IFAC World Congress 2023
https://www.ifac2023.org/

Open Invited Track Proposal

Title

"Aerospace Industrial Benchmark on Fault Detection and Fault Tolerant Control"

Abstract

Fault Detection (FD) and Fault Tolerant Control (FTC) are important topics in the aerospace industry as well as in academia, and thus many research projects and programmes have been conducted in the last two decades. To promote this movement, an open invited track related to FD and FTC focusing on FD and FTC in flight control of civil aircraft is proposed for the IFAC World Congress 2023. This open invited track is for a competition to use FD and FTC techniques with a benchmark problem, similar to the "Aerospace Industrial Benchmark on Fault Detection" competition at the IFAC World Congress 2020 in Germany.

Organizers

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Choice of an IFAC technical committee for evaluation

TC 6.4. Fault Detection, Supervision & Safety of Technical Processes-SAFEPROCESS

TC-7.3 Technical Committee on Aerospace (related TC)

Code for submitting contributions

ma3g7

Link to a web page to further describe the track

https://www.ifac2023.org/program/competitions/aerospace-industrial-benchmark/

Description of the Topic

This benchmark is dedicated to FD and FTC in the Flight Control System (FCS) of a civil commercial aircraft. For this competition, FTC means proposing a strategy for Flight Control Law Reconfiguration after FD, including control reallocation, and does not mean designing a new control law.

The FCS is part of the aircraft avionic systems and consists of all the elements located between the pilot inputs (in the cockpit) and the movable parts (the control surfaces), including these two elements. It is also comprised of sensors, probes, wiring, actuators, numerical buses, power sources, control computers, etc… It is used to control the aircraft attitude, trajectory and speed.

The detection of all related failures in FCS is a very important point to be considered in the aircraft design. In particular, in the context of aircraft overall optimization and their increasing size, system design objectives originating from structural loads design constraints are more and more stringent. The main issue is weight saving to improve aircraft performances (e.g. consumption, noise, range). Consequently, for system failures affecting the aircraft structure, the performance of detection methods must be improved while retaining a perfect robustness. This benchmark deals with a particular FCS failure, which has an influence on aircraft structural loads. This failure is called the oscillatory failure case (OFC) in literature. For structure-related system objectives, it is necessary to detect OFCs beyond a given amplitude in a given number of periods, whatever the unknown OFC frequency.

Moreover, from a control perspective, the failure case affects the quality of the airplane's closed-loop responses. In the nominal (fault-free) case, the aircraft is controlled using the so-called "Normal Law", which means the highest level of automation and protections. For some failure cases, the Normal Law minimum requirements cannot be met and reconfiguration to a less sophisticated control scheme is preferable. For example, after an OFC detection, the loss of one elevator causes a reconfiguration to "Alternate Law" (i.e. a degraded flight control law). The Alternate longitudinal controller is still a load factor scheme, but it uses simplified feedbacks and it is less demanding on actuation power (i.e. its gains are lower).

The benchmark consists of a Matlab/Simulink© model (a simple generic aircraft longitudinal model in cruise phase) accompanied with a technical note, which describes the industrial context of the benchmark and which provides the reader with the technical problem to solve, which is a combination of an FD and an FTC challenge.

How to participate?

If you and your team want to participate, you simply have to download the package "IFAC WC Benchmark.zip" available at the following address:[https://bit.ly/3QjUHcA]. It contains a Simulink model, as well as an accompanying technical note detailing the technical problem to solve and the model user guide.

Competition

The competition is based on the evaluation of two separate contributions: (i) the design (a Simulink subsystem block to be added in the global Simulink model (see the technical note) and that shall be able to detect all the fault cases and to perform control law reconfiguration according to the requirements detailed in the accompanying technical note); (ii) a regular paper (up to 6 pages) or a discussion paper (up to 4 pages) detailing the principles of the proposed design and submitted through the normal IFAC submission system. The organizers will review all submitted designs and papers and proceed to the selection of the 5 best teams. These teams will be allowed to present their work during a special invited session during the IFAC World Congress. The best team will receive an Airbus award at the end of the invited session.

Submission

This competition is categorized as an "open invited track" (OIT). The competing teams have two possible deadlines to submit their contributions (design and paper) depending on their paper choice: until November 30th for discussion papers or until October 31st for regular papers (exact time will be official time of the IFAC submission system, typically 23:59:59 CET). For the submission, please follow the IFAC submission site and submit under the category "Aerospace Industrial Benchmark on Fault Detection and Fault Tolerant Control" OIT. Please note that the Simulink designs shall be sent to the organizers (J. Engelbrecht, P. Goupil and S. Oudin) via email and that the papers shall be submitted through the IFAC submission system.

Please note the followings:

- Regular papers will be published in IFAC PapersOnLine. However, discussion papers will NOT be published in IFAC PapersOnLine. They will only appear in the USB proceedings and are typically four pages in length (6 pages for regular papers).
- Only 5 selected papers will be presented in our OIT. However, the papers which were not selected but highly evaluated by anonymous reviewers in the normal review process will also appear in IFAC PapersOnLine and USB proceedings (regular papers) or only in USB proceedings (discussion papers).