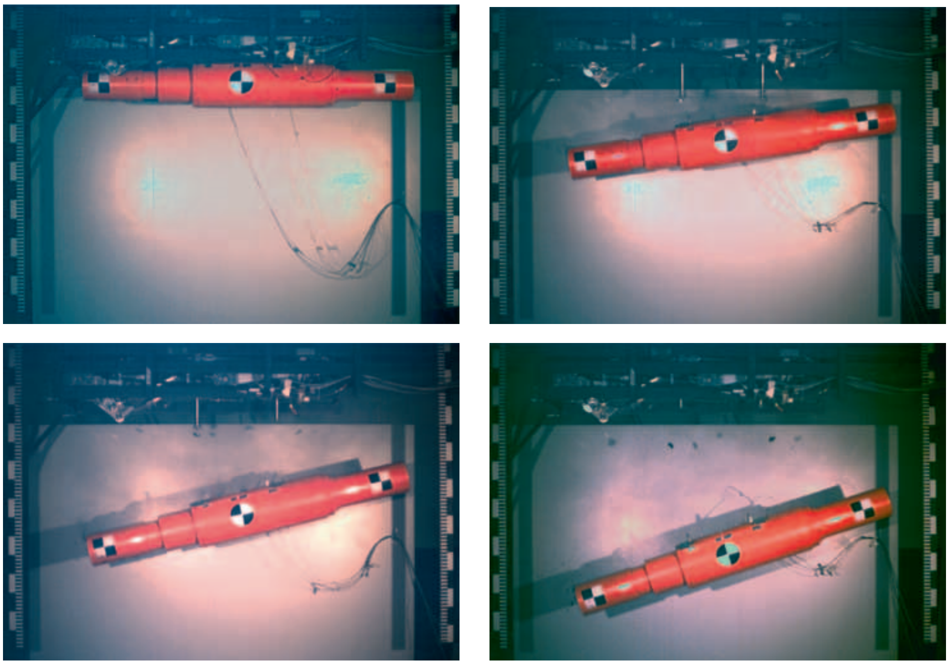
caused by varying flare ejection speeds and masses, the trajectories were measured in flight. A helicopter mounted camera system together with an in-house developed software-tool allowed to extract the precise path of the ejected flares and ultimately confirm the numerical simulations.

Store Separation Test

One of the responsibilities of RUAG within the Neuron UAV project was the release mechanism for the internally carried weapon. This included the design, manufacturing and validation. Computational and experimental analysis at the Aerodynamic Department had to validate the proper functioning of the complete store release sequence and separation process. The experiment was needed on one hand to provide realistic information about the pyrotechnical ejectors performance as an input for the computer simulations and on the other hand to validate the final result. The test setup included: a very stiff rig to which the RUAG release mechanism was fastened; a finely calibrated in terms of center of gravity and moment of inertia and instrumented 500 lbs MK 82 dummy bomb; a special impact receptacle that provided sufficiently low decelerations to allow safe and repeated use of the dummy bomb with its sensitive instrumentation; as well as a large amount of sensors and measurement equipment. Time-resolved ejector loads, numerous local stresses, the weapon's attitude, accelerations, and translational and rotational velocities and other signals were acquired and analyzed during the test. Initial findings of discrepancies between the experiment and the computer simulation could finally be traced to components not meeting their specifications. The information allowed the design team to better understand the sensitivities of the system and to provide a safe workaround. This is another example where the experiment provided results that a computer simulation, by definition, can not.



Ground based store separation test for the nEUROn pantograph release mechanism.

Recent Activities

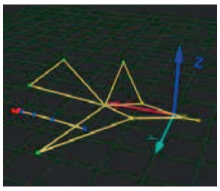
Shock Absorber Test Bench

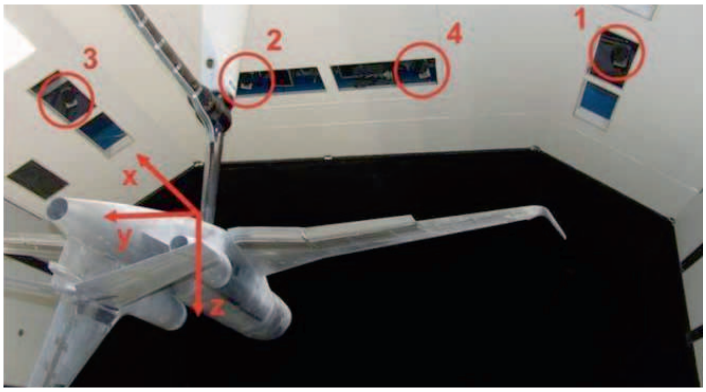
Testing aircraft components after servicing is essential if not even mandatory to ensure safe operation in flight. At the RUAG facility in Interlaken an existing test bench which was originally designed to verify the functionality of helicopter cargo hooks was extended in its mechanical interface and functionality to newly accommodate landing gear shock absorbers for the Dornier 328 Aircraft. The Aerodynamic Department had the opportunity to design, modify and reinforce the clamping jig to accommodate the 22 metric ton testing loads, update the electrically driven AC motors with more powerful servo drive units and program a new control, monitoring, display, recording and user interface software suite based on LabVIEW 2011.

