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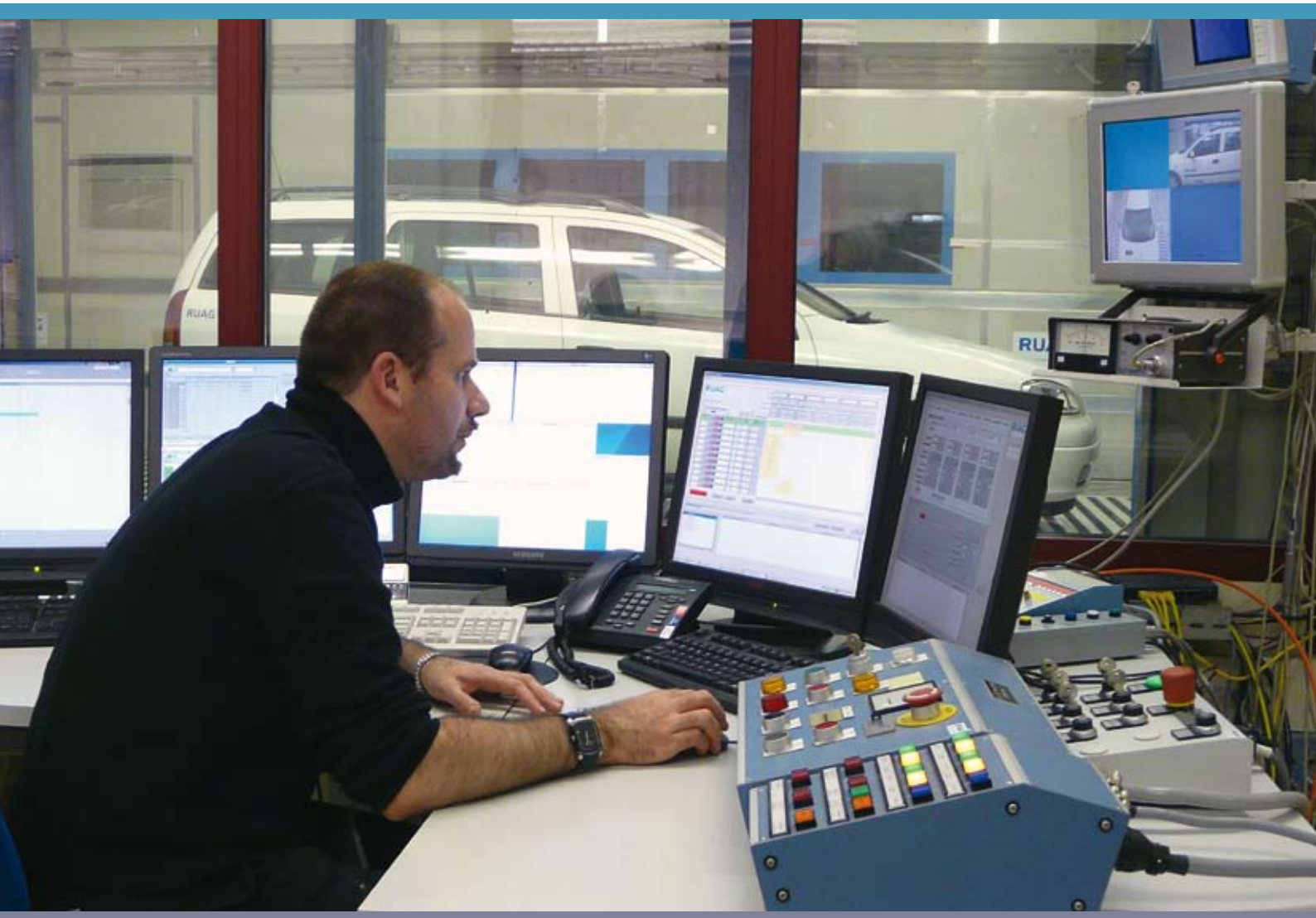


Center Aerodynamics – Newsletter 17

Increased productivity to offset rising energy cost

Dear reader,

Globally rising energy costs also affect the Center Aerodynamics of RUAG Aerospace. Tough negotiations by RUAG with the energy companies were not able to prevent a significant increase in the cost of the electricity. In fact, we will pay almost 60% more per kWh in 2009 than in 2008. Unfortunately, it is unavoidable that this will also affect the hourly rate which we have to charge our customers. The energy cost is indeed a significant part of the total cost of a wind tunnel test.

