Professional Development Short Course On:

Introduction To Control Systems

Instructor:

Paul Jackson

ATI Course Schedule:	**http://www.ATIcourses.com/schedule.htm**
ATI's Introduction To Control Systems:	**http://www.aticourses.com/introduction_to_control.htm**

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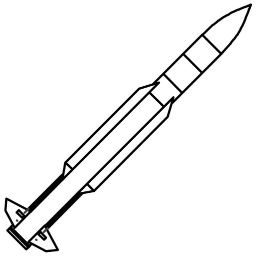
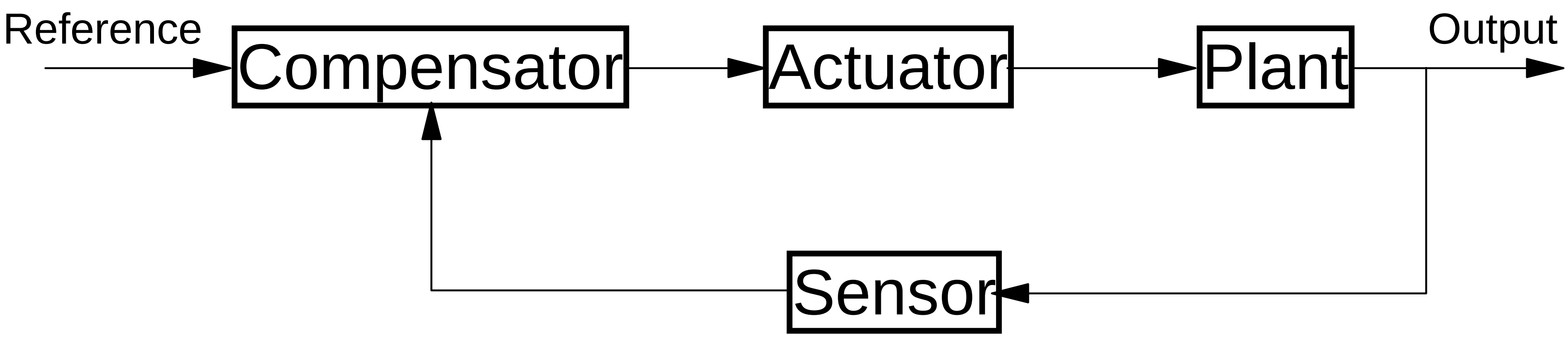
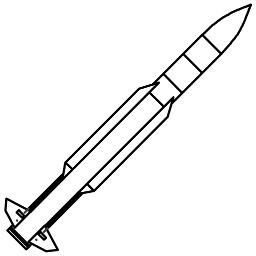


What is a Control System?

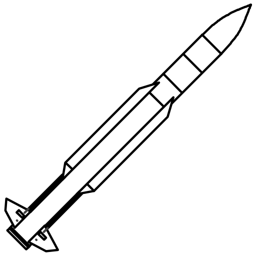
A Control System is Composed of a Compensator, Actuator, Sensor, and Plant. The Goal is to Have the Output of the Plant Track a Reference Input in Some Desirable Manner.





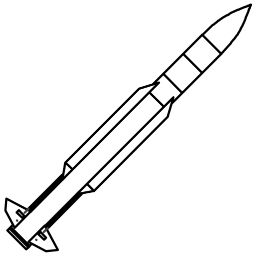
Example Applications

- Missile Autopilots
  - Acceleration Control
  - Position Control
  - Attitude Control
  - Speed Control
- Spacecraft Attitude Control
- Process Control
- Aircraft
- Cars
  - Cruise Control
  - Active Suspension Control
- Others



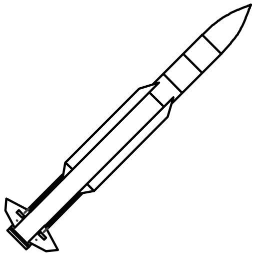
Day 1

- Linear Systems Review
- System Modeling
- Fundamental Issues
- Frequency Response
- Feedback Control



