

Press releases 2009

Mobile vibration tests save time and money in the development of new airliners – a report

5 August 2009

by Hans-Leo Richter

Taxi vibration test with DLR's Airbus A320 ATRA research aircraft at Manching airport



Airbus A320 ATRA during the taxi vibration test at Manching airport, near Ingolstadt

A rare sight at Manching airport, near Ingolstadt: over and over, an Airbus A320 rolls along taxiways and a specially-reserved runway at walking pace – with no sign of acceleration or lift-off. Externally, the Airbus no longer has much in common with a 'normal' airliner. Instead, the appearance of ATRA (Advanced Technology Research Aircraft) – the largest research aircraft in the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) fleet – seems to remind one more of a patient wired up in an intensive care unit than a normal commercial aircraft.

Moving along the test track with 140 sensors

Cables of considerable length, attached with silver tape, stretch across the fuselage and wings, across the tail unit and even the landing-gear doors; the scientists have attached a total of 140 acceleration-measuring sensors. Later in the tests, the airliner even switches to a circular path and jolts across a test track made with timber planks placed at fixed intervals. Perhaps tyre tests or trials with new landing gear components are being performed? In fact, it is neither of these. Rather, it is an innovative Taxi Vibration Test (TVT) developed by DLR: a vibration test for determining natural vibration patterns and frequencies.



140 sensors are connected to ATRA for the purpose of acceleration measurement

This TVT, which is currently unique, is a further development of a stationary vibration test that has been in use for a long time: a technique known as a Ground Vibration Test (GVT). As a rule, these test series are used to validate earlier comprehensive computer simulations. Recording vibration frequencies and patterns such as the bending and twisting of wings is of primary interest. In flight, an overlapping of these natural vibration patterns can, under certain circumstances, trigger the dreaded flutter phenomena. This, in a worst-case scenario, can lead to structural failure.

During a TVT, the scientists record important oscillation or vibration data. They start doing this when the aircraft is rolling comparatively slowly over the (in most cases, uneven) tarmac of the taxiways. Project leader Yves Govers, from DLR's Institute for Aeroelastics (Institut für Aeroelastik), emphasises that: "The advantage of the TVT is that large measuring equipment, which is indispensable for stationary vibration tests, is not required. We are already able to obtain important basic information about the aircraft's dynamic characteristics from the excitation of the aircraft when it moves across bumps in the taxiways. Our instrumentation can then record, for example, the oscillation amplitudes of the wings and identify the underlying dynamic structural behaviour. In these tests we have already identified 30 different vibration patterns."

DLR: Experience and competence in the area of ground vibration tests



DLR scientists follow events during the ground vibration test on computer monitors

Prior to the maiden flight of a new airliner, the international regulatory authorities require comprehensive tests for the purpose of aeroelastic stability analysis, known as ground vibration tests. In connection with these requirements, DLR has already carried out comprehensive ground vibration tests on different models in the Airbus family, together with the French aviation research facility ONERA.

Reducing costs and saving time with the taxi vibration test

However, these stationary test series are just as time-consuming as they are costly and they can take up to several weeks; the TVT, on the other hand, can be carried out in just a few days or even only hours. For example, during the development of the Airbus A380, approximately six weeks were required for the ground vibration test, while a taxi vibration test would have taken only a few days. For this reason, the new TVT process represents an important and, above all, a more cost-effective addition

to the available testing methods. The TVT will not replace the ground vibration tests; however, it can shorten them considerably.



The scientists from DLR Göttingen also conducted the rolling trials using different fuelling configurations, in order to study the influence of the distribution of mass on the quality of the results of the TVT process.

In addition to the rolling trials, DLR's scientists also completed a shortened conventional ground vibration test a few days later in one of the aircraft hangars at Manching. During this test, the transmission of force into the structure of the aircraft took place at ten positions, using electrodynamic vibration exciters. The scientists will use this test to compare with the outcomes of the previous rolling trials and validate the TVT results.

TVT accelerates the approval process for airliners

The scientists from DLR Göttingen tested the new process in the autumn of 2007 at DLR's research airport in Braunschweig, using a Dornier Do 228. The recent rolling trials using ATRA are the first significant tests of this process using a large airliner.



With the TVT, DLR is providing industry with a new and efficient test procedure for the rapid identification of dynamic structural characteristics. This could considerably accelerate the approval process for future airliners.

The Experimental Processes Department from DLR's Institute of Aerodynamics and Flow Technology (Institut für Aerodynamik und Strömungstechnik) in Göttingen also participated in the ATRA TVT campaign, in order to test new optical measuring processes versus conventional acceleration sensors for use in test flights.

Technical support from Airbus

For the entire period of the TVT/GVT campaign, Airbus placed a team at DLR's disposal. They provided direct support during all of the trials with respect to the aircraft itself and also the FTI system, a basic instrument for aircraft tests, as well as during the installation of DLR's measuring equipment.

The basic FTI installed in ATRA by Airbus was, for the first time, successfully connected to the DLR equipment (dynamic vibration and optical measuring equipment) for the TVT campaign. The data synchronisation between the measuring systems involved was achieved by way of a uniform time signal. This allowed the exchanging data between the different systems rapidly and securely – so the capability of the experimental infrastructure onboard ATRA could be demonstrated in a striking manner.

The planning, coordination and carrying out of the Manching test campaign represented the first test campaign to be carried out independently by DLR on ATRA. The excellent collaboration with Airbus and the 'hosts' – the armed forces testing station WTD61 – as well as the technical and logistical support provided by the two partners, were important factors contributing to the overall success.

Related Contacts

Hans-Leo Richter

German Aerospace Center
Corporate Communications, Editor, Aeronautics Research
Tel: +49 2203 601-2425
Fax: +49 2203 601-3249
E-Mail: Hans-Leo.Richter@dlr.de

Dr.-Ing. Yves Govers

German Aerospace Center
Institute of Aeroelasticity, Structural Dynamics and Aeroelastic System Identification
Tel: +49 551 709-2288
Fax: +49 551 709-2862
E-Mail: Yves.Govers@dlr.de

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.