Computer Based Real-Time Damaged Aircraft Model Identification with Two Step Method and Modified Stepwise Regression

Thomas Lombaerts[1], Hervé Huisman[2], Ping Chu[3], Bob Mulder[4] and Diederick Joosten[5]

1,2,3,4 Faculty of Aerospace Engineering, Delft University of Technology
Kluyverweg 1, 2629 HS Delft, the Netherlands
e-mail: {t.j.j.lombaerts/q.p.chu/j.a.mulder}@tudelft.nl
e-mail: h.o.huisman@student.tudelft.nl

5 Delft Center for Systems and Control (DCSC), Delft University of Technology Mekelweg 2, 2628 CD Delft, the Netherlands
e-mail: d.a.joosten@tudelft.nl

Abstract: This paper presents a study on the real time identification process of a damaged aircraft model. This is part of a Delft University research project, performed jointly by the Faculty of Aerospace Engineering and Delft Center of Systems and Control (DCSC), which investigates the possibilities of adaptive control methods for recovering damaged aircraft operating in failure conditions. With help of a Boeing 747 simulation model supplied by the Dutch Aerospace Laboratory, including realistic failure modes with additive as well as parametric failures, it is possible to analyse the considered method's capabilities to identify these types of damage. The types of failures included in the simulation model describe also asymmetric damage, resulting in a situation where it is impossible to base the damaged aircraft model upon the concept of decoupled longitudinal and lateral motions.

The considered identification method in this study is based upon the so-called two step method, which has been continuously under development at Delft University of Technology over the last 20 years. Using modified stepwise regression, the two step method can be extended in order to develop the aerodynamic model structure specifically for the occurring failure mode. This method has been applied on the failure scenario of the EL AL Boeing 747 of flight 1862 which crashed in the Bijlmermeer in Amsterdam. Future work will include further investigations on the capabilities and eventual modifications on the current status of the two step method, as well as the implementation of this resulting real time damaged aircraft model in an adaptive control strategy.

The work in this paper is also closely related to the work in a European research project. The Group for Aeronautical Research and Technology in Europe (GARTEUR) has installed action group AG16 with the specific goal to investigate the possibilities of fault tolerant control in aeronautics and to compare the results of different reconfiguring control theories applied on a reference benchmark scenario, inspired by the same Bijlmermeer disaster mentioned above. The faculty of Aerospace Engineering as well as DCSC are partners in this research project too.