Case Study

Dymola Generates Dynamic Inversion Flight Control Laws for Automatic Aircraft Landing

The Challenge

To design robust aircraft autopilots in a significantly shorter time frame.

The Project

The objective of the European project REAL - Robust and Efficient Autopilot Control Laws Design - was to improve the efficiency of the design process for autopilot control laws, and to increase robustness of the resulting control laws against uncertainty in the aircraft design model. Two design teams (from DLR and ONERA) were invited to propose a design process, to apply it to the design of an automatic landing system of a civil aircraft, and to perform flight tests with DLR's fly-by-wire aircraft ATTAS (Advanced Technologies Testing Aircraft System).

The Solution

DLR's solution is heavily based on the latest developments in modelling technology, in which Dymola plays the key role: Detailed aircraft models, including atmospheric effects, sensor systems, engines, landing guidance equipment, etc. were implemented in Dymola. Simulations in Dymola have been carried out for analysis and to design and optimise the control laws. By defining that the outputs of this non-linear aircraft model are the desired ones and the control inputs are unknown, Dymola generates automatically an inverse model of the aircraft, which was used as kernel of the autopilot controller.

The Result

After extensive flight simulator testing, the landing system, including the Dymola generated C-code of the inverse aircraft model, was implemented in the ATTAS aircraft, and tested very successfully during six automatic landings without any pilot interaction.

DLR's aircraft ATTAS, conducting an automatic landing using control laws that include Dymola-generated inverse model code as its kernel.

Partners:

- Delft University of Technology, faculty of Aerospace Engineering, The Netherlands, is the main institute in The Netherlands for academic education of aeronautical engineers. The faculty co-operates with universities and research institutions from all around the world to exploit the increased possibilities of joined forces. The division is actively involved in research programs to let industrial partners apply and commercialise the results of contract research.
- DLR, Germany, DLR is the German national organisation for aerospace research and development. The main research areas are aeronautics, space flight, energy technology and transport technology.
- EADS-Airbus Toulouse, France, is part of EADS, the European Aeronautic Defence and Space Company, Europe's premier aerospace company. EADS comprises the activities of the founding partners Aerospatiale Matra S.A. (France), Construcciones Aeronáuticas S.A. (Spain) and DaimlerChrysler Aerospace AG (Germany). In terms of market share EADS is one of the top manufacturers of commercial aircraft, helicopters, commercial space launchers and missiles. EADS is also a leading supplier of military aircraft, satellites and defence electronics.
- EADS-Airbus Hamburg, Germany, is also part of EADS, the European Aeronautic Defence and Space company.
- NLR, The Netherlands, is an independent, non-profit research institute partly funded by Dutch government. It gives support to the national and international Aerospace Industry, Civil and Military operators, government agencies and other organisations concerned with aeronautics and space flight.
- ONERA, France, is the French aeronautics and space research institute. It gives support to the national and international Aerospace Industry, Civil and Military operators and government agencies.

The REAL project was carried out in the fourth Framework Program of the Commission for the European Community (CEC). More information is available under:
http://www-er.df.op.dlr.de/projects/real/realpage.html