the guide.
   • Ensuring the system meets all requirements and does not add unnecessary functions.
   • How to use managed requirements to plan and perform system verification.
   • Attributes of requirements management databases.
   • Survey of requirements management tools.
   • Simple management in Excel.

7. Case Study. Small-group study of a virtual development project in five segments to apply the learned methods.
   • Defining the need.
   • Converting stakeholder requirements to technical requirements
   • Writing good requirements.
   • Requirements analysis.
   • Requirements allocation.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805

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Summary

One of the most significant impacts a systems engineer can have on a project is to ensure the successful identification, analysis, allocation, management, and use of requirements. This course provides both lecture and practical work on the creation and use of requirements in a system development from concept to verification.

The three-day course begins with an overview of the purpose and use of requirements. We identify the possible sources of requirements, and how to define and validate requirements from each type of source. We teach how to write requirements, with practical hands-on practice on each type of requirement. We also focus on the entire set of requirements, with methods to graphically analyze the requirements to ensure completeness, correctness, and cohesion. We teach requirements allocation, how to decompose high-level requirements into lower-level requirements that create meaningful practical specifications for the system components. We show how to use requirements to guide system verification. Finally, we look at the structure and tools for requirements management, to ensure that all requirements are met and that non-required features are not created. From beginning to verification, good systems engineers use requirements as the primary definition for the system and its elements, to help the product system.

Instructor

Dr. John Gill is a servant leader who empowers his colleagues by helping them develop the knowledge, skills and confidence to tackle new and exciting challenges. He has led significant technical initiatives to develop and field Electronic Warfare Systems for the F-22 Raptor and F-35 Lightning II. At BAE Systems, John was instrumental in guiding BAE Systems’ transition from traditional, paper-based engineering processes to a model-based development environment. John led the 800 person Systems and Software Engineering functions developing advanced processes, management and leadership skills. As a former US Air Force officer, John led advanced research initiatives involving Dense Particle Plasma Physics, Nuclear and Conventional Weapons Effects and Global Sensing and Communications Networks. John is one of the original set of 18 people certified as an INCOSE Expert Systems Engineering Professional (ESEP). He is committed to helping students get the most out of their training and development experiences.

What You Will Learn

• All the methods in collaborative work.
• Define and quantify the operation need.
• Write requirements.
• Graphical Requirements analysis.
• Allocate the requirements into an architecture.
• Plan verification.
May 7-9, 2019
Huntsville, Alabama

June 18-20, 2019
Fairfax, Virginia

$2195 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each
Off The Course Tuition.

System Architecting with SysML

Course Outline

2. Basic SysML Concepts (1:30). Where SysML came from; its purpose within the SE paradigms; the basic constructs of SysML. SysML underlying concepts: the information database; correct vs. complete. The SysML language. SysML and UML. The nine SysML diagram types. Common diagram structures: frames, headers, keywords, node symbols, path symbols, icons, notes.

3. Operational Definition and Analysis (3:00). Understanding stakeholder views of the problem and the system; stakeholder requirements; using SysML to analyze and document the operational architecture. The concept of a use case (scenario). System boundaries and external actors. Use Case diagrams to define functionality. Activity diagrams to elaborate the behavior of a use case.

4. System Requirements Modeling (2:00). Modeling technical requirements; the relationships between operations and requirements; how to document requirements and their relationships in SysML. How to express SysML requirements in their forms and uses. Requirements diagrams to show relationships among requirements. Types of requirement relationships and how to show them in SysML. Requirements rationale in SysML. Constraints as a part of requirements; the constraint block. Parametric diagrams to define constraints. Constraint blocks to modify flows. Representing trade-offs. Modeling requirements verification.

5. System Logical Architecting and Analysis (3:00). Requirements analysis using logical constructs; understanding the requirements better as a step toward physical system design; the logical architecture. Logical vs. physical architecture. Functional design vs. object-oriented design; how SysML supports either. The concept of a state; state transitions, triggers, guards, and effects. State hierarchies and operational calls. State Machine diagrams to analyze and document the event-based behaviors. Sequence diagrams to analyze and document the message-passing behaviors. Lifelines and interactions in sequences.

6. System Physical Architecting (3:00). System physical design; how to use SysML to show the physical architecture; the end-state of architecting. The block as a representation of systems, components, or flow items. Block relationship types: association, composite, reference, generalization. Block Definition diagrams to depict structural block relationships. Internal Block diagrams to depict dynamic block relationships. Parametric diagrams to define constraints. Quantifiable characteristics in a block. Modeling interfaces using ports and flows. Modeling block behavior. Modeling classifications and variants. Requirements diagrams to show hierarchical requirements allocations. Requirements allocations in the block diagrams.

7. Additional SysML Constructs (1:30). Some remaining features of SysML for better architecting: organizing the model; allocating relationships. Package diagrams to organize the model; types of organization; namespaces; imports and dependencies. Requirements containment hierarchies. Allocation between model constructs. Allocate constraints in SysML. Customizing SysML for projects or enterprises; SysML profiles; stereotypes.

8. Architecting Challenge Exercise (5:00). Student group work in four segments to practice the major aspects of architecting with SysML; creating the SysML model diagrams to define a system; Introduction to the remotely-piloted aircraft system. Part A: Operational definition with use cases and activities. Part B: Logical architecting with state machines, sequences, and parameters. Part C: Physical architecting and alternatives with block diagrams. Part D: Requirements allocation and package diagrams.

9. Summary (0:30). Review of the important points of the course. Interactive discussion of participant experiences that add to the material. Continuing Education: This course qualifies for 2.1 CEUs or 21 PDUs.

Summary
The discipline of systems engineering (SE) is transforming, with much of the design information now captured in graphical models. System Modeling Language (SysML) is the primary tool used to create and retain this design information. Design information in SysML includes operational (stakeholder) definition, technical requirements, architectural analysis/structure, parametric definition, and test information, which together represent nearly the entirety of SE artifacts. An underlying database holds the SysML information so that data from one diagram appears synchronized on other diagrams. The benefits to the system architect are extensive.

This three-day course shows how to architect and maintain a system definition using SysML. It is filled with graphic examples from SysML models, but it is unlike other SysML courses in that the spotlight is on the system architecting. Students do not work on a computer during class, so that they can focus on the concepts rather than on use of a specific software tool. The course flows through familiar SE processes while teaching how the SysML models and structures support and enhance each task. We cover every SE activity and every SysML diagram, from Use Case and Activity diagrams to define operations; through State Machine, Sequence and Parametric diagrams to define system requirements; to Block Definition, Internal Block, and Requirements diagrams to define architectural structure. By the completion of this course, you will be able to apply SysML effectively in your own work.

In addition to our complete course materials, students also receive a copy of the seminal textbook A Practical Guide to SysML by Friedenthal, Moore, and Steiner.

Instructor
Dr. John Gill is a servant leader who empowers his colleagues by helping them develop the knowledge, skills and confidence to tackle new and exciting challenges. He has led significant technical initiatives to develop and field Electronic Warfare Systems for the F-22 Raptor and F-35 Lightning II. At BAE Systems, John was instrumental in guiding BAE Systems’ transition from traditional, paper-based engineering processes to a model-based development environment. John led the 800 person Systems and Software Engineering functions developing advanced processes, management and leadership skills. As a former US Air Force officer, John led advanced research initiatives involving Dense Particle Plasma Physics, Nuclear and Conventional Weapons Effects and Global Sensing and Communications Networks. John is committed to helping students get the most out of their training and development experiences.

Who Should Attend
• Systems engineers.
• Design engineers.
• Technical team leaders.
• System support leaders.
• Others who participate in defining and developing complex systems.
Summary

Today's complex systems present difficult challenges to develop. From military systems to aircraft to environmental and electronic control systems, development teams must face the challenges with an arsenal of proven methods. Individual systems are more complex, and systems operate in much closer relationship, requiring a system-of-systems approach to the overall design.

This two-day workshop presents the fundamentals of a systems engineering approach to solving complex problems. It covers the underlying attitudes as well as the process definitions that make up systems engineering. The model presented is a research-proven combination of the best existing standards.

Participants in this workshop practice the processes on a realistic system development.

Course Outline


2. Where Do Requirements Come From? Requirements as the primary method of measurement and control for systems development. Three steps to translate an undefined need into requirements; determining the system purpose/mission from an operational view; how to measure system quality, analyzing missions and environments; requirements types; defining functions and requirements.

3. Where Does a Solution Come From? Designing a system using the best methods known today. What is an architecture? System architecting processes; defining alternative concepts; alternate sources for solutions; how to allocate requirements to the system components; how to develop, analyze, and test alternatives; how to trade off results and make decisions. Establishing an allocated baseline, and getting from the system design to the system. Systems engineering during ongoing operation.

4. Ensuring System Quality. Building in quality during the development, and then checking it frequently. The relationship between systems engineering and systems testing. Technical analysis as a system tool. Verification at multiple levels: architecture, design, product. Validation at multiple levels; requirements, operations design, product.

5. Systems Engineering Management. How to successfully manage the technical aspects of the system development; planning the technical processes; assessing and controlling the technical processes, with corrective actions; use of risk management, configuration management, interface management to guide the technical development.

6. Systems Engineering Concepts of Leadership. How to guide and motivate technical teams; technical teamwork and leadership; virtual, collaborative teams; design reviews; technical performance measurement.

7. Summary. Review of the important points of the workshop. Interactive discussion of participant experiences that add to the material.