Day 2

- Nyquist Criteria
- Root Locus
- Compensator Design
- Discrete Time Systems

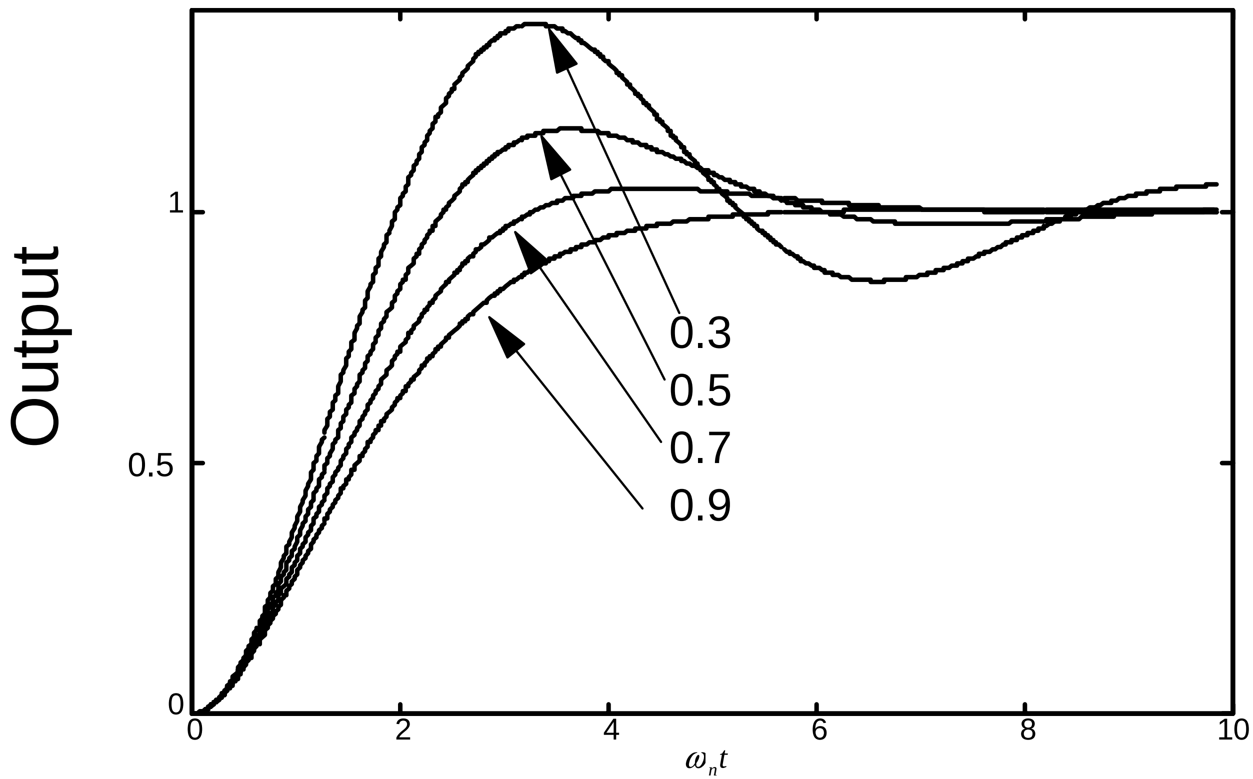


Day 3

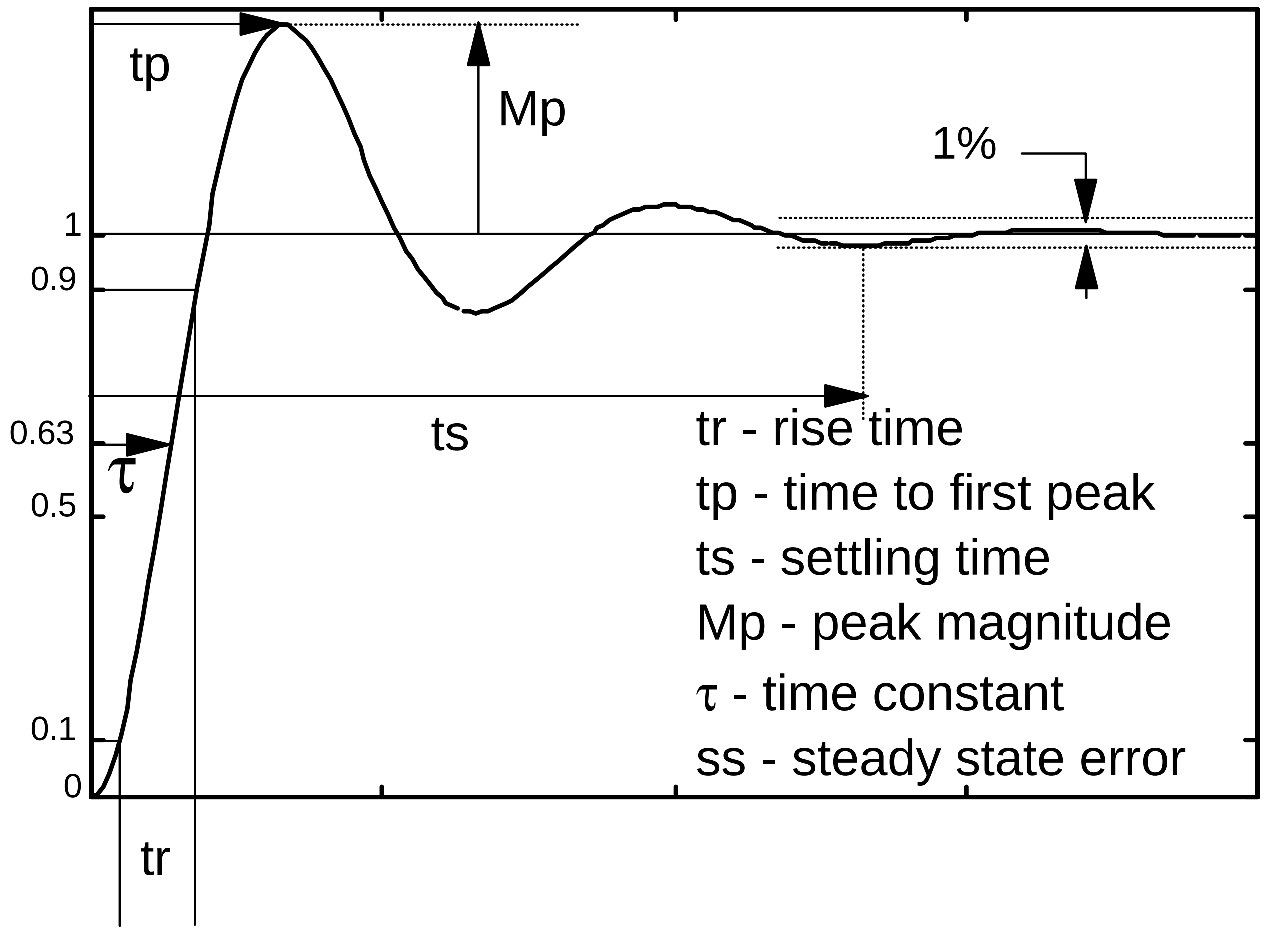
- Modern Control Theory
- Kalman Filtering
- Spacecraft Attitude Control
- Attitude Control Design Examples

Step Response - Second Order

$$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}, \zeta = 0.3, 0.5, 0.7, 0.9$$

