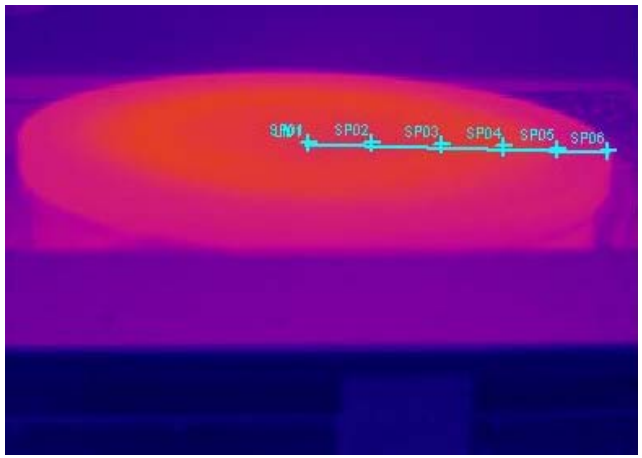
Special **I**nterest **G**roup

Euspen Special Interest Group on Thermal Items in Ultra Precision Machines



Eindhoven, 7th of December 2006

Fraunhofer IPT Institut Produktionstechnologie

WZL RWTH AACHEN

Agenda

- 08.30 - 09.00 Welcome
- 09.00 - 10.30 Measurement of temperature and corresponding deflections
- 10.30 - 12.00 Compensation methods for thermal deflections
- 12.00 - 13.30 Lunch
- 13.30 - 15.00 Modeling and calculation of thermal effects (temperature and deflections)
- 15.00 - 16.30 Thermal design strategies
- 16.30 – 17.00 Break
- 17:00 – 18.00 Wrap-up

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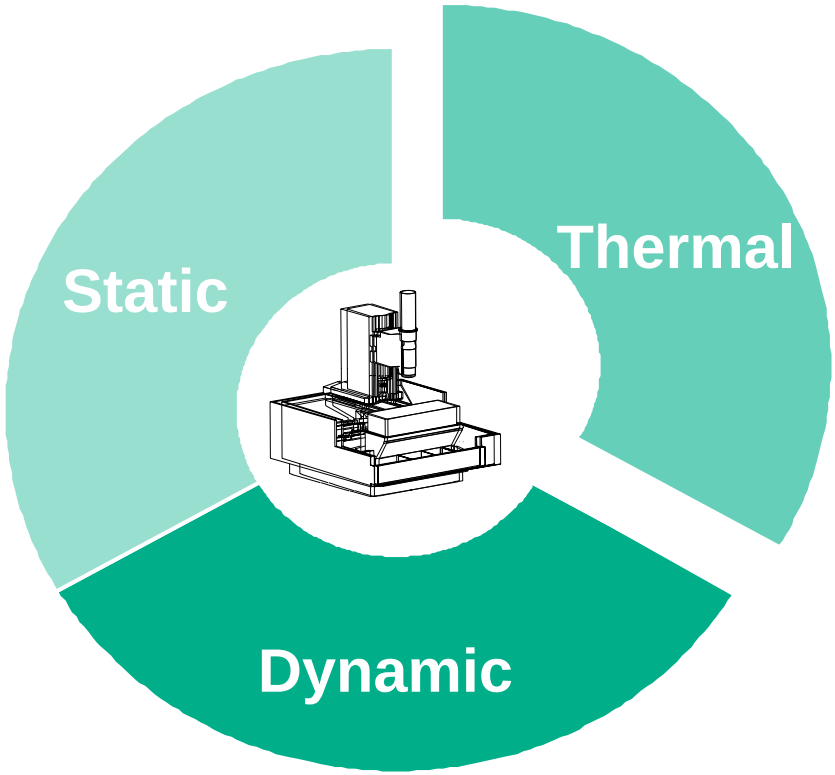
Relevance of the Thermo-Elastic Displacements



Factors of influence on the machining accuracy at the tool centre point (TCP) of machine tools

The relevance of the thermo-elastic displacement behavior increases

- Increasing requirements to the productivity
- Increase of the total installed power
- Higher heat input into the structure of the machine
- Thermo-elastic displacements at the TCP up to several 10 µm
- Need to identify, simulate, predict and compensate thermo-elastic displacements