Who Should Attend

You Should Attend This Workshop If You Are:

• Working in any sort of system development.
• Project leader or key member in a product development team.
• Looking for practical methods to use today.

This Course Is Aimed At:

• Project leaders.
• Technical team leaders.
• Design engineers.
• Others participating in system development.

Instructors

Mr. William "Bill" Fournier, ESEP is Senior Software Systems Engineering with 38 years of experience. Mr. Fournier taught DoD Systems Engineering full time at SMC/DAU as a Professor of Engineering Management. Mr. Fournier has taught Systems Engineering at least part time for more than the last 25 years. Mr. Fournier holds a MBS and a BS Industrial Engineering / Operations Research and is DOORS trained. He is a contributor to DAU / DSMC, Major Defense Contractor internal Systems Engineering Courses and Process, and INCOSE publications, speaking and review research.
Systems of Systems
Sound Collaborative Engineering to Ensure Architectural Integrity

April 11-12, 2019
Greenbelt, Maryland
$1590 (8:30am - 4:30pm)
"Register 3 or More & Receive 100% off
Off The Course Tuition."

Summary
Today's operational environments are dominated by complex Systems of Systems. We now create unprecedented scope and complexity. Extended life cycles, legacy systems and ongoing re-architecting add to the difficulty. Success requires sound methods to manage complexity while maintaining the integrity of the design and supporting shifting operational priorities.

When you think your systems should be working better than they are, this two-day workshop presents detailed, useful techniques to develop effective systems of systems and to manage the engineering activities associated with them. The course is designed for program managers, project managers, systems engineers, technical team leaders, logistic support leaders, and others who take part in developing today's complex systems.

Instructors
Eric Honour, CSEP, international consultant and lecturer, has a 40-year career of complex systems development & operation. Former President of INCOSE, selected as Fellow and as Founder. He has led the development of 18 major systems, including the Air Combat Maneuvering Instrumentation System and the Battle Group Passive Horizon Extension System. BSSE (Systems Engineering), US Naval Academy; MSEE, Naval Postgraduate School; and PhD, University of South Australia.

Dr. Scott Workinger has led projects in Manufacturing, Eng. & Construction, and Info. Tech. for 30 years. His projects have made contributions ranging from increasing optical fiber bandwidth to creating new CAD technology. He currently teaches courses on management and engineering and consults on strategic issues in management and technology. He holds a Ph.D. in Engineering from Stanford.

Course Outline

2. Complexity Concepts. Complexity and chaos; scale-free networks; complex adaptive systems; small worlds; synchronization; strange attractors; emergent behaviors. Introduction to the theories and how to work with them in a practical world.


4. Integration. Integration strategies for SoS with systems that originated outside the immediate control of the project staff, the difficulty of shifting SoS priorities over the operating life of the systems. Loose coupling integration strategies, the design of open systems, integration planning and implementation, interface design, use of legacy systems and COTS.

5. Collaboration. The SoS environment and its special demands on systems engineering. Collaborative efforts that extend over long periods of time and require effort across organizations. Collaboration occurring explicitly or implicitly, at the same time or at disjoint times, even over decades. Responsibilities from the SoS side and from the component systems side, strategies for managing collaboration, concurrent and disjoint systems engineering; building on the past to meet the future. Strategies for maintaining integrity of systems engineering efforts over long periods of time when working in independent organizations.


What You Will Learn
• Capabilities engineering methods.
• Architecture frameworks.
• Practical uses of complexity theory.
• Integration strategies to achieve higher-level capabilities.
• Effective collaboration methods.
• T&E for large-scale architectures.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805
Communications Payload Design and Satellite System Architecture

March 19-22, 2019
Columbia, Maryland
$2395 (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 each Off The Course Tuition."

Course Outline

1. Communications Payloads and Service Requirements. Bandwidth, coverage, services and applications (RF link characteristics and appropriate use of link budgets; bent pipe payloads using passive and active components; specific demands for broadband data, IP over satellite, mobile communications and service availability; principles for using digital processing in system architecture, and on-board processor examples at L band (non-GEO and GEO) and Ka band.

2. Systems Engineering to Meet Service Requirements. Transmission engineering of the satellite link and payload (modulation and FEC, standards such as DVB-S2 and Adaptive Coding and Modulation, ATM and IP routing in space); optimizing link and payload design through consideration of traffic distribution and dynamics, link margin, RF interference and frequency coordination requirements.

3. Bent-pipe Repeater Design. Example of a detailed block and level diagram, design for low noise amplification, downconversion design, OMUX and band-pass filtering, group delay and gain study, AGC and linearization, power amplification (SSPA and TWTA, linearization and parallel combining), OMUX and design for high power/multipactor, redundancy switching and reliability assessment.

4. Spacecraft Antenna Design and Performance. Fixed reflector antennas, phased array design requirements and technical features. You will understand the engineering processes and device characteristics that determine how the payload is put together and operates in a state - of - the - art telecommunications system to meet user needs.

Summary

This four-day course provides communications and satellite systems engineers and system architects with a comprehensive and accurate approach for the specification and detailed design of the communications payload and its integration into a satellite system. Both standard bent pipe repeaters and digital processors (on board and ground-based) are studied in depth, and optimized from the standpoint of maximizing throughput and coverage (single footprint and multi-beam). Applications in Fixed Satellite Service (C, X, Ku and Ka bands) and Mobile Satellite Service (L and S bands) are addressed as are the requirements of the associated ground segment for satellite control and the provision of services to end users. Discussion will address inter-satellite links using millimeter wave RF and optical technologies.

Attendees will receive a copy of Mr. Elbert’s textbook Introduction to Satellite Communication – 3rd ed. (Artech House, 2008).

Instructor

Bruce R. Elbert (MSEE, MBA) is president of an independent satellite communications consulting firm. He is a recognized satellite communications expert with 40 years of experience in satellite communications payload and systems engineering beginning at COMSATS Laboratories and including 25 years with Hughes Electronics (now Boeing Satellite). He has contributed to the design and construction of major communications satellites, including Intelsat V, Inmarsat 4, Galaxy, Thuraya, DIRECTV, Morelos (Mexico) and Palapa A (Indonesia). Mr. Elbert led R&D in Ka band systems and is a prominent expert in the application of millimeter wave technology to commercial use. He has written eight books, including: The Satellite Communication Applications Handbook – Second Edition (Artech House, 2004), The Satellite Communication Ground Segment and Earth Station Handbook (Artech House, 2004), and Introduction to Satellite Communication – Third Edition (Artech House, 2008), is included.

What You Will Learn

- How to transform system and service requirements into payload specifications and design elements.
- What are the specific characteristics of payload components, such as antennas, LNAs, microwave filters, channel and power amplifiers, and power combiners.
- What space and ground architecture to employ when evaluating on-board processing and multiple beam antennas, and how these may be configured for optimum end-to-end performance.
- How to understand the overall system architecture and the capabilities of ground segment elements - hubs and remote terminals - to integrate with the payload, constellation and end-to-end system.
- From this course you will obtain the knowledge, skill and ability to configure a communications payload based on its service requirements and technical features. You will understand the engineering processes and device characteristics that determine how the payload is put together and operates in a state - of - the - art telecommunications system to meet user needs.

Register online at www.ATIcourses.com or call ATI at 888.501.2100 or 410.956.8805 Vol. 130 – 43
Summary

Just about everyone involved in developing hardware for space missions (or any other purpose, for that matter) has been affected by problems with joints using threaded fasteners. Common problems include structural failure, fatigue, galling, inadequate preload, fasteners losing preload or falling out completely, low or nonlinear stiffness, joint slipping or loss of alignment, excess weight, procurement cost and lead time, incompatibility with the space environment, and time-consuming assembly. This three-day course includes many examples and class problems. Participants should bring calculators.

Recent attendee comments ...

“It was a fantastic course, one of the most useful short courses I have ever taken.” “Interaction between instructor and experienced designers (in the class) was priceless.”

“(The) examples (and) stories from industry were invaluable.” “Everyone at NASA should take this course!”

“(What I found most useful:) strong emphasis on understanding physical principles vs. blindly applying textbook formulas.”

(What you would tell others) “Take it!” “You need to take it.” “Take it. Tell everyone you know to take it.”

“Excellent instructor. Great lessons learned on failure modes shown from testing.”

“A must course for structural/mechanical engineers and anyone who has ever questioned the assumptions in bolt analysis”

“Well-researched, well-designed course.” “Kudos to you for spreading knowledge!”

Instructor

Tom Sarafin is the President and Chief Engineer of an engineering and consulting firm. He has worked full time in the space industry since 1979 as a structural engineer, a mechanical systems engineer, a project manager, and a consultant. Since founding Instar in 1993, he’s consulted for NASA, DARPA, the DOD Space Test Program, Lockheed Martin, DigitalGlobe, Space Systems/Loral, Spaceflight Industries, and other organizations. He was a key member of the team that developed NASA-STD-5020, “Requirements for Threaded Fastening Systems in Spaceflight Hardware” (March 2012). He is the editor and principal author of Spacecraft Structures and Mechanisms: From Concept to Launch and a contributing author to Space Mission Analysis and Design. He’s also the principal author of a series of papers titled “Vibration Testing of Small Satellites.” Since 1995, he has taught over 250 courses to more than 5000 engineers and managers in the aerospace industry.

