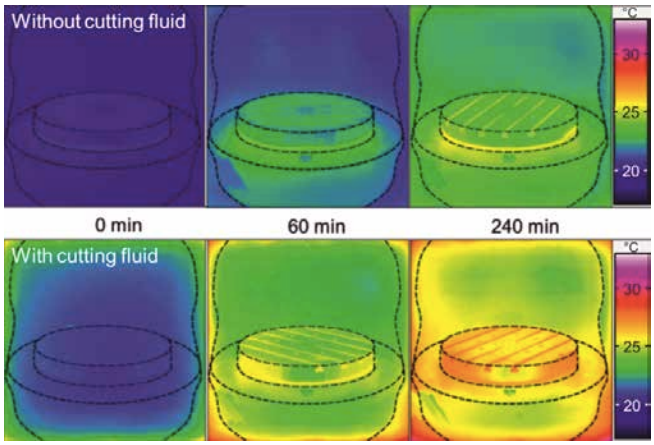
MTTRF equipment enables IWF of ETH Zürich to carry out research on machine tools of cutting edge technology and to train students and make them aware of the high standard of machine tool technology. Our Research topic is the exploration of unwanted but yet deterministic behavior of machine tools such as kinematic, gravitational, thermal and dynamic behavior to provide means for compensation and thus enhancing machine tools to the best of installed technology. This acquired knowledge is directly transferred to students in lectures, exercises, and project work on all levels bachelor, master and PhD.

RESEARCH

Thermo-Energetic Aspects on Five-axis Machine Tools

In the ISO standards as ISO 230-3, ISO 10791-10, ISO 13041-8 the evaluation of thermal errors of machine tools is standardized. Especially the influence of the environmental temperature as well as thermal errors, distortions caused by linear motion of machine components and rotating spindles are analyzed but rotary axes of machine tools, as used in swiveling rotary tables or universal heads, are not included in the standards. Also the standards only cover experimental analysis and neither model based analysis nor compensation. In the past, thermal displacements of and due to rotary axes, thermal environmental influences, and main spindle influences have been discussed. Measuring methods and different modelling techniques for the prediction of the behavior have been researched and developed for compensation.



In the ongoing research work, thermo-energetic aspects on five-axis machine tools are investigated. The work includes displacement measuring strategies, development of a thermal test piece, an adaptive thermal error compensation, a state-space thermal error compensation models for 5-axis machine tools, and a thermo-energetic model for the MTTRF equipment.

Further machine tool related research at IWF covers static compensation to cope with the machine tool kinematics, and gravity, dynamic compensation such as cross talk and coupling force compensation. Chatter mitigation, path planning with self learning aspects and optimization with respect to machine behavior as well as tool wear, and industry-4.0-topics as state monitoring and predictive maintenance are further investigated.

EDUCATION

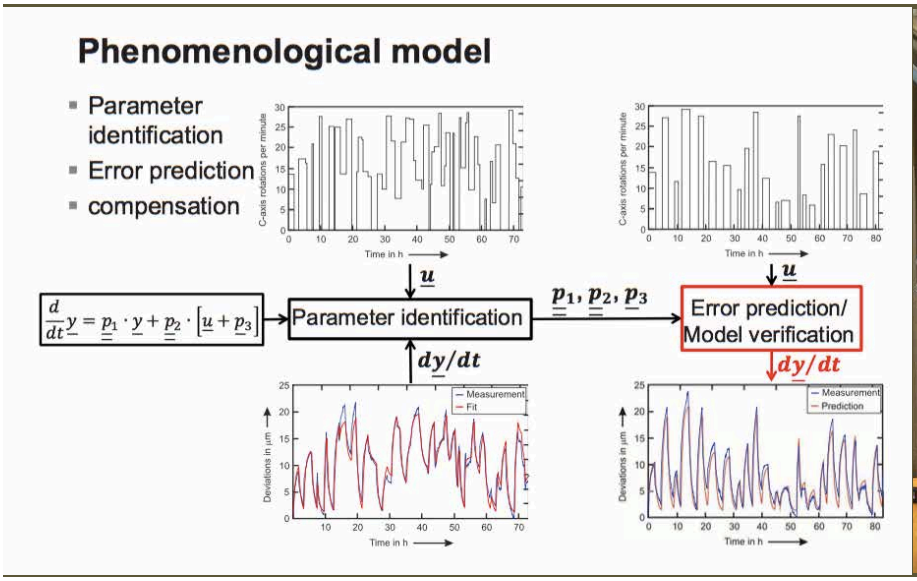
Focus Project Sun Car
(Undergraduate course)

This course is project based learning and covers the whole 2 semester long focusing part of studies, often including also the thesis. All education and teaching of engineering skills is packed into a project, which at the end leads to a realized product.

Sun Car is an ongoing project. After the last year's project for a fully electric vehicle, with two separate drive trains at the front-wheel drive, this year's project is continued by building a steer by wire concept for the car. MTTRF equipment is used for 5-axis machining of complex precision parts designed by the students, which are the core components of the steering.

Lectures and Lecture exercises
(Undergraduate/Graduate courses)

Lectures and exercises in machine tool metrology, machine tool design, manufacturing organization, and machining. MTTRF equipment is used to analyze and demonstrate modern machine tool technology and its embedding in industrial environments.



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MTTRF Awardee since 2008