MACHINE CHARACTERIZATION AND OPTIMIZATION
The efficiency of modern machine systems depends to a great extent on the accuracy with which they work. Static machine errors can be determined using various methods and provide information about the performance capability of machine tools. Consequently, the characterization of static machine errors is indispensable for both the purchase and the regular maintenance of machine systems.

Benefits of static machine characterization

• Acceptance inspections conforming to standards for the validation of your investment
• Determination of static machine errors
• Manufacturing and assembly control during the setup of prototypes and standard machines

Our skills

• Dedicated, interdisciplinary team of scientists, technicians and design engineers
• Expert identification of weaknesses in the mechanics and control of the machine system
• Custom-designed assortment of measurement equipment for the quickest and most efficient characterization of the machine tool
• Measurement equipment for comparative measurements with different systems

Our services

• Laser-interferometric geometry measurement systems for the determination of static errors in machine systems of any size
• Tactile geometry measurement systems for precision and ultra-precision machines
• Determination of spindle concentricity errors by means of contactless, capacitive sensors
• Determination of path accuracy using double-ball-bar systems or cross-grids for the analysis of the axis setup
HOLISTIC OPTIMIZATION OF MACHINE TOOLS

Based on detectable static, thermal and dynamic weaknesses in a machine system, the Fraunhofer IPT optimizes machine systems. This may involve control and/or constructional measures. Moreover, the minimization of possible error sources in the environment is also considered. The comparison of experimental and simulation results ensures the success of the optimization strategy.

Benefits of the holistic optimization of machine tools

- Holistic examination of machine systems enables effective optimization of machining accuracy
- Optimization measures are implemented during both the development and daily use of machine tools and therefore contribute to the profitability of the machine systems

Our services

- Enhancement of system accuracy through the development of control compensation strategies
- Setup and calibration of 5-axis machines for the optimal adjustment of the rotary axes to the linear axes
- Analysis during the design process using the finite-element method for the cost-efficient optimization of structural elements
- Adaptive design and optimized commissioning
- Enhancement of machine accuracy in existing systems by means of mechanical and thermal optimization

Our skills

- Close comparison between simulation and measurement results
- Many years of experience in the development and optimization of a wide variety of machine systems
- Interdisciplinary team of simulation, measurement and control engineers as well as scientists
Apart from reproducible static machine errors, thermal deformation also leads to a significant reduction in the accuracy attainable by a machine system. Dynamic effects likewise play a part in the deterioration of manufacturing results. In order to fully comprehend these two sources of error, suitable analysis methods are needed.

**Benefits of dynamic and thermal analyses**
- Increase technical comprehension of the machine system
- Evaluation of machine system with respect to dynamic and thermal behavior
- Identification of critical machine components with respect to dynamic and thermal behavior

**Our services**
- Determination of flexibility frequency responses of critical machine components
- Execution of experimental modal analysis for the characterization of structural and mounting elements
- Thermographic analysis of single machine components to identify critical heat sources
- Holistic thermal analysis of machine systems to determine the thermal equilibrium and identify weaknesses in cooling
- Process and vibration analysis by means of high-speed cameras to clarify the effects of process mechanisms on the structural elements

**Our skills**
- Qualified application of different sensors and actors for the identification of vibration-sensitive machine components
- Many years of experience in the scientific interpretation and practice-oriented preparation of measurement results
- Proven procedure for the targeted analysis of machine systems under manufacturing conditions

**DYNAMIC AND THERMAL ANALYSIS OF MACHINE TOOLS**