March 12-14, 2019
Greenbelt, Maryland

April 2-4, 2019
Littleton, Colorado

$1990 (8:30am - 5:00pm)

“Register 3 or More & Receive $1000 each Off The Course Tuition.”

Course Outline


February 11-14, 2019
Columbia, Maryland
$2395 (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 Off The Course Tuition."

This Course and Satellite Link Budget with SatMaster
(On Page 53)
Can Be Attended Together or Separately!

Summary

This intensive four-day course is intended for satellite communications engineers, earth station design professionals, and operations and maintenance managers and technical staff. The course provides a proven approach to the design of modern earth stations, from the system level down to the critical elements that determine the performance and reliability of the facility. We address the essential technical properties in the baseband and RF, and delve deeply into the block diagram, budgets and specifications of earth stations, hubs, and VSATS. Also addressed are practical approaches for the procurement and implementation of the facility, as well as proper practices for O&M and testing throughout the useful life. The overall methodology assures that the earth station meets its requirements in a cost effective and manageable manner.

Attendees will receive a copy of Mr. Elbert's textbook The Satellite Communication Ground Segment and Earth Station Handbook, 2nd ed, Artech House, 2014.

Instructor

Bruce R. Elbert, (MSEE, MBA) is president of an independent satellite communications consulting firm. He is a recognized satellite communications expert and has been involved in the satellite and telecommunications industries for over 40 years. He founded ATSI to assist major private and public sector organizations that develop and operate digital video and broadband networks using satellite technologies and interactive services. During 25 years with Hughes Electronics, he directed the design of several major satellite projects, including Palapa A, Indonesia's original satellite system; the Galaxy follow-on system; and the development of the first GEO mobile satellite system capable of serving handheld user terminals. Mr. Elbert was also ground segment manager for the Hughes system, which included eight teleport and 3 VSAT hubs. He served in the US Army Signal Corps as a radio communications officer and instructor. By considering the technical, business, and operational aspects of satellite systems, Mr. Elbert has contributed to the operational and economic success of leading organizations in the field. He has written seven books on telecommunications and IT, including Introduction to Satellite Communication, Third Edition (Artech House, 2008), The Satellite Communication Applications Handbook, Second Edition (Artech House, 2004); The Satellite Communication Ground Segment and Earth Station Handbook (Artech House, 2001), the course text.

Course Outline

1. Ground Segment and Earth Station Technical Aspects.
   Evolution of satellite communication earth stations—teleports and hubs • Earth station design philosophy for performance and operational effectiveness • Engineering principles • Propagation considerations • The isotropic source, line of sight, antenna principles • Atmospheric effects: troposphere (clear air and rain) and ionosphere (Faraday and scattering) • Rain effects and rainfall regions • Use of the DAH and Crane rain models • Modulation systems (QPSK, OQPSK, MSK, GMSK, 8PSK, 16 QAM, and 32 APSK) • Forward error correction techniques (Viterbi, Reed-Solomon, Turbo, and LDPC codes) • DBU-S2x and DVB-RCSC standards • Transmission equation and its relationship to the link budget • Radio frequency clearance and interference consideration • RFI prediction techniques • Interference criteria and coordination • Site selection • RFI problem identification and resolution.

2. Major Earth Station Engineering.
   RF terminal design and optimization. Antennas for major earth stations (fixed and tracking, LP and CP) • Upconverter and HPA chain (SSPA, TWTA, and KPA) • LNA/LNB and downconverter chain. Optimization of RF terminal configuration and performance (redundancy, power combining, and safety) • Baseband equipment configuration and integration • Designing and verifying the terrestrial interface • Station monitor and control • Facility design and implementation • Prime power and UPS systems. Developing environmental requirements (HVAC) • Building design and construction • Grounding and lightning control.

3. Hub Requirements and Supply.
   Earth station uplink and downlink gain budgets • EIRP budget • Uplink gain budget and equipment requirements • G/T budget • Downlink gain budget • Ground segment supply process • Equipment and system specifications • Format of a Request for Information • Operational requirements • Cost-benefit and total cost of ownership.

4. Link Budget Analysis Related to the Earth Station.
   Standard ground rules for satellite link budgets • Frequency band selection: L, C, X, Ku, and Ka • Satellite footprints (EIRP, G/T, and SFD) and transponder plans • Transponder loading and optimum multi-carrier backoff • How to assess transponder capacity • Maximize throughput • Minimize receive dish size • Minimize transmit power • Examples: DVB-S2 broadcast, digital VSAT network with multi-carrier operation.

5. Earth Terminal Maintenance Requirements and Procedures.
   Outdoor systems • Antennas, mounts and waveguide • Field of view • Shelter, power and safety • Indoor RF and IF systems • Vendor requirements by subsystem • Failure modes and routine testing.

6. VSAT Baseband Hub Maintenance Requirements and Procedures.
   IF and modern equipment • Performance evaluation • Test procedures • TDMA control equipment and software • Hardware and computers • Network management system • System software.

7. Hub Procurement and Operation Case Study.
   General requirements and life-cycle • Block diagram • Functional division into elements for design and procurement • System level specifications • Vendor options • Supply specifications and other requirements • RFP definition • Proposal evaluation • O&M planning.
Summary
This three-day course provides a practical introduction to all aspects of ground system design and operation. Starting with basic communications principles, an understanding is developed of ground system architectures and system design issues. The function of major ground system elements is explained, leading to a discussion of day-to-day operations. The course concludes with a discussion of current trends in Ground System design and operations.

This course is intended for engineers, technical managers, and scientists who are interested in acquiring a working understanding of ground systems as an introduction to the field or to help broaden their overall understanding of space mission systems and mission operations. It is also ideal for technical professionals who need to use, manage, operate, or purchase a ground system.

Instructor
Steve Gemeny is Director of Engineering for Syntonics. Formerly Senior Member of the Professional Staff at The Johns Hopkins University Applied Physics Laboratory where he served as Ground Station Lead for the TIMED mission to explore Earth's atmosphere and Lead Ground System Engineer on the New Horizons mission to explore Pluto by 2020. Prior to joining the Applied Physics Laboratory, Mr. Gemeny held numerous engineering and technical sales positions with Orbital Sciences Corporation, Mobile TeleSystems Inc. and COMSAT Corporation beginning in 1980. Mr. Gemeny is an experienced professional in the field of Ground Station and Ground System design in both the commercial world and on NASA Science missions with a wealth of practical knowledge spanning more than three decades. Mr. Gemeny delivers his experiences and knowledge to his students with an informative and entertaining presentation style.

What You Will Learn
• The fundamentals of ground system design, architecture and technology.
• Cost and performance tradeoffs in the spacecraft-to-ground communications link.
• Cost and performance tradeoffs in the design and implementation of a ground system.
• The capabilities and limitations of the various modulation types (FM, PSK, QPSK).
• The fundamentals of ranging and orbit determination for orbit maintenance.
• Basic day-to-day operations practices and procedures for typical ground systems.
• Current trends and recent experiences in cost and schedule constrained operations.

Course Outline
1. The Link Budget. An introduction to basic communications system principles and theory; system losses, propagation effects, Ground Station performance, and frequency selection.
2. Ground System Architecture and System Design. An overview of ground system topology providing an introduction to ground system elements and technologies.
4. Figure of Merit (G/T). An introduction to the key parameter used to characterize satellite ground station performance, bringing all ground station elements together to form a complete system.
7. Ground System Networks and Standards. A survey of several ground system networks and standards with a discussion of applicability, advantages, disadvantages, and alternatives.
8. Ground System Operations. A discussion of day-to-day operations in a typical ground system including planning and staffing, spacecraft commanding, health and status monitoring, data recovery, orbit determination, and orbit maintenance.
9. Trends in Ground System Design. A discussion of the impact of the current cost and schedule constrained approach on Ground System design and operation, including COTS hardware and software systems, autonomy, and unattended “lights out” operations.

February 12-14, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 off The Course Tuition."
Summary
This three-day course is designed as a practical course for practicing engineers, and is intended for communications engineers, spacecraft engineers, managers and technical professionals who want both the "big picture" and a fundamental understanding of satellite communications. The course is technically oriented and includes examples from real-world satellite communications systems. It will enable participants to understand the key drivers in satellite link design and to perform their own satellite link budget calculations. The course will especially appeal to those whose objective is to develop quantitative computational skills in addition to obtaining a qualitative familiarity with the basic concepts.

Instructor
Chris DeBoy leads the RF Engineering Group in the Space department at the Johns Hopkins University Applied Physics Laboratory, and is a member of APL’s Principal Professional Staff. He has over 25 years of experience in satellite communications, from systems engineering (he is the lead RF communications engineer for the New Horizons Mission to Pluto) to flight hardware design for both low-Earth orbit and deep-space missions. He holds a BSEE from Virginia Tech, a Master's degree in Electrical Engineering from Johns Hopkins, and teaches the satellite communications course for the Johns Hopkins University.

What You Will Learn
• A comprehensive understanding of satellite communication.
• An understanding of basic vocabulary.
• A quantitative knowledge of basic relationships.
• Ability to perform and verify link budget calculations.
• Ability to interact meaningfully with colleagues and independently evaluate system designs.
• A background to read the literature.