Influencing Variables on the Thermo-Elastic Machine Behavior

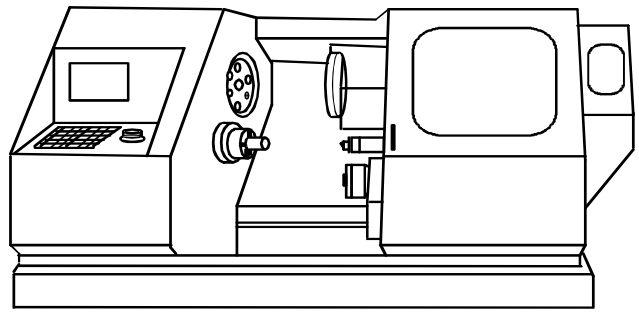
Environmental influences

Machine shop climate	■ Temperature distribution (vertical/horizontal) ■ Variations of temperature (day/night, air condition) ■ Airflow
Heat sources	■ Sun ■ Radiators ■ Neighbouring machines
Heat sinks	■ Foundations ■ Open shop gates

Machine internal influences

Machine elements	■ Bearings, guide ways ■ Ball screws ■ Motors ■ Gears ■ Hydraulic
Process	■ Cutting heat ■ Chips ■ Cooling liquid
Cooling	■ Motor/spindle cooling ■ Frame temperature control

Heat input into the structure of the machine



Material properties	**Design**
Thermal capacity Thermal conductivity	Mass distribution Location of heat sources

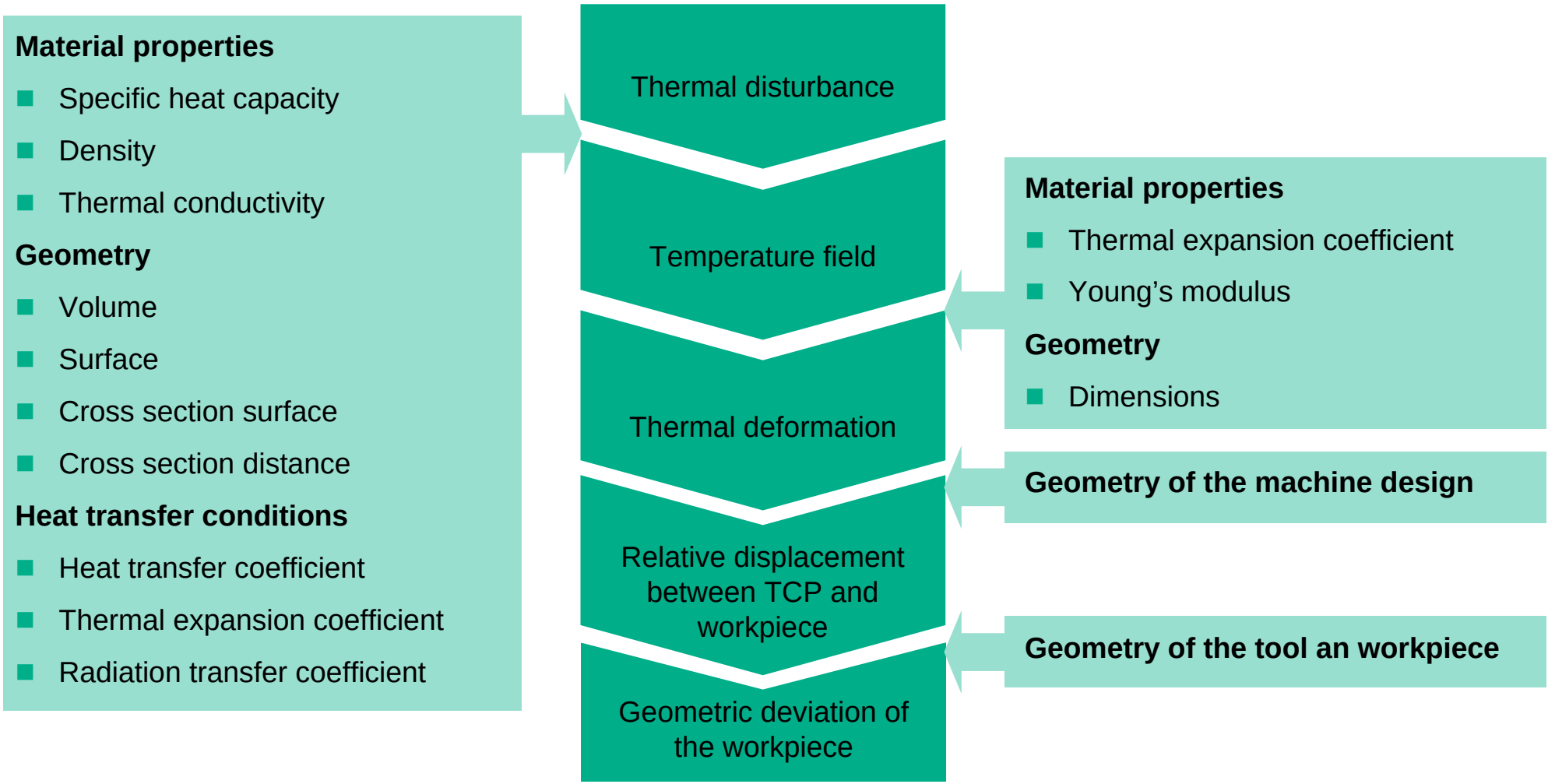
Unsteady temperature distribution, 3D temperature gradient

