1. ES418 Optimal Control and Estimation

2. 3 credit hours, 2 recitation hours, 2 laboratory hours

3. Course Coordinator: CAPT Michael Hurni, USN, PhD

4. References

   Calculus of Variations: Mechanics, Control, and other Applications, C.R. MacCluer, Pearson/Prentice Hall, 2005.

   A Primer On Pontryagin's Principle In Optimal Control, 2nd Ed., I. Michael Ross, Collegiate Publishers, 2015.

5. Specific course information

   a. Analysis and design of control systems and estimators using optimal control theory.

   b. Prerequisites: ES306 or ES306H

   c. Elective course

6. Specific goals for the course

   a. At the conclusion of the course, students will be able to:

      - To obtain mathematical models of mechanical apparatus (mechanism, machinery, and appendages) using energy methods.
      - To design control laws and estimation algorithms given competing (hence conflicting) objectives.
      - To understand and apply the fundamental principles of optimality

   b. This course assesses the following Student Outcomes

      - (a) an ability to apply knowledge of mathematics, science, and engineering
      - (b) an ability to design and conduct experiments, as well as to analyze and interpret data
      - (c) an ability to design a system
      - (e) an ability to identify, formulate, and solve engineering problems
      - (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

7. Topics covered:

Degrees of freedom, functionals, Hamilton's Principle, Linearization, linear perturbation equation, Euler-Lagrange equations, setpoint tracking, disturbance rejection, linear quadratic regulators, statistical state estimation, Kalman filters, DIDO, KKT conditions, fundamental principles of optimality, Bellman's principle, feasibility, Pontryagin's minimum principle, necessary conditions for optimality