Course Outline
2. The RF Link – The Signal. Antenna gain, effective isotropic radiated power, receive flux density and receive power, Friis link equation and variants. Review of decibels (dB's).
3. The RF Link – Noise. Antenna gain, effective isotropic radiated power, receive flux density and receive power, Friis link equation and variants. Review of decibels (dB's).
4. The RF Link – Putting It Together. Receiver system G/T, received CNR, SNR. Bent-pipe and regenerative transponders, multiple carrier operation, noise power robbing and back-off.
7. Digital Modulation. Nyquist sampling, analog-to-digital conversion, ISI, Nyquist pulse shaping, raised cosine filtering, BPSK, QPSK, MSK, QAM, GMSK, GMSK, higher order modulation, bandwidth, power spectral density, constellation diagrams.
8. Demodulation and Bit Error Rate. Coherent detection and carrier recovery, phase-locked loops, bit synchronizers, bit error probability, Eb/No, BPSK, QPSK detection, digital modulation performance.
9. Coding. Information theory basics, Shannon’s theorem, code rate, coding gain, Hamming, BCH, and Reed-Solomon block codes, convolutional codes, Viterbi decoding, hard and soft decision, concatenated coding, Trellis coding, Turbo codes, LDPC codes.
11. Antennas. Directivity and gain, reciprocity, antenna patterns, beam solid angle, half-power beamwidth, nulls and sidelobes, efficiency, large apertures, antenna examples, shaped reflectors, phased-arrays.
14. Propagation. Earth’s atmosphere, atmospheric attenuation, rain attenuation, rain models and variation with frequency, impact on G/T, system examples.
15. Earth Stations. Antenna types, facilities, RF components, operations center.
18. Link Budgets. Communications link calculations, uplink, downlink, and composite performance, link budgets for single carrier and multiple carrier operation. Detailed worked examples.
19. Diversity. Site, phase, frequency, time, polarization diversity techniques and system examples.
20. Navigation. Range and range-rate (Doppler) tracking, GPS.
21. VSATs. Applications, access techniques, typical implementations.
22. Commercial and Military Satcom. System examples, GEO platforms, high throughput satellites, Inmarsat, Globalstar, Orbcomm, O3B, MILSATCOM, etc.
Satellite Communications: Introduction

Course Outline

1. Satellite Systems, Services, and Regulation. Introduction and historical background. The place of satellites in telecommunications. Satellite service definitions: broadcasting BSS, fixed-satellite FSS, and mobile satellite MSS. Major suppliers and operators of satellites. Satellite regulation: role of the ITU, FCC, and regulatory bodies of the various countries where services are provided. Satellite system design overview. Satellite real-world demands: security, control of accidental and intentional interference, resolving RFI.


3. The Space Segment. The space environment: gravity, radiation and space debris. Orbits: geostationary orbits; non-geostationary orbits. Orbital slots, footprints, and coverage; satellite spacing; eclipses and sun interference. Basic design of a satellite: structure and spacecraft subsystems (bus), antennas and repeaters (payload).

4. The Ground Segment. Earth stations: types – VSATs and hubs, RF equipment (amplifiers and frequency converters), antenna configurations (reflector designs, phased arrays), mounting and pointing (fixed and mobile installations). Antenna properties: gain; directionality; sidelobes and legal limits on sidelobe gain. Electronics, EIRP, and G/T: LNA and LNB, SSPA; signal flow through an earth station.

5. The Satellite Earth Link. Atmospheric effects on signals: rain effects and rain climate models; rain fade margins. Link budgets, CN and EbNo. Multiple access techniques: FDMA, TDMA and ALOHA, CDMA; Pairing Carrier Multiple Access, demand assignment; on-board processing. Signal security issues. Internet Protocol networks and adaptation to the satellite link.


Summary

This three-day introductory course reviews the essential elements of all satellite communications systems, with an emphasis on system design and performance. The objective is to inform new engineers and other professionals as well as those knowledgeable in specific technical and business areas by covering the technical characteristics of each aspect of the space and ground system, and show how they relate to each other. The fundamental connection is the radio link between satellite and earth station, which is covered in detail. Basic design of the satellite and earth station are covered to identify primary elements of each and to compare alternatives which have been and continue to be employed in real systems. These include geostationary satellites and non-geostationary constellations that are currently in development.

Instructor

Bruce R. Elbert, (MSEE, MBA) is president of an independent satellite communications consulting firm. He is a recognized satellite communications expert and has been involved in the satellite and telecommunications industries for over 40 years. He founded ATSI to assist major private and public sector organizations that develop and operate digital video and broadband networks using satellite technologies and interactive services. During 25 years with Hughes Electronics, he directed the design of several major satellite projects, including Palapa A, Indonesia’s original satellite system; the Galaxy follow-on system; and the development of the first GEO mobile satellite system capable of serving handheld user terminals. Mr. Elbert was also ground segment manager for the Hughes system, which included eight teleporters and 3 VSAT hubs. He served in the US Army Signal Corps as a radio communications officer and instructor. By considering the technical, business, and operational aspects of satellite systems, Mr. Elbert has contributed to the operational and economic success of leading organizations in the field. He has written seven books on telecommunications and IT, including Introduction to Satellite Communication, Third Edition (Artech House, 2008). The Satellite Communication Applications Handbook, Second Edition (Artech House, 2004); The Satellite Communication Ground Segment and Earth Station Handbook (Artech House, 2001), the course text.

May 1-3, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
“Register 3 or More & Receive $1000 each Off The Course Tuition.”

What You Will Learn

• How satellite communications relates to other forms of wireless systems that are used to provide one-way broadcasting and two-way interactive services, especially those delivered through the global Internet.

• The framework that defines the properties of the satellite itself as part of the system and as governed by international rules and regulations, and as offered by commercial operators around the world.

• The types of earth stations used to employ space resources, particularly very small aperture terminals (VSATs) to fixed and mobile users, and larger stations used as hubs and gateways.

• The basic principles of radio-wave propagation and the link budget, which establish whether the connection between user and satellite will work as required.

• The tradeoffs among the various orbits, frequency bands, and modulation and coding technologies needed to realize the required services via the satellite link.

• The evolution of this technology in a changing world.

Register online at www.ATLcourses.com or call ATI at 888.501.2100 or 410.956.8805

48 – Vol. 130
February 5-7, 2019
Columbia, Maryland
$2195  (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 Off The Course Tuition."

Instructor
Bruce R. Elbert, (MSEE, MBA) is president of an independent satellite communications consulting firm. He is a recognized satellite communications expert and has been involved in the satellite and telecommunications industries for over 40 years. He founded ATSI to assist major private and public sector organizations that develop and operate digital video and broadband networks using satellite technologies and services. During 25 years with Hughes Electronics, he directed the design of several major satellite projects, including Palapa A, Indonesia's original satellite system; the Galaxy follow-on system; and the development of the first GEO mobile satellite system capable of serving handheld user terminals. Mr. Elbert was also ground segment manager for the Hughes system, which included eight teleport and 3 VSAT hubs. He served in the US Army Signal Corps as a radio communications officer and instructor. By considering the technical, business, and operational aspects of satellite systems, Mr. Elbert has contributed to the operational and economic success of leading organizations in the field. He has written seven books on telecommunications and IT, including Introduction to Satellite Communication, Third Edition (Artech House, 2008); The Satellite Communication Applications Handbook, Second Edition (Artech House, 2004); The Satellite Communication Ground Segment and Earth Station Handbook (Artech House, 2001).

What You Will Learn

• Characteristics of satellites – GEO vs. non-GEO, area coverage vs. spot beam, bent pipe vs. processor-based.
• Characteristics of satellite networks – broadcast, interactive, star and mesh, high-throughput satellite (HTS) alternatives.
• The tradeoffs between major alternatives in SATCOM system design.
• SATCOM modulation and coding tradeoffs and link budget analysis.
• DAMA/BoD for FDMA, TDMA, and CDMA systems.
• Critical RF parameters in terminal equipment and their effects on performance.
• Technical details of RF antennas, amplifiers and receivers.
• Use of spread spectrum for Comm-on-the-Move and aeronautical broadband.
• Characteristics of IP traffic over satellite.
• Innovative approaches using phased arrays, cancellation and adaptive coding and modulation.

Summary
This three-day course covers all the technology of advanced satellite communications as well as the principles behind current state-of-the-art satellite communications equipment. New and promising technologies will be covered to develop an understanding of the major approaches. Network topologies, VSAT, and IP networking over satellite. Material will be complemented with a continuously evolving example of the application of systems engineering practice to a specific satellite communications system. The example will address issues from the highest system architecture down to component details, budgets, specifications, etc. Attendees will receive a copy of Mr. Elbert's textbook Introduction to Satellite Communications, 3rd Ed.

