SIEMENS
Ingenuity for life

Simcenter Engineering services for ground vibration testing

Performing large-scale modal tests on aircraft and providing technology transfer

Benefits

- Identify all critical modes during the physical test
- Cover full process from pretest analysis to modal correlation
- Provide assistance and technology transfer during all phases of the ground vibration testing campaign
- Support the customer to solve issues that are revealed during the ground vibration test
- Support discussions with certification authorities

Summary

A ground vibration test (GVT) is a critical high-visibility, high-pressure activity that is conducted shortly before the first flight. It provides critical information to validate the aircraft design and flight certification. The data quality is essential to successful aircraft design and development. Tests are typically conducted under strict time limits.

With expertise in both test and simulation, Simcenter™ Engineering services provide solutions ranging from assistance to turnkey projects with technology transfer during all phases of the ground vibration testing campaign. Simcenter Engineering shares its knowledge of virtual and physical GVT with aerospace manufacturers by providing a full set of solutions, such as for personnel resources (engineers and technicians), technical resources (test equipment) and services (such as conducting the test within imposed test schedules, dealing with non-linearity in the structure and supporting discussions with the certification authorities). Modal correlation and refinement can be included.

Simcenter Engineering has experience in flutter prediction and analyzing the evolution of natural frequencies and damping of the aircraft while exploring its flight envelope.

Wing-bending mode.

Simcenter Engineering services for ground vibration testing

A typical Simcenter Engineering ground vibration testing project is comprised of the following phases:

Virtual prototype

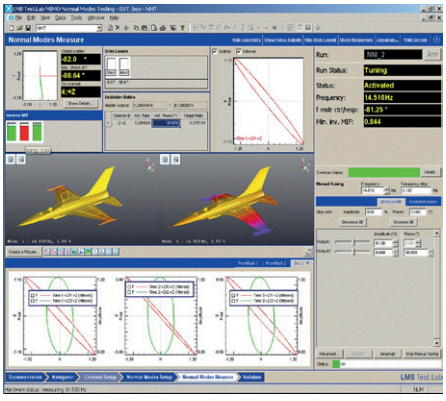
An aircraft development project usually starts with a finite element (FE) before any prototype is built. Simcenter Engineering specialists set up a pretest analysis. By making use of the FE results, Simcenter experts can optimize the test campaign to facilitate the modal testing process, the test setup phase and the various testing strategies.

Physical tests

The aircraft is lifted from the ground with a soft suspension system that creates a free-free condition. The airplane is instrumented with accelerometers and excited simultaneously with shakers in different locations. The nonlinearity of the airplane is studied while excited with different load levels. The measured data are analyzed to extract modal information such as resonance, frequency, damping and mode shape.

Identifying critical modes

For certification purposes, a number of aircraft conditions need to be tested during a GVT, such as with an empty fuel tank, with a full fuel tank and with flaps extracted. All the critical modes are already identified during the physical tests to secure availability of all data for the analysis.



Tuning flutter critical modes during ground vibration testing.

Ground vibration testing setup.

Analysis

Experimental and analytical modal models are compared and, if needed, the FE model of the virtual prototype is updated to better match the test results. With the calibrated virtual prototype, further analysis can be done, such as response analysis or design modifications in case of critical dynamic issues.

Flutter

GVT testing plays a fundamental role in the standard flutter simulation process. The accuracy predicts the interaction between elastic, inertial and aerodynamic forces, and depends on the quality of the structural dynamic behavior that is described by finite element analysis (FEA) models. A GVT is used to correlate and update those models.

As an alternative, Simcenter Engineering can propose the direct use of GVT results in the flutter prediction by converting them into an equivalent modal model. This is particularly useful when no reliable FE model is available.

Siemens Digital Industries Software
siemens.com/software

Americas +1 314 264 8499
Europe +44 (0) 1276 413200
Asia-Pacific +852 2230 3333

50002-C13 8/17 H