Kind/mounting of the position measuring system, position of components to each other, thermal expansion coefficient, active length of expansion

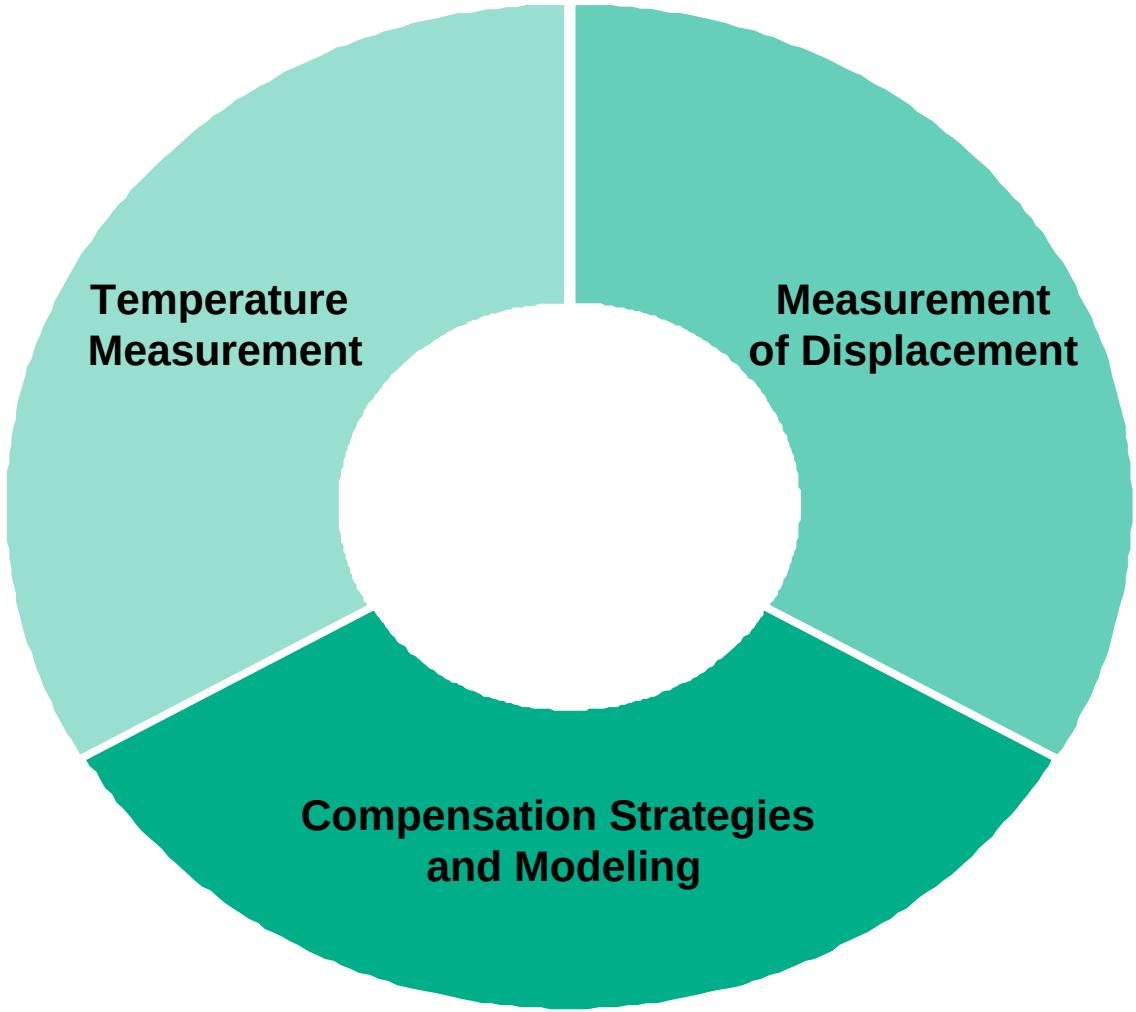
Displacements and inclinations between work piece and tool

Workpiece error

Thermal Functional Chain



Current Research Issues and White Spots



Special Interest Group on Thermal Items in Ultra Precision Machines

Goal of the SIG

- Gathering of existing knowledge and latest activities in the field of temperature as well as deflection measurement and compensation strategies
- Planning of coordinated activities for focused development under the Euspen umbrella

Time line, activities

- Preparation of a work shop in the field of “Thermal Issues for Precision Machines”
- Definition of research topics and joint proposals

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