Course Outline

1. Introduction to SATCOM. History and overview. Examples of current military and commercial systems.
2. Satellite Orbits and Transponder Characteristics. Area coverage, high throughput at Ku and Ka bands, advanced L and S band systems.
3. Traffic Connectivities. Mesh, Hub-Spoke, Point-to-Point, Broadcast.
5. Communications Link Calculations. Definition of EIRP, G/T, Eb/No, Es/No, Noise Temperature and Figure. Transponder gain and SFD. Link Budget Calculations.
6. Digital Modulation Techniques. BPSK, QPSK, 8PSK, 16QAM, 32/64APSK. Nyquist signal shaping (raised cosine). Ideal BER performance, implementation margin, adaptive codes and modulation (ACM).
7. RF Components. HPA, SSPA (GaN), LNA, Up/down converters. Intermodulation, band limiting, oscillator phase noise. Examples of BER Degradation.
8. TDMA Networks. Time Slots. Preambles. Suitability for DAMA and BoD, ALOHA.
10. VSAT Networks and Their System Characteristics: DVB-S2 and DVB-RCS standards and MF-TDMA.
Course Outline

1. Standard ground rules for satellite link budgets.
   - Review of link parameters and propagation characteristics at microwave frequencies.
   - Transmission equation and its relationship to the link budget.
2. Introduction to the user interface of SatMaster.
   - File formats: antenna pointing, database, digital link budget, and digital processing/regenerative repeater link budget.
   - Built-in reference data and calculators.
3. Example of a digital one-way link budget (DVB-S2) using equations and SatMaster.
4. Transponder loading and optimum multi-carrier backoff; power equivalent bandwidth.
5. Link budget workshop example using SatMaster: Single Channel Per Carrier (SCPC).
6. Review of link budget optimization techniques using the program’s built-in features.
   - Transponder loading and optimization for minimum cost and resources, maximum throughput and availability.
   - Computing the minimum transmit power; uplink power control (UPC).
7. Interference sources. (X-pol, adjacent satellite interference, adjacent channel interference).
8. Example: digital VSAT, multi-carrier operation, forward and return links.
9. Use of batch location files to prepare link budgets for a large table of locations.
10. Case study from the class using the above elements and SatMaster.

Summary

Link budgets are the standard tool for designing and assessing satellite communications transmissions, considering radio-wave propagation, satellite performance, terminal equipment, radio frequency interference (RFI), and other physical layer aspects of fixed and mobile satellite systems. This one-day SatMaster link budget tool course can be taken with Earth Station Design (during the preceding four days) or by itself for engineers already familiar with the satellite link.

The course notes are provided. Bring a Windows OS laptop to class loaded with SatMaster software. It can be purchased from www.satmaster.com directly or through the instructor. The software can be provided for use during the course only.

Instructor

Bruce R. Elbert, MS (EE), MBA, Adjunct Professor (ret), College of Engineering, University of Wisconsin, Madison. Mr. Elbert is a recognized satellite communications expert and has been involved in the satellite and telecommunications industries for over 40 years. He founded Application Technology Strategy, LLC, to assist major private and public sector organizations that develop and operate cutting-edge networks using satellite and other wireless technologies. During 25 years with Hughes Electronics, he directed the design of several major satellite projects, including Palapa A, Indonesia’s original satellite system; the Galaxy follow-on; and the development of the first GEO mobile satellite system capable of serving handheld user terminals. Mr. Elbert was also ground segment manager for the Hughes system, which included eight teleport sites and 3 VSAT hubs. He served in the US Army Signal Corps as a radio communications officer and instructor. By considering the technical, business, and operational aspects of satellite systems, Mr. Elbert has contributed to the operational and economic success of leading organizations in the field. He has written nine books on telecommunications and IT.
Space Mission Structures
From Concept to Launch

April 16-18, 2019
Littleton, Colorado

$1990 (8:30am - 5:00pm)
"Register 3 or More & Receive $100 Off The Course Tuition."

Summary
This 3-day course presents the structure for a space or launch vehicle as a system. Originally based on the instructor’s book, Spacecraft Structures and Mechanisms: From Concept to Launch, this course has evolved and been improved continuously since 1995.

If you are an engineer involved in any aspect of spacecraft or launch-vehicle structures, regardless of your level of experience, you will benefit from this course. Subjects include functions, requirements, environments, stress analysis, fracture mechanics, finite element analysis, configuration development, preliminary design, designing to avoid problems with dynamic loads, improving the loads-cycle process, verification planning, quality assurance, testing, and risk assessment.


Instructor
Tom Sarafin, is President and Chief Engineer of Instar Engineering and Consulting, Inc. He has worked full time in the space industry since 1979 as a structural engineer, a mechanical systems engineer, a project manager, and a consultant. Since founding Instar in 1993, he’s consulted for NASA, DARPA, the DOD Space Test Program, Lockheed Martin, DigitalGlobe, Space Systems/Loral, Spacelift Industries, and other organizations. He was a core member of the team that developed NASA-STD-5020, “Requirements for Threaded Fastening Systems in Spaceflight Hardware” (March 2012). He is the editor and principal author of Spacecraft Structures and Mechanisms: From Concept to Launch and is a contributing author to Space Mission Analysis and Design. He’s also the principal author of a series of papers titled “Vibration Testing of Small Satellites.” Since 1995, he has taught over 250 courses to more than 5000 engineers and managers in the aerospace industry.

What You Will Learn
The objectives are to a systems perspective of space-mission structures and improve your understanding of:

- Structural functions, requirements, and environments.
- How structures behave and how they fail.
- How to develop structures that are cost-effective and dependable for space missions.

Course Outline


4. Overview of Finite Element Analysis. Idealizing structures. Introduction to FEA and stiffness matrices. Effective use of FEA. Quality assurance for FEA.


Who Should Attend
Structural design engineers, stress and dynamics analysts, systems engineers, and others interested in the topic.
Summary

This four-day course provides an overview of the fundamentals of concepts and technologies of modern spacecraft systems design. Satellite system and mission design is an essentially interdisciplinary sport that combines engineering, science, and external phenomena. We will concentrate on scientific and engineering foundations of spacecraft systems and interactions among various subsystems. Examples show how to quantitatively estimate various mission elements (such as velocity increments) and conditions (equilibrium temperature) and how to size major spacecraft subsystems (propellant, antennas, transmitters, solar arrays, batteries). Real examples are used to permit an understanding of the systems selection and trade-off issues in the design process. The fundamentals of subsystem technologies provide an indispensable basis for system engineering. The basic nomenclature, vocabulary, and concepts will make it possible to converse with understanding with subsystem specialists.

The course is designed for engineers and managers who are involved in planning, designing, building, launching, and operating space systems and spacecraft subsystems and components. The extensive set of course notes provide a concise reference for understanding, designing, and operating modern spacecraft. The course will appeal to engineers and managers of diverse background and varying levels of experience.

Instructor

Dr. Mike Gruntman is Professor of Astronautics at the University of Southern California. He is a specialist in astronautics, space physics, space technology, rocketry, sensors and instrumentation. Gruntman participates in theoretical and experimental programs in space science and space technology, including space missions. He authored and co-authored nearly 300 publications.

What You Will Learn

• Common space mission and spacecraft bus configurations, requirements, and constraints.
• Common orbits.
• Fundamentals of spacecraft subsystems and their interactions.
• How to calculate velocity increments for typical orbital maneuvers.
• How to calculate required amount of propellant.
• How to design communications link.
• How to size solar arrays and batteries.
• How to determine spacecraft temperature.
Spacecraft Systems Integration and Testing
A Complete Systems Engineering Approach to System Test

March 11-14, 2019
Columbia, Maryland
$2290 (8:30am - 4:30pm)

"Register 3 or More & Receive $1000 each Off The Course Tuition."

Course Outline
1. System Level I&T Overview. Comparison of system, subsystem and component test. Introduction to the various stages of I&T and overview of the course subject matter.
4. Staffing the Job. Building a strong team and establishing leadership roles. Human factors in team building and scheduling of this critical resource.
5. Test and Processing Facilities. Budgeting and scheduling tests. Ambient, environmental (TV, Vibe, Shock, EMC/RF, etc.) and launch site (VAFB, CCAFB, KSC) test and processing facilities. Special considerations for hazardous processing facilities.
6. Ground Support Systems. Electrical ground support equipment (GSE) including SAS, RF, Umbilical, Front End, etc. and Mechanical GSE, such as stands, fixtures and 1-G negation for deployments and robotics. I&T ground test systems and software. Ground Segment elements (MOCC, SOCC, SDPF, PDF, CTV, network & flight resources).
7. Preparation and Planning for I&T. Planning tools. Effective use of block diagrams, exploded views, system schematics. Storyboard and schedule development. Configuration management of I&T, development of C&T database to leverage and empower ground software. Understanding verification and validation requirements.
11. Milestone Progress Reviews. Preparing the I&T presentation for major program reviews (PDR, CDR, L-12, Pre-Environmental, Pre-ship, MRR).
12. Subsystem and Instrument Level Testing. Distinctions from system test. Expectations and preparations prior to delivery to higher level of assembly.

Summary
This four-day course is designed for engineers and managers interested in a systems engineering approach to space systems integration, test and launch site processing. It provides critical insight to the design drivers that inevitably arise from the need to verify and validate complex space systems. Each topic is covered in significant detail, including interactive team exercises, with an emphasis on a systems engineering approach to space systems engineering approach to getting the job done. Actual test and processing facilities / capabilities at GSFC, VAFB, CCAFB and KSC are introduced, providing familiarity with these critical space industry resources.

Instructor
Robert K. Vernot has over twenty years of experience in the space industry, serving as I&T Manager, Systems and Electrical Systems engineer for a wide variety of space missions. These missions include the UARS, EOS Terra, EO-1, AIM (Earth atmospheric and land resource), GGS (Earth / Sun magnetics), DSCS (Military communications), FUSE (space based UV telescope), MESSENGER (interplanetary probe).

What You Will Learn
• How are systems engineering principals applied to system test?
• How can a comprehensive, realistic & achievable schedule be developed?
• What facilities are available and how is planning accomplished?
• What are the critical system level tests and how do their verification goals drive scheduling?
• What are the characteristics of a strong, competent I&T team / program?
• What are the viable trades and options when I&T doesn’t go as planned?

