Technology Strategy Board
Driving Innovation

Knowledge Transfer Network

Industrial Mathematics

Touchdown

ANALYSING FLIGHT TEST DATA FOR IMPROVING BRAKE SAFETY

Airbus / Glasgow Caledonian University

The need

The assessment of braking system performance is often dependent on the visual inspection of flight test data plots by an experienced engineer. This approach, although providing valuable insight, is reliant on an individual's opinion.

Airbus often uses simulation platforms (in various configurations) for a quick, cost effective way of assessing the impact on system performance due to a design change.

The aim of the project was to extract important parameters from real flight test data which improves the potential for a valid simulation and the recreation of critical scenarios observed in flight tests.

The outcomes

This project has enabled the calculation of friction-slip coefficients directly from flight test data to improve the replication of the wheel/runway dynamics during simulation.

The intern also improved the presentation of braking performance data in terms of quantifying the characteristics of the landing test data. Tables detailing this information and a plot of the wavelet information in the form of an 'Attack chart' are now automatically generated in the form of a report when each set of flight test data is loaded.

This presentation allows easier comparison of system activity which enables tuning of components done for like for like cases. (e.g. from a key flight test runway profile). Any improvement in behaviour can be quantified quickly.

The work in this project is independent of platform or aircraft, therefore providing a technique that may be applied in future aircraft and simulation platforms.

The intern has also gained an appreciation of the role of modelling and simulation within system engineering and learned about Airbus and its engineering practices.

"[David] has brought a new approach with fresh ideas to the complex problem of braking control system analysis and development. His methods have enabled some good insights and provided us with real benefits."

Eve-Lise Guillebault Stoll and Adrian Wombwell
Airbus

Technical summary

The intern has previous experience in the field of wavelet analysis, a technique used to extract ramp profiles from test data that appears to be erratic with discontinuous features.

This approach is ideal for the analysis of the flight test data profile. Each wavelet provides information in frequency and depth of the event under study enabling quantitative descriptions of the system.

The friction-slip information is used to provide relationships for the calculation of parameters used by the simulation platforms for determining the wheel/runway dynamics. The approach used here is to fit the friction-slip data to the Pacejka formula. If *R* is the force resulting from a slip parameter *k*, then

$$R(k) = d\sin\left(c\tan^{-1}\left(b(1-e)k + e\tan^{-1}(bk)\right)\right).$$

The parameters *b,c,d* and *e* are extracted from the flight data.

"The internship project has given me the opportunity to apply techniques and skills developed through my PhD in practical situations for a leading aerospace company. I would recommend a PhD Internship to a student as an excellent opportunity to make contacts and gain experience in their chosen field."

David Reid, Glasgow Caledonian University

"The experience at Airbus UK has been extremely valuable for David. He has been able to use some of the techniques learned as part of his PhD and see them applied in an industrial context. The industrial mathematics internship is an excellent scheme."

Roy Bradley
Glasgow Caledonian University

This project was part of the programme of industrial mathematics internships managed by the Knowledge Transfer Network (KTN) for Industrial Mathematics. The KTN works to exploit mathematics as an engine for innovation. It is supported by the Technology Strategy Board, in its role as the UK's national innovation agency, and the Engineering and Physical Sciences Research Council, in its role as the main UK government agency for funding research and training in engineering and the physical sciences.

EPSRC
Engineering and Physical Sciences Research Council

Project Details

Partners
Airbus
Glasgow Caledonian University

Project investment
£13,000

Intern
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