In previous Newsletters, we have reported on our activities to replace the data acquisition chain with a modern HBM system and to improve the interface to the various controlled systems in the wind tunnel (stings, supports, etc.). The latest upgrade, which has been commissioned at the end of 2007 and has been in essentially trouble-free operation in the Large Wind Tunnel (LWTE) ever since, is the new Master Computer Program (MCP). This internally developed software package allows to prepare, perform and evaluate a wind tunnel test in a more efficient manner. Its modular design allows to efficiently cater to the specific needs of our customers. Further details are given in the feature article of the present Newsletter.

These upgrades which have been implemented during the past few years have not only improved the accuracy and quality of the delivered results but have also had a direct impact on the efficiency of a test. Time is saved both during the preparation and the performance of the test to the benefit of the customer.

The wind tunnel occupancy rate price hike may partly be compensated by the increased productivity which reduces the total time spent by the customer in the wind tunnel. We hope that our customers will quickly realize this and continue to accept us as a cost efficient and reliable partner for their aerodynamic testing needs.

Sincerely,

M. Guillaume

Michel Guillaume
General Manager Aerodynamics

A New Foundation for the Wind Tunnel Software System

The customers in our aerodynamic testing facilities come from a wide range of fields (aerospace, automotive, civil engineering, sports, etc.). Thus their specific testing needs differ greatly. In fact, not one test setup is exactly the same as the other. This requires a high degree of flexibility for the wind tunnel, the associated systems and not the least also of the control and data acquisition software. This flexibility often lacks in commercial software solutions. Therefore, when it became time to look at a replacement for the data acquisition software, it was decided to develop a new computer program in-house, building on the tradition that the Center Aerodynamics has in developing software solutions for wind tunnel applications. It was also felt that keeping the relevant know-how in-house would ultimately benefit the customer due to short reaction times in case of unforeseen requirements. After several years of development, the new **M**aster **C**omputer **P**rogram (MCP) was successfully commissioned at the end of 2007.

In parallel to the development of the wind tunnel software the data acquisition hardware and the controlled systems have been replaced by new and advanced systems during the past years:

- **DAE** (2005-06): **D**ata **A**cquisition **E**quipment based on MGCplus technology from Hottinger Baldwin Messtechnik (HBM)
- **COSYS** (2006-07): **CO**ntrolled **SYS**tems e.g. for model manipulators with central and rear strut based on LabVIEW technology from National Instruments

These new systems have been presented in detail in earlier issues of our newsletter.

Main Features of the new Master Computer Program

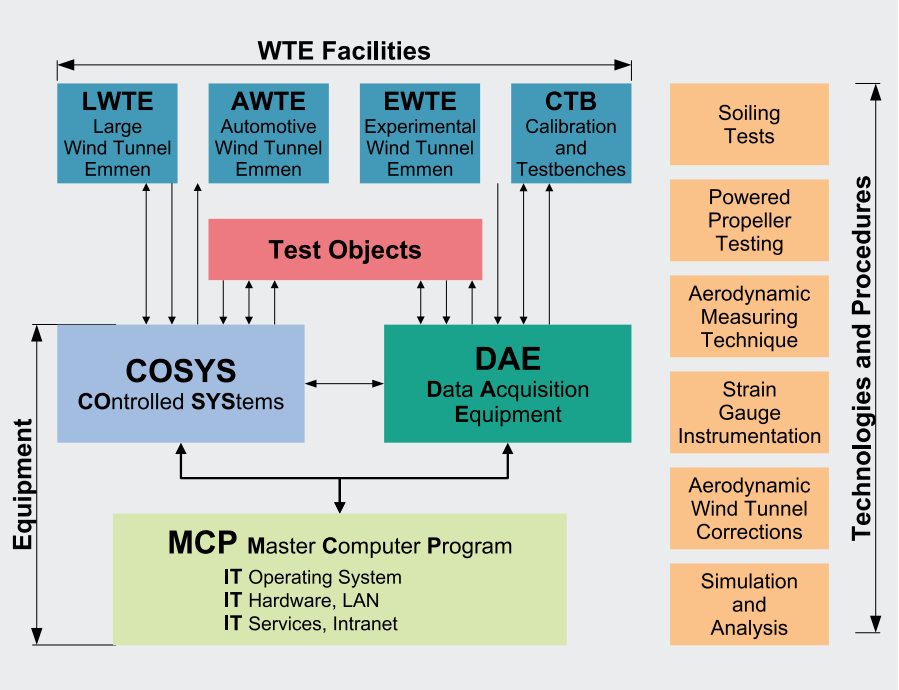
The new «Master Computer Program»

