The Center for Control, Dynamical Systems, and Computation
Spring Seminars
Presents

Theory and Practice of Fault Detection and Identification

by

Professor Jason Speyer

Mechanical and Aerospace Department
University of California, Los Angeles

Friday, April 28th, 2006 3:00 - 4:00 PM Engineering II Pavilion

Abstract:

The restricted diagonal fault detection filter was first developed from a geometric and spectral approach. The idea of the filter is to place each fault into invariant subspaces which do not overlap each other. Then, when a nonzero residual is detected, the fault can be announced and identified by projecting the residual onto each of the invariant subspaces. In this way, multiple faults can be monitored in one filter. Strict geometric structures can be sensitive to system uncertainties. Therefore, derivations based on minimizing a cost criterion are explored which can be shown to acquire the properties of the geometric fault detection filter in an appropriate limit. One approach, the unknown input observer, simplifies the restricted diagonal fault detection filter problem by dividing the faults into two groups: a single target fault and possibly several nuisance faults. The nuisance faults are placed in an approximate invariant subspace that is unobservable to the residual. Therefore, the residual is only sensitive to the target fault, but not to the nuisance faults. Since each unknown input observer can detect only one fault, multiple unknown input observers are required to detect and identify all faults. However, an approach which does approximate the restricted diagonal fault detection filter is the robust multiple-fault detection filter. These schemes are first applied to a vehicle health monitoring system evaluated in real-time on a Buick LeSabre. Secondly, a health monitoring system based on analytical redundancy is developed for satellites on elliptical orbits consisting of periodic fault detection filters and parity equations.

About the Speaker:

Professor Jason L. Speyer received his B.S. degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology, Cambridge, Massachusetts, in 1960 and his Ph.D. degree in Applied Mathematics from Harvard University, Cambridge, Massachusetts, in 1968. He is currently a Distinguished Professor in the Mechanical and Aerospace Engineering Department at the University of California, Los Angeles. His industrial experience includes research at Boeing, Raytheon, Analytical Mechanics Associated, and the Charles Stark Draper Laboratory. He is a fellow of the AIAA and the IEEE (Life Fellow). He was awarded the AIAA Mechanics and Control of Flight Award, the AIAA Dryden Lectureship in Research, the Air Force Exceptional Civilian Decoration, 1991 and 2001, and the IEEE Third Millennium Medal. He is a member of the National Academy of Engineering.