Semester- /Master thesis

When bad things happen to good rockets: Failure Detection Algorithms in Rocket and Missile Avionics

Motivation and task description:

The Institute of Flight System Dynamics is currently developing a flying missile testbed for the evaluation of nonlinear-adaptive flight control algorithms and state of the art avionics concepts. This is done in the scope of a joint development project together with companies from the aerospace industry and the Technion in Haifa. A sensor- or actuator fault in the rocket or missile avionics can lead to a chain of effects resulting in a disastrous outcome. The application of Failure Detection, Isolation and Reconfiguration (FDIR) algorithms are therefore of particular interest in rocket and missile avionics design.

In the scope of this development project two special cases demand the implementation of a failure detection algorithm: First, during test flights the flight termination system shall be triggered when a component fault is detected and hence limit the impact of the missile on the test site. Second, novel flight control systems offer the possibility of coping with hardware faults by implementing redundancy measures. However, this redundancy can only be useful when the fault can be detected, the origin of the fault isolated and the undesired outcome mitigated by reconfiguring the flight control system.

In the scope of this thesis a fault detection and isolation algorithm shall be developed that is able to detect sensor or actuator faults within the avionics system and activate the flight termination system accordingly. Special emphasis shall be taken to allow the extension of the algorithm to cope with systematic failures and the reconfiguration of the Flight Control System.

Working packages:

- WP1: Literature review on faults, fault modeling and fault detection (FDIR) within an avionics system
- WP2: Identification of possible failure modes within the avionics system
- WP3: Modeling of the identified faults and implementation into a missile flight simulation environment
- WP4: Development of a suitable failure detection and isolation algorithm
- WP5: Implementation and test of the developed algorithm into the missile flight simulation environment
- WP6: (Optional) Implementation and test of the developed algorithm into the missile avionics testbed

Requirements:

- Self organized and independent working style
- Experience with Matlab/Simulink required
- Experience with filter design and systems engineering desirable
- Interest in rocket flight control and simulation

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