Do 328 landing gear prepared for the shock absorber qualification test

Optical measurement system in LWTE

In our continuous effort to introduce new measurement technologies, a recent test showed the usability of a high speed optical tracking system in the wind tunnel. Model position and deformation information were derived with excellent accuracy and over a large range using non-intrusive, retro-reflective markers on the model. With the goal to prove also the dynamic capabilities of the system, a towed target was attached to the model and was successfully tracked with a sampling rate of 500 Hz.





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Together ahead.

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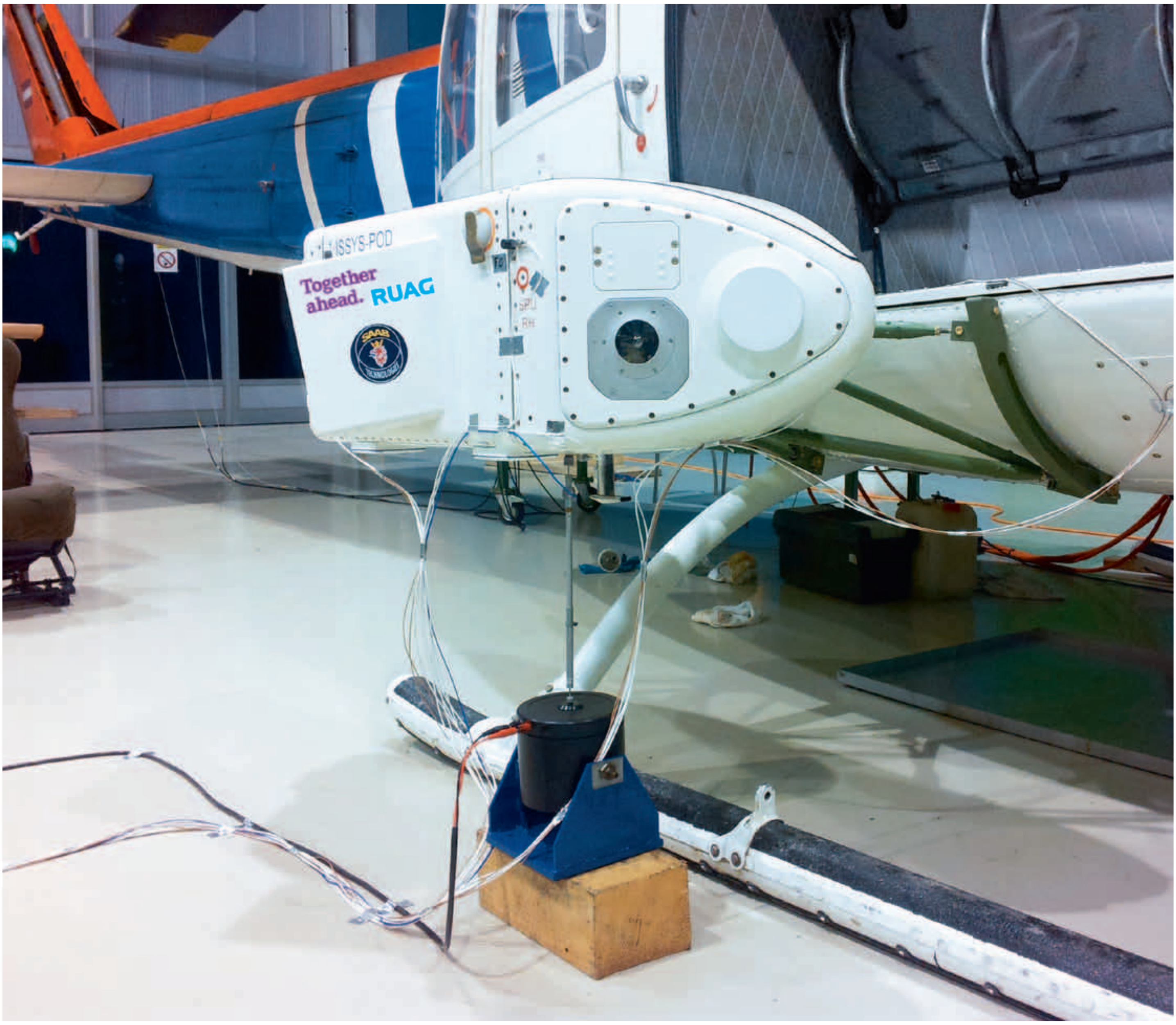
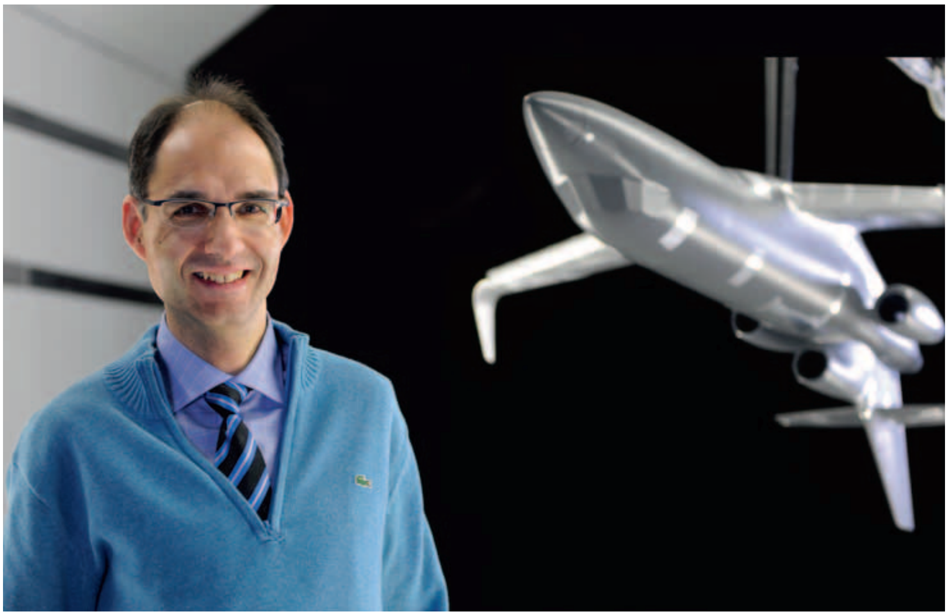
Optical measurement system in LWTE