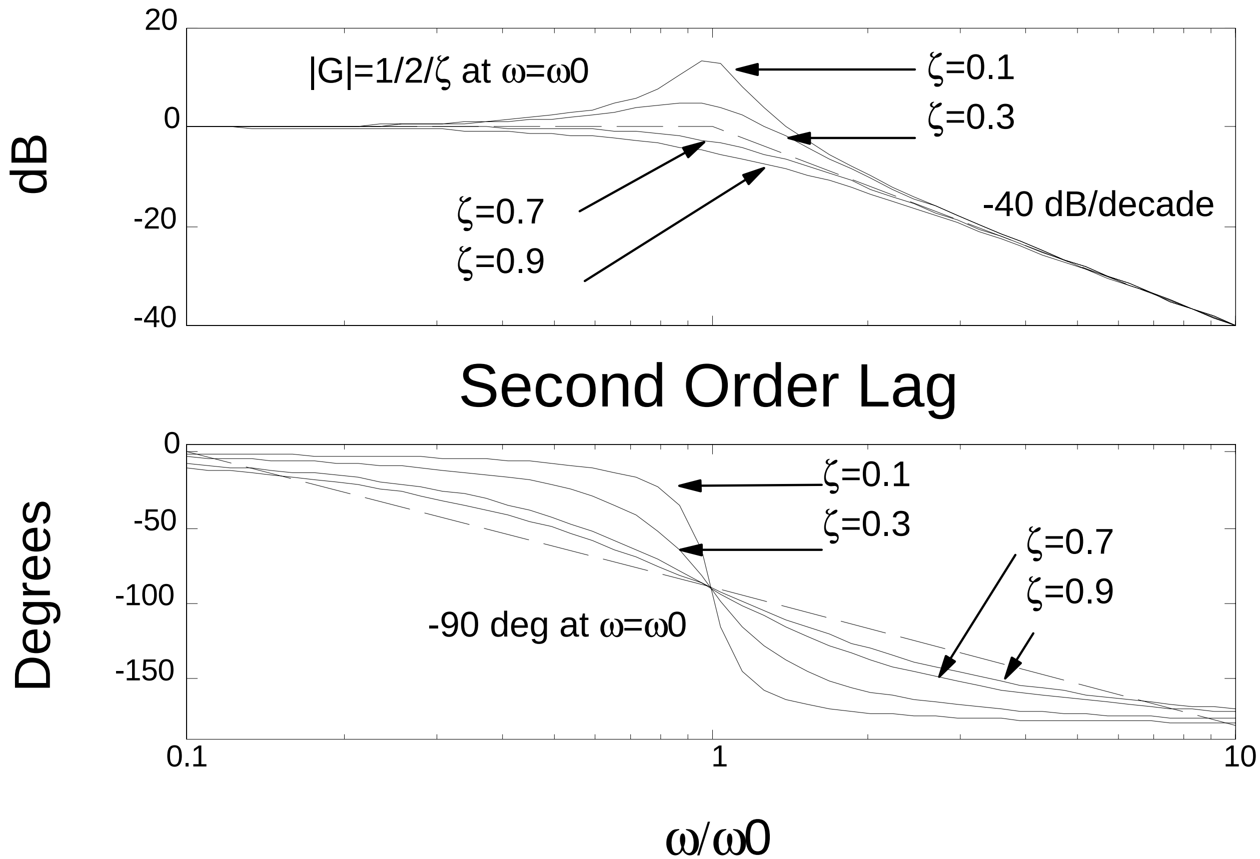


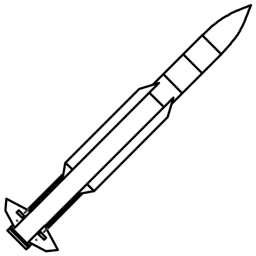
Step Response - Specifications



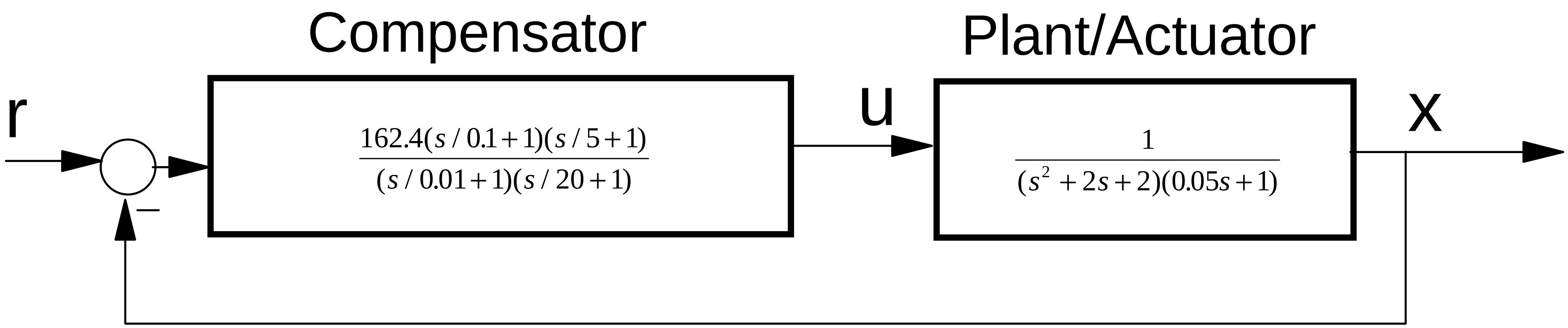
Complex Conjugate Poles in LHP

$$G(s) = 1/((s/\omega_0)^2 + 2\zeta s/\omega_0 + 1), \omega_0 > 0, 0 < \zeta < 1$$

