

Course Structure

Course Code : SM7101

Course Title : Fault Tolerance control for smart systems

Credit Hours : 3

Course Description

A fault-tolerant control may not offer optimal performance in a strict sense for normal system operation, but generally it can mitigate effects of system component failures without completely jeopardizing the mission or putting the users/public at risk. Clearly, the philosophy of fault-tolerant control systems design is different from other design methodologies. Consequently, their behavior under system component failures will also be different.

Also about the design of control systems to achieve fault-tolerance for closed-loop control of safety-critical systems has been an active area of investigation for many years. It becomes more and more clear that there is certain trade-offs between achievable normal performance and fault-tolerance capability. A fault-tolerant control system design has essentially become a decision on manipulation of such trade-offs.

Course Objectives

- The students will learn about the fault-tolerant control system is a control system specifically designed with potential system component failures in mind.
- Design of control system to achieve fault-tolerance for closed-loop control of safety-critical systems.

Course Topics

- Introduction to Fault Classification. Types of Redundancy.
Basic Measures of Fault Tolerance
- Hardware Fault Tolerance. Failure Rate, Reliability, and Mean Time to Failure
Canonical and Resilient Structures.
- Other Reliability Evaluation Techniques. Poisson Processes and Markov Models.
Fault-Tolerance Processor-Level Techniques
- Information Redundancy. Coding. Check sum.
Data replication. Algorithm-Based Fault Tolerance
- Fault-Tolerant Networks. Measures of Resilience. Graph-Theoretical Measures.
Computer Networks Measures
Common Network Topologies and Their Resilience
- Software Fault Tolerance. Single-Version Fault Tolerance. N-Version Programming
Preconditions, Post conditions, and Assertions
- Exception-Handling. Software Reliability Models
- Fault-Tolerant Remote Procedure Calls
Simulation Techniques. Simulation Program. Parameter Estimation
- Variance Reduction Methods. Random Number Generation
- Actuator and Sensor Fault-tolerant Control Design
- Actuator and Sensor Fault-tolerant Control Design- continued

M.Sc. in Smart Control Systems for Energy Management

Course Structure

- Application to a Winding Machine
- Application to a Three-tank System
- Sensor Fault-tolerant Control Method for Active Suspension System
- Sensor Fault-tolerant Control Method for Active Suspension System
- Three-tank System

References

- Fault Tolerant Control Systems , design and practical applications by Hasan N. , Didier T., Jean C. and Abbas C., 2009
- Fault tolerant systems. Israel Koren, C. Mani Krishna
- Fault Tolerant control Design for Hybrid systems by Thomas M., Allgower F. and Morari M. 2010
- Fault tolerant Real-Time systems. The problem of Replica Determination by Stefan P. and Kopetec H.