KNOWLEDGE-BASED INSPECTION PLANNING FOR MULTI-SCALED QUALITY TESTING

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Outline

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Principal tasks of inspection planning

- Wann? (When?)
- Wie? (How?)
- Womit? (With which?)
- Wer? (Who?)
- Was? (What?)
- Inspection

Diagram showing the relationships between the tasks.
Principal tasks of inspection planning

- main parts of inspection planning are the selection of a capable measuring instrument and the configuration of adequate inspection strategies
- sensor selection in a manual way is very costly in terms of time, is based on the inspection planners know-how and can cause rough errors.

AIM: Automation of sensor selection within inspection planning
Problem definition & requirements

- multifarious and multi-scaled measuring quantities on one device under test
  
  These can not be met with the operation mode of a single sensor

- large number of inspection features on multi-scaled devices under test

- measurements in micro- and nano scale generate huge measurement data
Multi-scaled device under test

Definition of inspection features with specifications/tolerances (using CAD-data if available)

Sensor selection

Stepwise inspection planning (1)
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Stepwise inspection planning (2)

1. Sensor selection
2. Planning of the inspection strategy
3. Strategy realisable with the selected sensor?
   - No
Stepwise inspection planning (3)

1. Strategy realisable with the selected sensor?
   - Yes
     - Calculation of measurement times and costs
     - Arrangement of the inspection plan
Approach to the automation of sensor selection

- database is the foundation of the automated sensor selection of micro- and nanoscaled inspection features
- main part of necessary information on the inspection feature can be taken from the CAD-data
- sensor selection is a complex decision problem
- inspection task based measurement uncertainty should be analysed
- operation areas of several sensors should be confined in relation to their application
Acquisition of sensor-specific properties

- database with:
  - information on available sensors
  - materials and surfaces of devices under test
  - general rules to the suitability of sensors and surfaces
- definition, characterisation and classification of the inspection feature
- experiments to measurability on the available sensors
- evaluation of experimental results:
  - feasibility of the measuring task
  - capable parameter settings and inspection strategies
  - measuring condition requirements
  - expression of the measurement uncertainty
  - measuring time
- transfer of results in the database
Examples of Measurements on a Micro Lens

**lens (length = 5 mm)**

**Edge on the lens:**

**Topography view**

**Surface measurement with laser scanning microscope**

magnification: 100x

\[ l = 1.55 \mu m, \; 31.8^\circ \]
Sensor selection assistance tool

What kind of device under test?

- Established device under test
- Non-established inspection feature

Please select the measuring task!

- Measuring task not available

Please select the measuring method!

- Measuring method not available

Please select the direction sensitivity!

- Not applicable

Please characterise the surface property!

reset next finish
Concept for multi-scaled quality inspections

1. Database:
   - Concept of a database with sensor- and inspection task information

2. Knowledge-based Sensor Selection:
   - Knowledge processing
   - Information on the measuring task
   - Sensor Selection
   - Development of inspection strategies based on measuring tasks and adequate sensors
   - Knowledge-based methods for automated sensor selection multi-sensor measuring machines with regard to given tolerances

3. Inspection Strategy:
   - Inference rules
   - Knowledge processing
   - Sensor Selection

Automation of inspection planning yields to the objectification of the measurement, reduction of measurement uncertainty and measuring time as well as increase of usability and reduction of the planning effort.
Conclusion

• Concept for multi-scaled quality inspections

• Preparation of knowledge and rules for assigning of capable sensors to current inspection tasks with assistance tool for sensor selection

• Further research: methodologies for automated planning of inspection strategy and sensor parameter setting e.g. using simulations
Thank you for attention

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