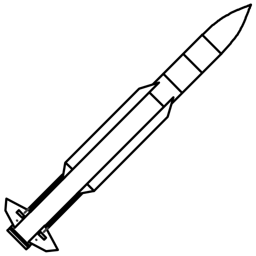




Control System Design

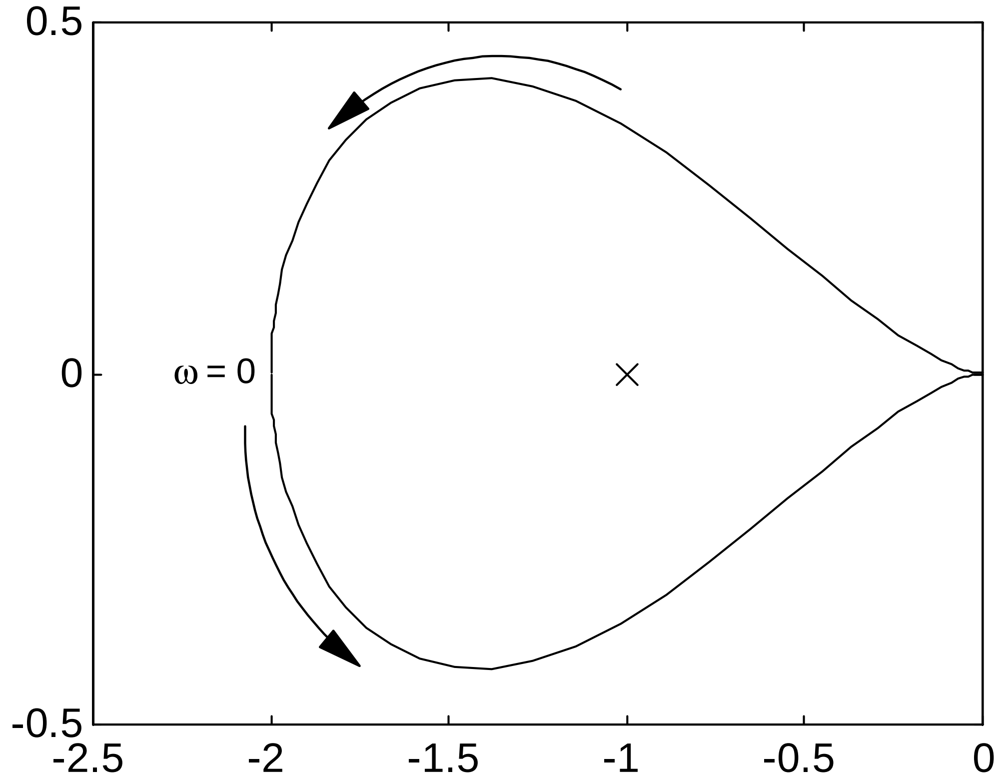


- How Was the Compensator Designed?
  - How Does It Relate to Design Goals?
- Is it a Good Design?

