CONTROLLER SOLUTION

# NEWSLETTER II

Abb.: IMA Dresden - Rumpfschalenprüfung

## A NEW GENERATION OF MULTI-PURPOSE DIGITAL CONTROL- AND MONITORING SYSTEMS FOR TEST RIGS

**CONTROLLERSOLUTION GmbH** is the first company to produce model-based multi-purpose digital control- and monitoring systems that are fully interlinked with easy-to-use model generation and system simulation tools. These innovative controllers are equipped with a physical real-time dynamical model of the test rig and provide for maximum efficiency in terms of safety, ease of operation, automation, fast setup, high tracking speed and control performance. Important unique selling propositions of our controllers are described in the following.

### BASICALLY A TEST ENGINEERING APPLICATION IS DIVIDED INTO THREE PHASES:

- **Phase 1: project planning**

This is the first implementation phase of a project for a test engineering application, where planning and concept of the test rig and estimation of total costs have to be carried out. Usually in this planning phase the test article is still not available.

- **Phase 2: assembling and initial operation of the test rig (setup)**

In this phase the test rig is assembled and the test article is already supplied. Phase 2 is completed with the successful initial operation of the test rig and the fine tuning of its control system settings.

- **Phase 3: regular test operation**

In this phase the actual operation of the test rig is carried out, i.e. the static and dynamic testing is performed. The dynamic tests are executed according to a cyclic loading program which mainly determines the total test duration.

### PHASE 1 ( PROJEKT PLANNING )

**Efficient and assured planning of a test engineering project is provided by the model-based system simulation tool:**

**A. Automatic layout and dimensioning of the test rig and oil supply**

- Calculation of the nominal values for the servo valves.
- Calculation of the nominal loads and deflections for the actuators.
- Calculation of the utilized capacity for the oil supply unit, e.g. the total oil consumption of test rig.
- Calculation of the dimensioning (diameters) for the high-pressure piping system.

**B. Automatic calculation of the dynamic test duration at maximum test speed**

- Assured estimation of the total test duration.
- Assured cost and project planning which minimizes risks of incorrect planning.

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## PHASE 2 ( ASSEMBLING AND INITIAL OPERATION OF THE TEST RIG )

**Efficient and fast assembling and fast setup for ready-to-start operation of the test rig is provided by the model-based system simulation tool:**

### A. Automatic calculation of the control system settings

- Significantly reduced effort and costs for the optimization of the control system settings.
- The safety requirements are significantly increased during initial operation of the test rig. This is especially important for damage-prone or for expensive and not easily substitutable test articles.

### B. Accessory simulations for verification of the dimensioning of test rig components based on the actual (final) loading program

- Accurate calculation of the total duration of the testing process at maximum test speed.
- Accurate calculation of the utilized capacity of the servo-valves, the high-pressure piping system and the oil supply unit.

## PHASE 3 ( REGULAR TEST OPERATION )

**Safe dynamic test operation at maximum test speed by system simulation and model-based control engineering methods which utilize the real-time dynamical model of the test rig:**

### A. Maximum tracking speed and safe test operation by optimized command signal

- The dynamic test speed is significantly increased compared to conventional solutions. Examples in the test engineering practice show that the test duration can reduced by a factor of 2.
- Explicit conversion of all technical constraints by automatic optimized command signals generation based on a loading program. In particular e.g. the utilized capacities of all servo-valves and the oil supply unit at maximum test speed are always below 100 percent.
- Special suitability for safety-critical test engineering applications as unfeasible wrong loading caused by control deviation or hard shut down is avoided.

### B. Maximum tracking accuracy and maximum security

- Substantial reduction of phase delay between command and feedback signals through online compensation of control signals by model-based test engineering methods. By that the load reproduction at rods and bearings of the test article is substantially improved.
- Improved load reproduction at test rig through online inertia compensation which utilizes the real-time dynamic model of the test rig. In particular, tampering of measured loads at high test speed is avoided.
- Improved control tracking behaviour during test operation through elimination of acceleration peaks in the command signals. This is achieved by automatic command signals generation subject to preservation of test speed.
- For higher-frequency test engineering applications: Minimization of control deviation through automatic pre-deformation of the control signals by the RPC-method.
- Reduction of the number of the comparably time-consuming RPC-iteration processat the test rig and improved load reproduction at the beginning of the RPC-iteration process at the test rig through the automatic pre-optimization of the RPC-signals by means of system simulation.