Dynamic model position and deformation measurements in wind tunnel. **Page 6**



Together ahead. RUAG

Editorial



Dear reader,

With the daily increase of computing power and the continuous refinement of numerical simulation models and tools, today's engineers are better equipped than ever to predict physical phenomena and dynamic behavior of mechanical, electrical or pyrotechnical systems. However, every numerical model is just that – a hopefully useful engineering approximation of a real-life event. With our wind tunnel customers we regularly see that experimental validation of simulation results is key to the correct engineering decisions and that even the best tools do not replace understanding. Refer to our examples below.

While the main focus of the Aerodynamic Department centers on its wind tunnel testing activities, a significant amount of our resources are often engaged in other activities. With the present newsletter, I would like to provide insight into recent projects that did not take place in the wind tunnel but made good use of our competent engineering and testing staff and the equipment of the entire Aerodynamic Department.

Sincerely,

M. Guillaume

Michel Guillaume
Department Manager Aerodynamics

Non-aerodynamic testing in the Aerodynamic Department

In the 1940s an engine and wind tunnel testing facility were built in Emmen to serve the needs of the Swiss government and aeronautical industry. But soon new capabilities were added, expanding the department into a research facility with a wide scope of activities in the aeronautical area.

An aluminum and carbon balde, designed by RUAG for a counter rotating open fan propulsor

Due to a shift of priorities and technological advances (for example a new engine test stand was built at another RUAG location for high performance jet engines), the main focus of the Aerodynamic Department is nowadays on the operation of its wind tunnels and associated systems. Nevertheless, activities not strictly coupled to aerodynamics but having synergies in equipment and tools remain an important part of the daily business. Most prominent are our activities related to wind tunnel balances and other testing equipment. But also vibration and store separation analyses represent an area of expertise.

Ground Vibration Test

Today's system requirements often call for radical designs in terms of weight, strength, fatigue, noise and vibration, going very close to the physical limits. As a consequence a thorough understanding of the dynamic behavior of components and complete systems is essential. While current simulation tools are capable to reliably predict the modal shapes, resonant-frequencies and the damping characteristics of simple structures, it is still difficult to determine accurate results for complex systems by computer simulation alone. This is where the experimental determination of the modal characteristics, the so called modal survey or Ground Vibration Test (GVT), provides the required information. In the aerospace industry, ground vibration testing of complete aircraft has been standard for many years since such tests are mandated by certification requirements to complement the accuracy of flutter predictions.