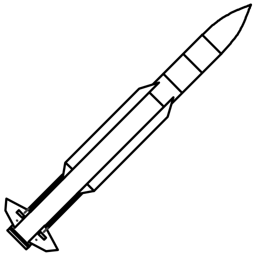


Example 4

$$K(s)G(s) = \frac{1}{(s+1)(s-0.5)}$$



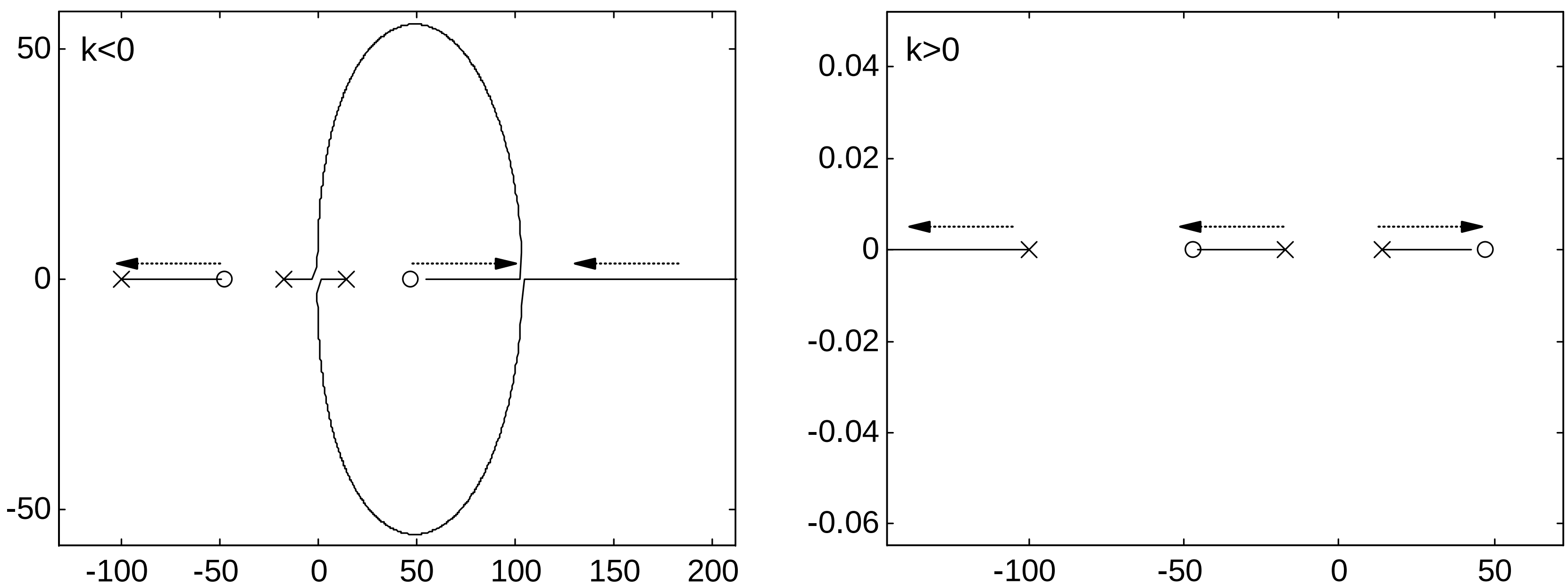
Z = -1 + 1 = 0 → Stable
(Closed Loop Poles:
s = -0.25 ± 0.6*j*)

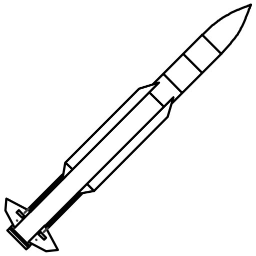


Example - Unstable Missile

Unstable Acceleration Transfer Function with First Order Actuator Model:

$$G(s) = \frac{0.604(s^2 - 2228)}{(s/100+1)(s^2+3.33s-248)}, z = \pm 47, p = 100, -17.5, 14.2$$





Design via Root Locus

- Choose Desired Dominant Pole Locations Based on Time Domain Requirements (ωn, ζ)
- Draw Root Locus of G(s)
- Lead Compensator with Zero to Left of Plant Poles Pulls Closed Loop Poles to Left
- Lag Compensator with Pole to Left of Plant Poles Pushes Closed Loop Poles to Right
- Lag Compensator at Low Frequency Increases Low Frequency Gain to Reduce Steady State Error

Assume Leading Coefs. of n(s) and d(s) are Unity

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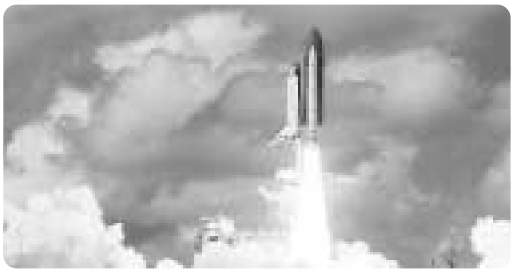

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- Our instructors are the best in the business, averaging 25 to 35 years of practical, real-world experience. Carefully selected for both technical expertise and teaching ability, they provide information that is practical and ready to use immediately.
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- Sonar & Acoustic Engineering
- Spacecraft & Satellite Engineering

I suggest that you read through these course descriptions and then call me personally, Jim Jenkins, at (410) 531-6034, and I'll explain what we can do for you, what it will cost, and what you can expect in results and future capabilities.

Our training helps you and your organization remain competitive in this changing world.