This course provides the participant with knowledge and systems engineering perspective to plan and conduct successful space system I&T and launch campaigns. All engineers and managers will attain an understanding of the verification and validation factors critical to the design of hardware, software and test procedures.
Summary
This is a fast-paced two-day course appropriate for System Engineers/Managers with an interest in improving their understanding of spacecraft thermal design or Engineers who want to get an overview of thermal systems engineering process. All phases of thermal design, integration, testing, and in-flight operations are covered in enough depth to give a deeper understanding of the design process. The goals are to have every student understand (1) “bigger picture” system and tradeoff issues (2) thermal analysis, design, thermal devices, thermal testing, and (3) how the thermal design interacts with the overall system design and fits into the overall picture of satellite design. Case studies, lessons learned, and interactive problems, illustrate the importance of thermal design and the current state of the art.

Recent attendee comments ...
Several of our employees took Ms. Mosier’s Spacecraft Thermal Systems Engineering course. It was a great overview to thermal design, analysis, hardware, integration and testing. Our employees especially liked the systems perspective, real life examples, and hands on problems. - Associate Branch Head NASA GSFC

Carol Mosier is an outstanding teacher! She is a renowned expert in her field and shares her expertise in thermal systems engineering. She explains things clearly and well, without making one feel inferior, and she gives relevant examples and stories from real-world applications. It was a pleasure to learn from her in her class. – HB

Instructor
Carol L. Mosier, NASA Emeritus, has over 30 years of experience in the field of thermal engineering. Ms. Mosier was a 2017 recipient of NASA’s highest award, the Distinguished Service Medal, for her key contributions to mission success, thermal software development, and thermal training. Her diverse work portfolio includes a variety of instrument, ballooncraft, and spacecraft systems, operating in cryogenic, convective and high-temperature environments and enabling more than twenty missions ranging from technology demonstrations to Earth and interplanetary science. Ms. Mosier is experienced in all aspects of thermal engineering, including design, analysis, requirements development, integration, testing, and flight operations. Ms. Mosier’s educational activities included developing and teaching thermal design classes for the Goddard Space Flight Center, University of Maryland, NASA Engineering & Safety Center, and Thermal and Fluids Analysis Workshops (TFAWS).ustry.

March 5-6, 2019
Columbia, Maryland
$1590 (8:30am - 4:30pm)
"Register 3 or More & Receive $100 off each Off The Course Tuition."

Course Outline
1. Why is the Thermal Design So Important?
2. The Role of Thermal Control in Spacecraft Design. What does the thermal design have to accomplish? What factors affect the thermal design? Type of thermal systems. The thermal design process. Special considerations for subsystems.
9. Summary and Questions.

What You Will Learn
How the Thermal Systems Engineer:
• Defines Thermal Requirements
• Sets Thermal Limits throughout the project lifecycle
• Does basic conduction, convection, and radiation analysis
• Devises and Implements Thermal Testing
• Chooses Thermal Hardware (active and passive)
• Performs Computer calculations
• Interacts with other systems and project management
**Summary**

This new two-day course provides a tutorial, practical guidance, examples, and recommendations for testing a small satellite on an electrodynamic shaker. Addressed are sine-burst testing, random vibration testing, and low-level diagnostic sine sweeps. Notching, response limiting, and force limiting are addressed in detail, with examples. The course is primarily aimed at satellites in the 50 – 500 lb (23 – 230 kg) range, but it also applies to CubeSats. Most of the guidance applies to larger satellites as well if they will be tested on a shaker. This course is designed for engineers and managers involved in ensuring small spacecraft can withstand launch environments.

**Instructor**

Tom Sarafin is President and Chief Engineer of an engineering company. He has worked full time in the space industry since 1979 as a structural engineer, a mechanical systems engineer, a project manager, and a consultant. Since founding Instar in 1993, he’s consulted for NASA, DARPA, the DOD Space Test Program, Lockheed Martin, DigitalGlobe, Space Systems/Loral, Spaceflight Industries, and other organizations. He was a key member of the team that developed NASA-STD-5020, Requirements for Threaded Fastening Systems in Spaceflight Hardware" (March 2012). He is the editor and principal author of *Spacecraft Structures and Mechanisms: From Concept to Launch* and is a contributing author to *Space Mission Analysis and Design*. He’s also the principal author of a series of papers titled “Vibration Testing of Small Satellites.” Since 1995, he has taught over 250 courses to more than 5000 engineers and managers in the aerospace industry.

**What You Will Learn**

The objectives of this course are to improve your understanding of how to:

- Establish an effective vibration test program.
- Identify and clearly state test objectives.
- Design (or recognize) a test that satisfies the identified objectives while minimizing risk of an over test.
- Establish pass/fail criteria and interpret test data.
- Write effective test plans and reports.

**April 30 - May 1, 2019**

Littleton, Colorado

$1550  (8:30am - 4:30pm)

"Register 3 or More & Receive $100 off each

Off The Course Tuition."

**Course Outline**


Register online at [www.ATIcourses.com](http://www.ATIcourses.com) or call ATI at 888.501.2100 or 410.956.8805
Acoustic Fundamentals & Measurements with Underwater Applications

March 26-28, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
Register 3 or More & Receive $100 Off Each Off The Course Tuition.

Summary
This three-day course is intended for engineers and other technical personnel and managers who have a work-related need to understand basic acoustics concepts and how to measure and analyze sound. This is an introductory course and participants need not have any prior knowledge of sound or vibration. Each topic is illustrated by relevant applications, in-class demonstrations, and worked-out numerical examples. Since the practical uses of acoustics principles are vast and diverse, participants are encouraged to confer with the instructor (before, during, and after the course) regarding any work-related concerns. On-site courses are fully customized to the customer’s applications.

Instructor
Dr. Alan D. Stuart, Associate Professor Emeritus of Acoustics, Penn State, has over forty years experience in the field of sound and vibration. He has degrees in mechanical engineering, electrical engineering, and engineering acoustics. For over thirty years he has taught courses on the Fundamentals of Acoustics, Structural Acoustics, Applied Acoustics, Noise Control Engineering, and Sonar Engineering on both the graduate and undergraduate levels as well as at government and industrial organizations throughout the country.

What You Will Learn
- How underwater sensors work.
- How to make proper sound level measurements.
- How to analyze and report acoustic data.
- The basis of decibel (dB) scale used in underwater acoustics.
- How to use third-octave band analyzers and narrow-band spectrum analyzers.
- How acoustic arrays are used to improve target detection.
- How to measure sound propagation loss including surface scatter and bottom penetration.
- How to detect a passive target in a background of ambient and self-noise.
- How to detect an active sonar ping in a background of reverberation noise.

Recent attendee comments ...
“Great instructor made the course interesting and informative. Helped clear-up many misconceptions I had about sound and its measurement.”

“Enjoyed the in-class demonstrations; they help explain the concepts. Instructor helped me with a problem I was having at work, worth the price of the course!”

Course Outline
Sonar Principles & ASW Analysis

Summary

This 3-day course provides an excellent introduction to underwater sound and highlights how sonar principles are employed in ASW analyses. The course provides a solid understanding of the sonar equation and discusses in-depth propagation loss, target strength, reverberation, arrays, array gain, and detection of signals.

Physical insight and typical results are provided to help understand each term of the sonar equation. The instructors then show how the sonar equation can be used to perform ASW analysis and predict the performance of passive and active sonar systems. The course also reviews the rationale behind current weapons and sensor systems and discusses directions for research in response to the quieting of submarine signatures.

The course is valuable to engineers and scientists who are entering the field or as a review for employees who want a system level overview. The lectures provide the knowledge and perspective needed to understand recent developments in underwater acoustics and in ASW. A comprehensive set of notes and the textbook Principles of Underwater Sound will be provided to all attendees.

Course Outline

Sonar concepts and units. The sonar equation. Typical active and passive sonar parameters. Signal detection, probability of detection/false alarm. ROC curves and detection threshold.

2. Propagation of Sound in the Sea.
Oceanographic basis of propagation, convergence zones, surface ducts, sound channels, surface and bottom losses.

3. Target Strength and Reverberation.

4. Arrays and Beamforming.
Directivity and array gain; sidelobe control, array patterns and beamforming for passive bottom, hull mounted, and sonobuoy sensors; calculation of array gain in directional noise.

5. Elements of ASW Analysis.
Utility and objectives of ASW analysis, basic formulation of passive and active sonar performance predictions, sonar platforms, limitations imposed by signal fluctuations.

Criteria for the evaluation of sonar models, a basic sonobuoy model, in-class solution of a series of sonar problems.

Instructor

Dr. Nicholas C. Nicholas received a B. S. degree from Carnegie-Mellon University, an M. S. degree from Drexel University, and a PhD degree in physics from the Catholic University of America. His dissertation was on the propagation of sound in the deep ocean. He has been teaching underwater acoustics courses since 1977 and has been visiting lecturer at the U.S. Naval War College and several universities. Dr. Nicholas has more than 35 years experience in underwater acoustics and submarine related work. Dr. Nicholas is currently consulting for several firms.

