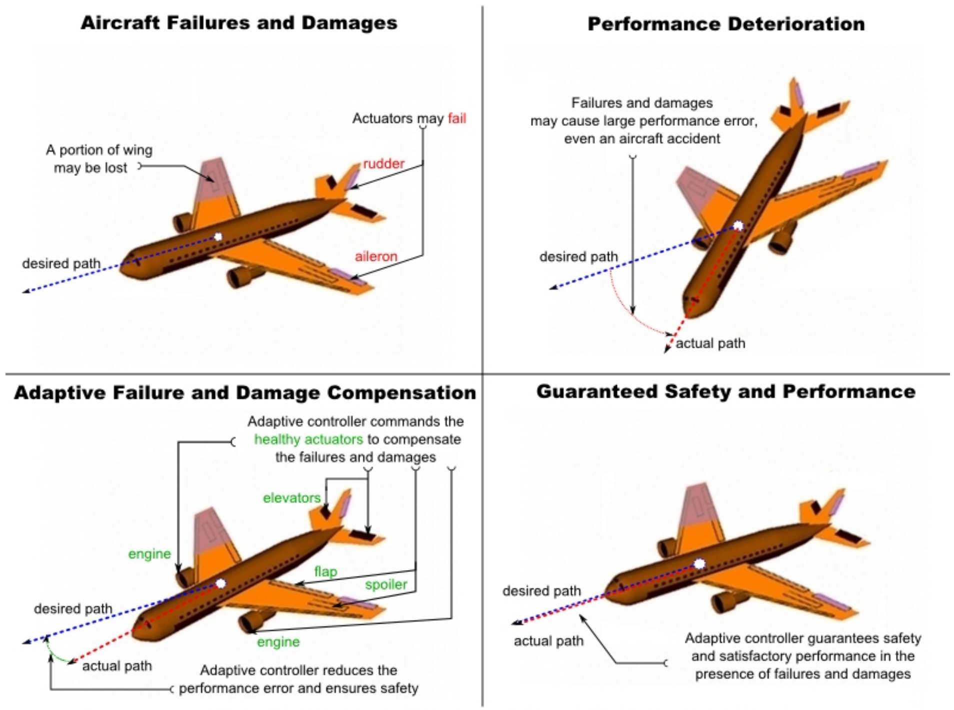
Adaptive Systems & Control Group



Adaptive Failure and Damage Compensation for Aircraft Flight Control Systems

Our group is focused on the area of adaptive control of systems with multiple inputs and outputs. We are particularly interested in systems with non-smooth nonlinearities and actuator failures, in stability and robustness of adaptive control systems, and in passivity characterizations of control systems. We are developing adaptive control techniques for compensation of uncertain actuator failures and nonlinearities, sensor uncertainties and failures, and uncertain structural damage in dynamic systems, for guaranteed feedback control system performance, and apply them to aircraft systems, for resilient and autonomous flight control.

Gang Tao

Professor
gt9s@virginia.edu
people.virginia.edu/~gt9s/

Dept. of Electrical & Computer Engineering
University of Virginia
Charlottesville, VA
434.924.4586

"Wonderful field and interesting problems."

University of Virginia Engineering

Fault Detection and Fault-Tolerant Control

Research in fault detection, diagnosis and tolerance control is crucial for enhancing the reliability and safety of modern technologies to human life, society and the environment. System faults can cause system performance deterioration and even lead to catastrophic accidents but many of such accidents could be avoided with the presence of more powerful fault detection, diagnosis and tolerant control systems. We are working to develop novel feedback-based fault detection algorithms for effective detection of system actuator, component and sensor faults while ensuring system stability, and to develop new adaptive fault-tolerant control techniques for performance-critical systems involving large actuator and sensor networks and multivariable dynamics such as intelligent robots, smart grid and energy control systems, aircraft control systems, and cyber-physical system applications. Our fault detection and fault-tolerant control framework is based on direct adaptive multiple-model fault detection and fault-tolerant control, which has effective advantages in dealing with system faults.

Adaptive Actuator Failure Compensation

Actuator failures may cause severe problems in control systems, such as flight control, process control, and power systems. Actuator failure compensation is an important research topic of both theoretical and practical significance. It is desirable that a control system is able to compensate actuator failures by using the remaining actuation to accomplish a desired control task. Adaptive control is capable of accommodating system parametric, structural, and environmental uncertainties, and it is suitable for control of systems with actuator failures which are usually unknown in terms of failed actuators, failure time instants, and failure values. We are working to use adaptive algorithms for control of systems with both unknown plant parameters and actuator failure parameters. Our objective is to learn and apply adaptive control theory to advanced application examples such as process control and power systems.

RECENT RESEARCH DEVELOPMENTS

New theory and techniques for:

- Feedback based adaptive fault detection
- Adaptive multiple-model based fault-tolerant control
- Multivariable adaptive actuator nonlinearity compensation
- Adaptive structural damage compensation

RECENT GRANTS

- Air Force – Adaptive Control of Synthetic Jet Arrays with Unknown Nonlinearities
- NASA – Active Flow control with Adaptive Design Techniques for Improved Aircraft Safety
- NSF – Adaptive Failure Compensation for Performance-Critical Control Systems
- NASA – Adaptive Control Techniques for Systems Under Structure Uncertainties with Aircraft Control Application

SEAS Research Information
Pamela M. Norris, Associate Dean
University of Virginia
Box 400242
Charlottesville, VA 22903
pamela@virginia.edu
434.243.7683

UNIVERSITY of VIRGINIA ENGINEERING