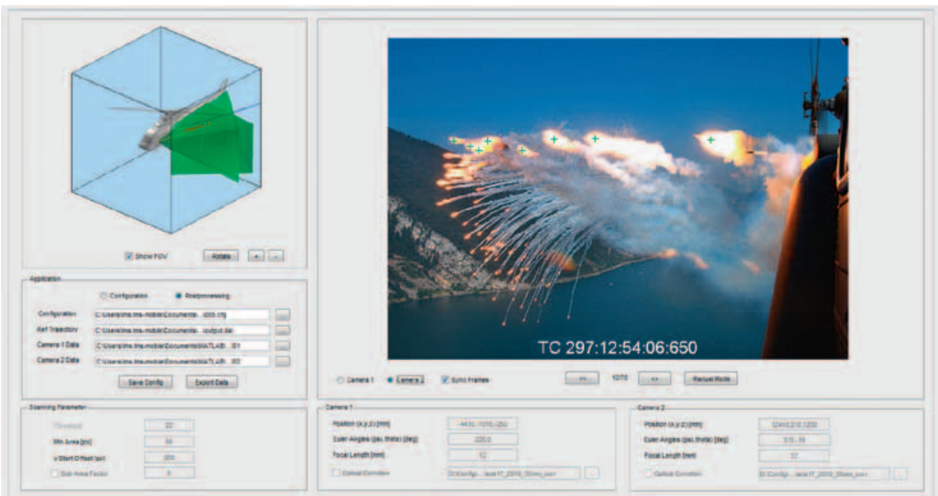
RUAG developed self protection pod on the Bell 205 being subjected to modal investigations.

The Aerodynamic Department has a small number of experts in this field and the appropriate equipment for up to medium sized system tests. During the last year, a wide range of different ground vibration tests was successfully carried out, the smallest object being a 30 gram carbon model propeller blade which was studied in order to assess the newly developed design and fabrication processes as well as to verify the blade's safe operation on a counter rotating airplane propulsor simulator in the wind tunnel. The modal characteristics of the carbon blades, tunable during design/fabrication, were compared with those of aluminum blades of identical shape. Depending on damping characteristics and practicability, either accelerometers, strain gauges and/or laser sensors were used in conjunction with either hammer or shaker excitation. The frequency tailoring process of carbon blades was verified and the mechanical design and the computer simulations confirmed. The encouraging results triggered additional steps to further improve the frequency and damping tailoring design process for the delicate shapes of today's blade designs.

At the other extreme of the modal characteristics test range was a 1.6 ton solid aluminum frame, which was instrumented at 16 locations with 3-axis accelerometers. In this case the frame itself was suspended by elastic chords creating a free-free boundary condition. The excitation was achieved through the use of an electrodynamic shaker (sine and random excitation).

Modal characteristics test on the 1.6t wafer stage metro frame

A more challenging test setup was necessary for the determination of the modal characteristics of the RUAG self-protection system "ISSYS pod" mounted on a helicopter. The ISSYS pod supports chaff and flare decoys plus the necessary instrumentation to detect approaching missiles. The pod is a universal solution to be attached to any helicopter – in this particular case a Bell 205 – or airframe through a specific interface adaptor. For the test the helicopter was positioned on its skids on the hangar floor with the main rotor loosely secured to prevent it from turning. The baseline configuration, without any payload, was excited by a simple hammer providing a broadband impulse to the system. Even though this method is rather crude, it was sufficient to provide a rough understanding of the helicopter's rigid body modes while standing on its skids. This information was needed to separate the local pod modes from the global helicopter modes. For the configurations of interest, with the ISSYS pod installed, excitation was provided by an electrodynamic shaker. The experiment, although generally in good agreement with the computer simulation, was able to pinpoint certain design weaknesses and provide corresponding feedback to the design team.



Flare separation prediction and optical tracking during flight tests

Ejection Test and Optical Tracking

For the ISSYS self protection system it must be assured that the separation of flares from the pod mounted cartridges in the complete maneuver and flight envelope is safe and does not endanger the helicopter. The corresponding RUAG proprietary simulation tool allows the prediction of the flare trajectories relative to the airframe, taking into account the effects of flight maneuvers, rotor-downwash and flare momentum variation. To validate the predictions and to get statistical information about the real world scatter of the flare trajectories,