What You Will Learn

• Sonar parameters and their utility in ASW Analysis.
• Sonar equation as it applies to active and passive systems.
• Fundamentals of array configurations, beamforming, and signal detectability.
• Rationale behind the design of passive and active sonar systems.
• Theory and applications of current weapons and sensors, plus future directions.
• The implications and counters to the quieting of the target's signature.
Summary

This intensive short course provides an overview of sonar signal processing. Processing techniques applicable to bottom-mounted, hull-mounted, towed and sonobuoy systems will be discussed. Spectrum analysis, detection, classification, and tracking algorithms for passive and active systems will be examined and related to design factors. Advanced techniques such as high-resolution array-processing and matched field array processing, advanced signal processing techniques, and sonar automation will be covered.

The course is valuable for engineers and scientists engaged in the design, testing, or evaluation of sonars. Physical insight and realistic performance expectations will be stressed. A comprehensive set of notes will be supplied to all attendees.

Instructors

James W. Jenkins joined the Johns Hopkins University Applied Physics Laboratory in 1970 and has worked in ASW and sonar systems analysis. He has worked with system studies and at-sea testing with passive and active systems. He is currently a senior physicist investigating improved signal processing systems, APB, own-ship monitoring, and SSBN sonar. He has taught sonar and continuing education courses since 1977 and is the Director of the Applied Technology Institute (ATI).

Dr. Bruce Newhall has over 40 years of experience in underwater acoustics, sonar, and signal processing. He was chief scientist for several large scale Navy experiments, and the supervisor of the Acoustic and Electromagnetics Group at the Johns Hopkins Applied Physics Lab. He has served as Associate Editor for the IEEE Journal of Oceanic Engineering. In recognition of his innovative work, he is a fellow of the Acoustic Society, received the bronze medal from the NDIA and is the 2017 recipient of the Donald W. Tufts award in underwater acoustic signal processing from the IEEE.

Course Outline

1. Introduction to Sonar Signal Processing. Introduction to sonar detection systems and types of signal processing performed in sonar. Correlation processing, Fourier analysis, windowing, and ambiguity functions. Evaluation of probability of detection and false alarm rate for FFT and broadband signal processors.


5. Passive and Active Designs and Implementations. Design specifications and trade-off examples will be worked, and actual sonar system implementations will be examined.

6. Advanced Signal Processing Techniques. Advanced techniques for beamforming, detection, estimation, and classification will be explored. Optimal array processing. Data adaptive methods, super resolution spectral techniques, time-frequency representations and active/passive automated classification are among the advanced techniques that will be covered.

What You Will Learn

- Fundamental algorithms for signal processing.
- Techniques for beam forming.
- Trade-offs among active waveform designs.
- Ocean medium effects.
- Optimal and adaptive processing.
Summary
This three-day course is designed for SONAR systems engineers, combat systems engineers, undersea warfare professionals, and managers who wish to enhance their understanding of this discipline or become familiar with the "big picture" if they work outside of the discipline. Each topic is illustrated by worked numerical examples, using simulated or experimental data for actual undersea acoustic situations and geometries.

Instructor
Dr. Harold "Bud" Vincent Research Associate Professor of Ocean Engineering at the University of Rhode Island and President of DBV Technology, LLC is a U.S. Naval Officer qualified in submarine warfare and salvage diving. He has over twenty years of undersea systems experience working in industry, academia, and government (military and civilian). He served on active duty on fast attack and ballistic missile submarines, worked at the Naval Undersea Warfare Center, and conducted advanced R&D in the defense industry. Dr. Vincent received the M.S. and Ph.D. in Ocean Engineering (Underwater Acoustics) from the University of Rhode Island. His teaching and research encompasses underwaer acoustic systems, communications, signal processing, ocean instrumentation, and navigation. He has been awarded four patents for undersea systems and algorithms.

What You Will Learn
• What are the various types of SONAR systems in use on Naval platforms today.
• What are the major principles governing their design and operation.
• How is the data produced by these systems used operationally to conduct Target Motion Analysis and USW.
• What are the typical commercial and scientific uses of SONAR and how do these relate to military use.
• What are the other military uses of SONAR systems (i.e. those NOT used to support Target Motion Analysis).
• What are the major cost drivers for undersea acoustic systems.

May 14-16, 2019
Newport, Rhode Island
$2090 (8:30am - 4:30pm)
"Register 3 or More & Receive $1000 off each Off The Course Tuition."

Course Outline
2. SONAR Equations. Review of Active and Passive SONAR Equations, Decibels, Source Level, Sound Pressure Level, Intensity Level, Spectrum Level.
4. SONAR System Fundamentals. Review of major system components in a SONAR system (transducers, signal conditioning, digitization, signal processing, displays and controls). Review of various SONAR systems (Hull, Towed, SideScan, MultiBeam, Communications, Navigation, etc.).
5. SONAR Employment, Data and Information. Hull arrays, Towed Arrays. Their utilization to support Target Motion Analysis.
6. Target Motion Analysis (TMA). What it is, why it is done, how is SONAR used to support it, what other sensors are required to conduct it.
8. Time Frequency Analysis. Doppler shift, Received Frequency, Base Frequency, Corrected Frequency. Use of Time-Frequency information to assess target motion.
9. Geographic Analysis. Use of Time-Bearing and Geographic information to analyze contact motion.
11. Relative Motion Analysis and Display: Single steady contact, Single Maneuvering contact, Multiple contacts, Acoustics Interference.
Course Outline

1. Overview. Review of how transducer and performance fits into overall sonar system design.

2. Waves in Fluid Media. Background on how the transducer creates sound energy and how this energy propagates in fluid media. The basics of sound propagation in fluid media:
   - Plane Waves.
   - Radiation from Spheres.
   - Linear Apertures Beam Patterns.
   - Planar Apertures Beam Patterns.
   - Directivity and Directivity Index.
   - Scattering and Diffraction.
   - Radiation Impedance.
   - Transmission Phenomena.
   - Absorption and Attenuation of Sound.

3. Equivalent Circuits. Transducers equivalent electrical circuits. The relationship between transducer parameters and performance. Analysis of transducer designs:
   - Mechanical Equivalent Circuits.
   - Acoustical Equivalent Circuits.
   - Combining Mechanical and Acoustical Equivalent Circuits.

4. Waves in Solid Media: A transducer is constructed of solid structural elements. Background in how sound waves propagate through solid media. This section builds on the previous section and develops equivalent circuit models for various transducer elements. Piezoelectricity is introduced.
   - Waves in Homogeneous, Elastic Solid Media.
   - Piezoelectricity.
   - The electro-mechanical coupling coefficient.
   - Waves in Piezoelectric, Elastic Solid Media.

5. Sonar Projectors. This section combines the concepts of the previous sections and develops the basic concepts of sonar projector design. Basic concepts for modeling and analyzing sonar projector performance will be presented. Examples of sonar projectors will be presented and will include spherical projectors, cylindrical projectors, half wave-length projectors, tonpilz projectors, and flexural projectors. Limitation on performance of sonar projectors will be discussed.

6. Sonar Hydrophones. The basic concepts of sonar hydrophone design will be reviewed. Analysis of hydrophone noise and extraneous circuit noise that may interfere with hydrophone performance.
   - Elements of Sonar Hydrophone Design.
   - Analysis of Noise in Hydrophone and Preamplifier Systems.
   - Specific Application in Sonar Hydronpone Design.
   - Hydrostatic hydrophones.
   - Spherical hydrophones.
   - Cylindrical hydrophones.
   - The affect of a fill fluid on hydrophone performance.

Summary

This three-day course is designed for sonar system design engineers, managers, and system engineers who wish to enhance their understanding of sonar transducer design and how the sonar transducer fits into and dictates the greater sonar system design. Topics will be illustrated by worked numerical examples and practical case studies.

Instructor

Mr. John C. Cochran is a Sr. Engineering Fellow with Raytheon Integrated Defense Systems, a leading provider of integrated solutions for the Departments of Defense and Homeland Security. Mr. Cochran has 35 years of experience in the design of sonar transducer systems. His experience includes high frequency mine hunting sonar systems, hull mounted search sonar systems, undersea targets and decoys, high power projectors, and surveillance sonar systems. Mr. Cochran holds a BS ChE degree from the University of California, Berkeley, a MS ChE degree from Purdue University, a MS EE degree from University of California, Santa Barbara, and a PhD EE degree from the University of Massachusetts - Dartmouth. He holds a certificate in Acoustics Engineering from Pennsylvania State University and Mr. Cochran has taught as a visiting lecturer for the University of Massachusetts, Dartmouth.

What You Will Learn

- Basic acoustic parameters that affect transducer designs including:
  - Aperture design.
  - Radiation impedance.
  - Beam patterns and directivity.
- Fundamentals of acoustic wave transmission in solids including the basics of piezoelectricity.
- Basic modeling concepts for transducer design.
- Transducer performance parameters that affect radiated power, frequency of operation, and bandwidth.
- Sonar projector design parameters.

From this course you will obtain the knowledge and ability to perform sonar transducer systems engineering calculations, identify tradeoffs, interact meaningfully with colleagues, evaluate systems, understand current literature, and how transducer design fits into greater sonar system design.
Submarines & Submariners – An Introduction

Summary
This three-day course is designed for engineers in the field of submarine R&D and Operational Test and Evaluation. It is an introductory course presenting the fundamental philosophy of submarine design, submerged operation and combat system employment as they are managed by a battle-tested submarine organization that all-in-all make a US submarine a very effective warship at sea—and under it.

Today's US submarine tasking is discussed in consonance with the strategy and policy of the US, and the goals, objectives, mission, functions, tasks, responsibilities, and roles of the US Navy as they are so funded.

