Ultra Precision Encoder Technology for Position Referencing

Kai Hollstein
Supervisor: Paul Morantz

1. Background
R2R platform used for research in film embossing for wide plastic films containing micro structures. This can be used in mass production of precision film-based products (flexible displays, wall-coverings, and others).

2. Aim & Objectives
Applying encoder technology for position referencing. Necessary precision rotary control of spindle system has to be achieved and encoder patterns on plastics will be used to reference movement of the PET film.

3. Fundamentals
Reflected light method:
Scale containing alternating reflecting and absorbing lines.

Interferential method:
Phase modulation of light wave due to diffraction phenomena.

4a. Rotational Axis Control using Lithography Discs

1. The Proposed System
Head placed over disc with circumferential alternating reflective and absorbing lines.

2. Manufacturing of Discs
Lithography used to manufacture discs with chrome, aluminium and silicon.

3. Experimental Testing
Testing of signal amplitude, position accuracy, varying speed, repeatability, etc.

4. Results
Etched aluminium with highest signal amplitude. Deviation of ±10 μm (STD of ~2.5 μm). Accuracy of industrially applied linear encoder achieved.

Conclusion and Further Work
Applicability of lithography discs has been shown (testing with final system needed). Downscaling of period necessary to achieve higher accuracies.

4b. Position Referencing of Linear Plastic Film Movement

1. Concept Study
Using plastic film as diffraction grating and placing amplitude mask behind will generate demanded signals.

2. Simulation of System
Analysing grating design and system behaviour for varying parameters (grid position, manufacturing tolerances, etc.).

3. Experimental Testing
Film with 16 μm period and 690 nm step height. Analysed parameters: Position of grid, light intensity, repeatability, amplitude period, etc.

4. Results
Accuracy of ±200 nm achieved, average maximum deviation of ±500 nm. Good repeatability shown.

Conclusion and Further Work
Suitability has been demonstrated. Further parameter evaluation has to be done and final setup has to be developed.