

Ultra Precision Encoder Technology for Position Referencing

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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).

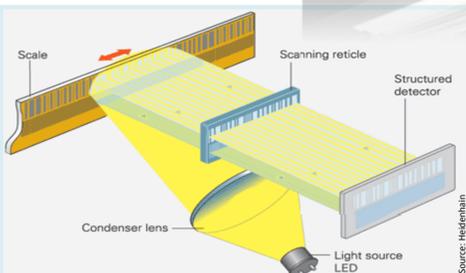


2. Aim & Objectives

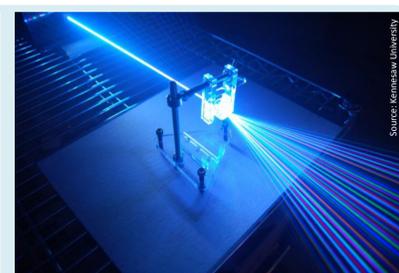
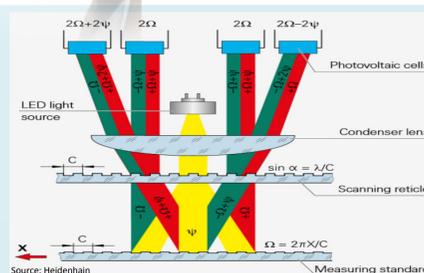
Applying encoder technology for position referencing. Necessary precision rotary control of spindle system has to be achieved and encoder patterns on plastics will be used to reference movement of the PET film.

3. Fundamentals

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



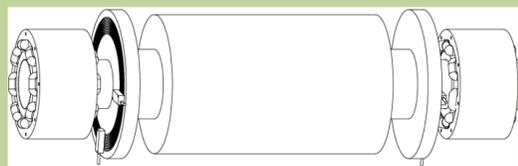
Interferential method:
Phase modulation of light wave due to diffraction phenomena.



4a. Rotational Axis Control using Lithography Discs

1. The Proposed System

Head placed over disc with circumferential alternating reflective and absorbing lines.



Assembly of spindle system with magnetic bearing

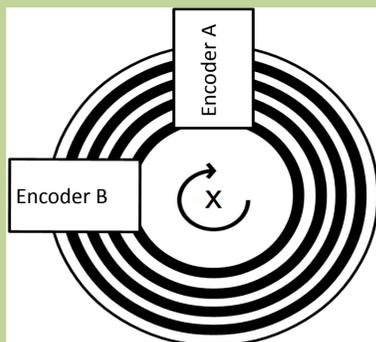
2. Manufacturing of Discs

Lithography used to manufacture discs with chrome, aluminium and silicon.



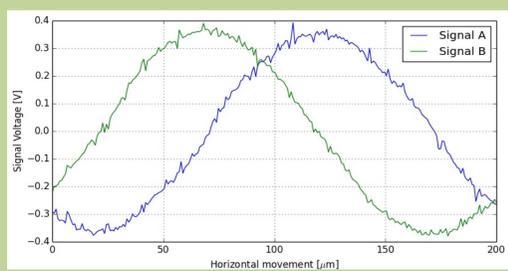
Chrome lines on glass

Aluminium with etched lines



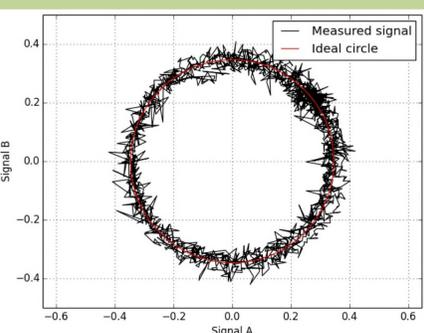
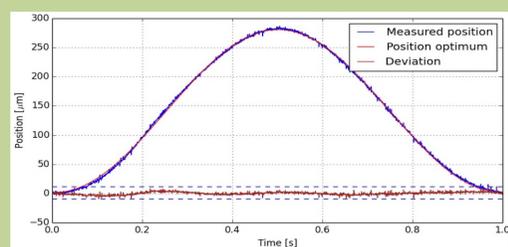
3. Experimental Testing

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



4. Results

Etched aluminium with highest signal amplitude. Deviation of $\pm 10 \mu\text{m}$ (STD of $\sim 2.5 \mu\text{m}$). Accuracy of industrially applied linear encoder achieved.



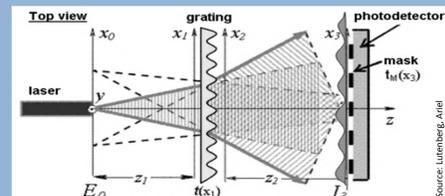
Conclusion and Further Work

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

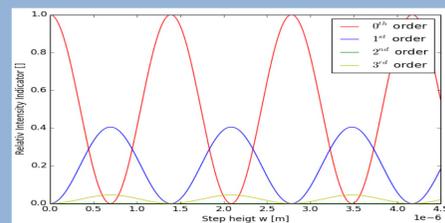
1. Concept Study

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



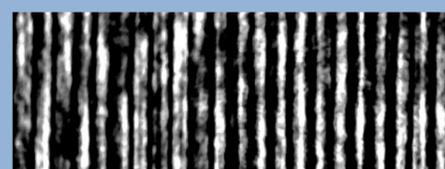
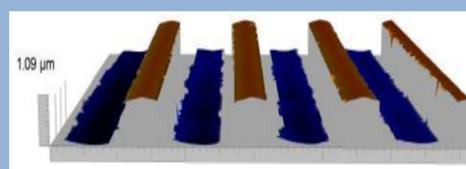
2. Simulation of System

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



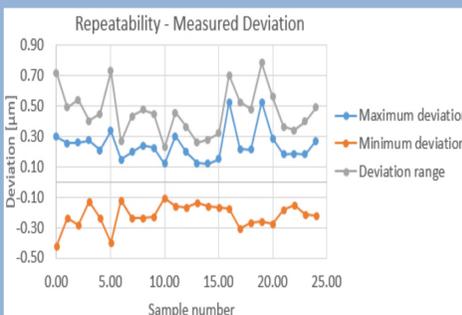
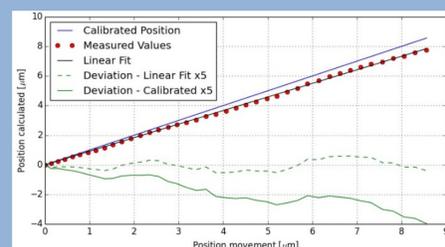
3. Experimental Testing

Film with $16 \mu\text{m}$ period and 690 nm step height. Analysed parameters: Position of grid, light intensity, repeatability, amplitude period, etc.



4. Results

Accuracy of $\pm 200 \text{ nm}$ achieved, average maximum deviation of $\pm 500 \text{ nm}$. 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.