- Is based on an IT-environment with standard-hardware and a standard-operating system
- Establishes software frameworks to support the integration of new
  - data acquisition systems (sensors, amplifiers, signal conditioners, A/D-converters, etc.)
  - controlled systems (model manipulators, fan control, etc.)
  - data processing modules (e.g. wind-tunnel corrections)
- Allows for scaleability:
  - only system immanent limitations (CPU-speed, memory-size, etc.)
  - by distributing software modules to different computers in the LAN to avoid bottlenecks
- Achieves transparency:
  - access data with standardized names for files and variables
  - allow multiple simultaneous access to values during processing – online as well as offline after the end of a test run or measurement campaign
  - graphical user interfaces to set up, control, and survey the entire measurement process and to present data online and offline in tabular and graphic form
- Tools to provide customer specific data representations
- Provides results in 9 commonly used coordinate systems in aerospace and automotive aerodynamics
- Built in procedures to allow model internal and/or external balances
- Achieves a synchronous acquisition of the measured signals (values from multiple MGCplus-systems and pressures from multiple PSI-systems) and provide accurate time-stamps

In addition to their application to both of our wind tunnels, the MCP and the associated tools are also used whenever a measurement needs to be performed on any of our test rigs (for example balance calibrations). A sketch of the systems and technologies used in our wind tunnel environment is shown below.

Building the Software

The scope of the "Master Computer Program" software covered areas including graphical user interfaces, set up and control, customer specific data presentations, and software drivers for the data acquisition hardware. Also included are coordinate transformations, flight mechanic calculations and wind tunnel corrections. A profound understanding of the equipment, the aerodynamic and flight mechanic details and the operating system was therefore needed. Possible current and future requirements had to be accounted for. The resulting software finally contains about 300'000 lines of code. In software development circles this is generally recognized as a "large scale application".



Such an endeavour was only possible with an interdisciplinary effort between the software team, which during the development phase was uniquely dedicated to this project, and other experienced experts in the Center Aerodynamics.

Introduction to the Wind Tunnel

A key issue was the test phase in our EWTE (Experimental Wind Tunnel Emmen) where the interactions of the software modules were tested under real world conditions. It also gave a first impression of how good we achieved the expectations.

In November 2007 the new wind tunnel software system was introduced in a first production wind tunnel test in our LWTE (Large Wind Tunnel Emmen). There were no significant problems – on the contrary: operators, test engineers and customers appreciated the new possibilities.

As of this day we have performed many wind tunnel test campaigns to the satisfaction of all involved parties. The new MCP-software has already proved its efficiency and transparency. The established software basis allows a smooth implementation of enhancements for requirements in the future.

Customer benefits
The system provides a faster and easier online and offline access to the data.
The flexibility of the new MCP enables us to better respond to customer requirements for measurement setup, data reduction, data presentation, ...
Data delivery online and offline is available in Tecplot, Matlab or WDF format and others upon request.
Because of the optimized use of the possibilities of the data acquisition equipment an improved measurement quality is achieved.
It is possible to simultaneously perform averaged and time resolved measurements.

Newsflash

Turkish Aerospace Industries (TAI) is developing a new military training aircraft: the Turkish Primary and Basic Training Aircraft TBTEU "Hurkus". The Center Aerodynamics was subcontracted for building a model and performing the wind tunnel tests in its LWTE facility. Starting from the digital dataset of the aircraft's outer shape, the 1:3.5 scale wind tunnel model was designed, manufactured and instrumented in less than 6 months. Beside the internal 6-component balance, the model is equipped with a large number of pressure taps, strain gauged hinge moment balances for all control surfaces and flaps. An 80 kW hydraulic motor is installed to simulate the power effects.

The wind tunnel test campaign covered more than 1000 polars most of which were in a power-on configuration. During two extensive test campaigns, the model and its instrumentation performed flawlessly, allowing the test to be performed on schedule and giving the customer perfect satisfaction.

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