From this course you will gain a better understanding of submarine warships being stealth-oriented, effective combat systems at sea. Those who have worked with specific submarine sub-systems will find that this course will clarify the rationale and essence of their interface with one another. Attendees will receive copies of the presentation along with some relevant white papers.

June 4-6, 2019
Columbia, Maryland
$2090 (8:30am - 4:30pm)
"Register 3 or More & Receive $100 Off The Course Tuition."

Instructors
Capt. James Patton, (USN ret.) is President of Submarine Tactics and Technology, Inc. and is considered a leading innovator of pro- and anti-submarine warfare and naval tactical doctrine. His 30 years of experience include actively consulting on submarine weapons, advanced combat systems, and other stealth warfare-related issues to over 30 industrial and government entities. He served in 5 SSNs and 2 SSBNs, commanding USS Pargo, (SSN650). While at OPNAV, Capt Patton actively participated in submarine weapon and sensor research and development, and was instrumental in the development of the towed array. As Chief Staff Officer at Submarine Development Squadron Twelve (SUBDEVRON 12), and as Head of the Advanced Tactics Department at the Naval Submarine School, he was instrumental in the development of much of the current tactical doctrine.

CAPT (ret) Todd Massidda, P.E. has over 30 years of Navy leadership experience serving on seven different submarines, including command of USS ALABAMA SSBN-731. As commanding officer of ALABAMA and executive officer on ALASKA, he has extensive experience in bringing combat systems technologies to the fleet after major overhaul periods. In addition to his operational submarine experience he served as a Future Concepts Officer at US Special Operations command during which he had extensive experience in bringing new technologies and ideas to special operations forces. As Operations Officer at Submarine Group Nine, he led a highly successful multi-year effort to proof SSGN concepts ahead of the SSGN conversion program. He completed his career as the Branch Head for Ocean Systems and Nuclear Matters on the OPNAV staff in Washington, DC. He is currently applying his knowledge as a Program Manager in the SSBN Security Technology Program at John Hopkins Applied Physics Laboratory.

Course Outline
1. Warfare from Beneath the Sea:
   • US Submarines - From a glass-barrel in circa 300 BC, to SSN 774.
   • Review of the Order of Battle for Submarines of the World.
2. Submarine Warfare Basics:
   • Employment of Submarines past, current and future.
   • US/UK/USSR Cold War Submarine Operations.
3. Current Day Submarine Tasking:
   • What US nuclear-powered submarines are tasked to do.
   • What the tasking of US submarines is based on.
4. Submarine Organization (Onboard and Force Wide):
   • Makeup of today's submarine crew.
   • What does it mean to be "Qualified in Submarines."
   • What does the shore based support for the “Submarine Enterprise” do.
5. Fundamentals of Submarine Design, Construction and Modernization:
   • Makeup of today's submarine force.
   • Submarine Form, Fit, & Function.
   • Basic submarine operational characteristics.
6. Maintenance Cycles for Submarines:
   • Submarines Maintenance cycles - past, current and future.

What You Will Learn
• Differences of submarine types (SSN/SSBN/SSGN).
• Submarine onboard organization and day to day operations.
• Basic Fundamentals of submarine systems and sensors.
• Submarine Mission profiles.
• Basics of Submarine Warfare tactical and operational control.
• How submarines support national military objectives.
• Makeup and function of the Submarine Support Enterprise.
• How the sea impacts submarine operations.
• Submarine Maintenance Cycles – Supporting the Tip of the Spear.

Instructors
Capt. James Patton, (USN ret.) is President of Submarine Tactics and Technology, Inc. and is considered a leading innovator of pro- and anti-submarine warfare and naval tactical doctrine. His 30 years of experience includes actively consulting on submarine weapons, advanced combat systems, and other stealth warfare-related issues to over 30 industrial and government entities. He served in 5 SSNs and 2 SSBNs, commanding USS Pargo, (SSN650). While at OPNAV, Capt Patton actively participated in submarine weapon and sensor research and development, and was instrumental in the development of the towed array. As Chief Staff Officer at Submarine Development Squadron Twelve (SUBDEVRON 12), and as Head of the Advanced Tactics Department at the Naval Submarine School, he was instrumental in the development of much of the current tactical doctrine.

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## Course Outline


2. **Acoustical Oceanography.** Distribution of physical and chemical properties in the oceans. Sound speed calculation, measurement, and distribution. Surface and bottom boundary conditions. Effects of circulation patterns, fronts, eddies and fine-scale features on acoustics. Biological effects. References.


8. **Effects of Sound on the Marine Environment.** Changes in the ocean soundscape driven by anthropogenic activity (e.g. marine hydrokinetic devices) and natural factors (e.g. ocean acidification). Mitigation of marine-mammal endangerment. References.


11. **Demonstrations and Problem Sessions.** In-class demonstration of PC-based propagation and active sonar models. Hands-on problem sessions and discussion of results.

## Summary

The subject of underwater acoustic modeling deals with the translation of our physical understanding of sound in the sea into mathematical formulas solvable by computers. This four-day course provides a comprehensive treatment of all types of underwater acoustic models including environmental, propagation, noise, reverberation, and sonar performance models. Specific examples of each type of model are discussed to illustrate model formulations, assumptions, and algorithm efficiency. Guidelines for selecting and using available propagation, noise, and reverberation models are highlighted. Problem sessions allow students to exercise PC-based propagation and active sonar models. Each student will receive a copy of *Underwater Acoustic Modeling and Simulation* (5th edition) by Paul C. Etter (a $215 value) in addition to a complete set of lecture notes.

## Instructor

Paul C. Etter has worked in the fields of ocean-atmosphere physics and environmental acoustics for the past forty years supporting federal and state agencies, academia and private industry. He received his BS degree in Physics and his MS degree in Oceanography at Texas A&M University. Mr. Etter served on active duty in the U.S. Navy as an Anti-Submarine Warfare (ASW) Officer aboard frigates. He is the author or co-author of more than 200 technical reports and professional papers addressing environmental measurement technology, underwater acoustics and physical oceanography. Mr. Etter is the author of the textbook *Underwater Acoustic Modeling and Simulation* (5th edition).

## What You Will Learn

- What models are available to support sonar engineering and oceanographic research.
- How to select the most appropriate models based on user requirements.
- Where to obtain the latest models and databases.
- How to operate models, generate reliable results, and assess prediction uncertainties.
- How to solve the active and passive sonar equations to simulate sonar performance.
- How acoustic models serve as enabling tools for assessing noise impacts on the ocean soundscape.
- What regulations govern protection of marine mammals while operating sonar equipment.
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5. Introduction To Human Spaceflight
6. Launch Vehicle Design & Selection
7. Launch Vehicle Systems - Reusable
8. Liquid Rocket Engines for spacecraft
9. Orbital & Launch Mechanics
10. Planetary Science for Aerospace
11. Rocket Propulsion 101
12. Rockets & Missiles - Fundamentals
13. Satellite Design & Technology
14. Satellite Liquid Propulsion Systems
15. Six Degrees Of Freedom Modeling and Simulation
16. Solid Rocket Motor Design & Applications
17. Space-Based Laser Systems
18. Space Environment for Spacecraft Design
19. Space Environment & Its Effects On Space Systems
20. Space Mission Analysis and Design
21. Space Systems & Space Subsystems Fundamentals
22. Space Radiation Effects On Space Systems & Astronauts
23. Spacecraft Communications & Telecommunications
24. Spacecraft Reliability, Quality Assurance & Testing
25. Spacecraft Power Systems
26. Spacecraft Solar Arrays
27. Spacecraft Systems Design
28. Spacecraft Systems Integration & Test
29. Spacecraft Thermal Control
30. Structural Test Design and Interpretation

Satellite Communications & Telecommunications
1. Antenna & Array Fundamentals
2. Communications Payload Design & System Architecture
3. Digital Video Systems, Broadcast & Operations
4. Earth Station Design, Implementation & Operation
5. Fiber Optic Communication Systems
6. Fiber Optics Technology & Applications
7. Fundamentals of Telecommunications
8. IP Networking Over Satellite (3 day)
9. Optical Communications Systems
10. Quality Of Service In IP-Based Mission Critical Networks
11. ROCKETS & SPACE-RELATED SYSTEMS
12. Satellite Communications - An Essential Introduction
13. Satellite Communications - ASW Analysis
14. Satellite Communications - Essential Introduction
15. Satellite Communications - Essential Introduction Using SatMaster Software
16. Satellite Laser Communications
17. Satellite Link Budget Training Using SatMaster Software
18. Satellite Link Budget Training Using SatMaster Software
19. Software Defined Radio
20. Space-Based Laser Systems
21. Spacecraft Thermal Control
22. Spacecraft Systems Design
23. Spacecraft Systems Integration & Test
24. Spacecraft Thermal Control
25. Structural Test Design and Interpretation

Other Topics
- Acoustic, Underwater Sound & Sonar
  1. Acoustics Fundamentals, and Applications
  2. Applied Physical Oceanography Modeling and Acoustics
  3. COTS-Based Systems - Fundamentals
  4. Certified Systems Professional - CSEP Preparation
  5. Fundamentals of Sonar Transducer Design
  6. Fundamentals of Space-Based Radar
  7. Fundamentals of Telecommunications
  8. IP Networking Over Satellite (3 day)
  9. Optical Communications Systems
  10. Quality Of Service In IP-Based Mission Critical Networks

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