Measurement and characterisation of micro/nano-scale structured surfaces

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Introduction

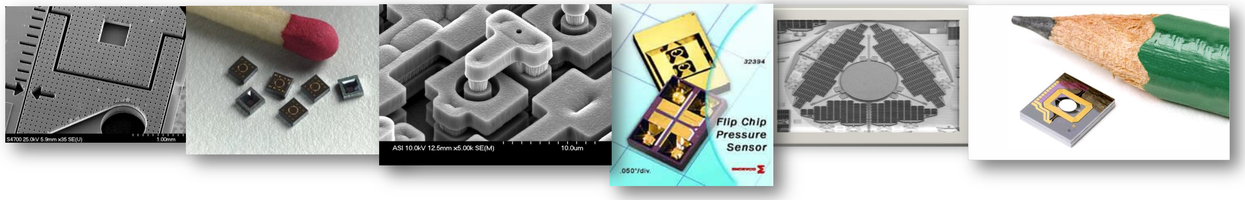
This project aim to investigate basic surface metrology techniques for micro/nano-scale structured surfaces, especially MEMS surfaces. The project will focus on developing a methodology for preparing and conducting the measurement of MEMS surfaces, and further more to study the pattern recognition and characterisation of basic geometry specification of those micro-structures.

Aim

The principle objectives are as follows:

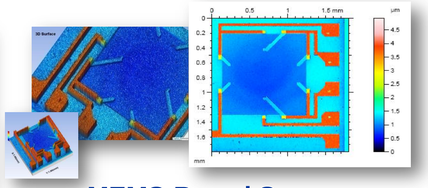
1) Develop a thorough understanding of requirement and measurement preparing for micro-structured surface.
2) Develop a practical guide of measurement of micro/nano-scale structured surfaces.
3) Investigate morph-network techniques for separating those features with consideration of the measurement noise influence.
4) Develop the characterisation for those micro-structures in the light of the latest ISO standard for surface feature parameters.
5) Establish the pattern recognition and matching between the designing and evaluating of the micro-structured features.

MEMS Micro-structured Surface

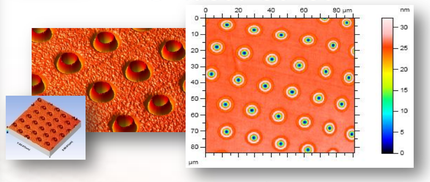


Instrument & Measurement Data

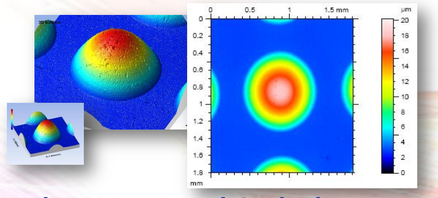
- ***0.01nm Vertical Resolution***
- ***Quantitative 3D (Areal) Results***
- ***Non-destructive Testing***
- ***High Gauge Repeatability***
- ***Low Noise Measurements***
- ***Measurements Traceable to International Standards***



MEMS-Based Sensor



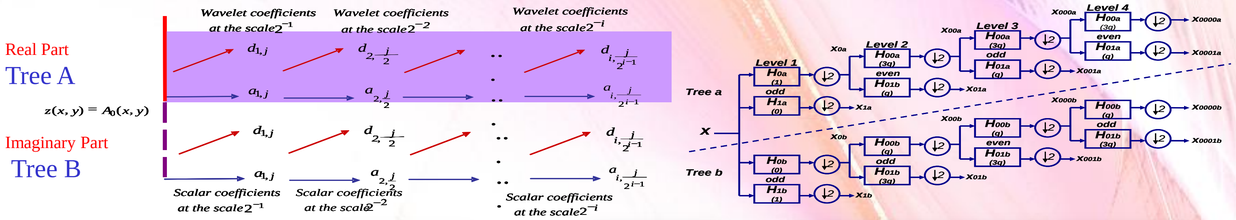
Hard disk surface

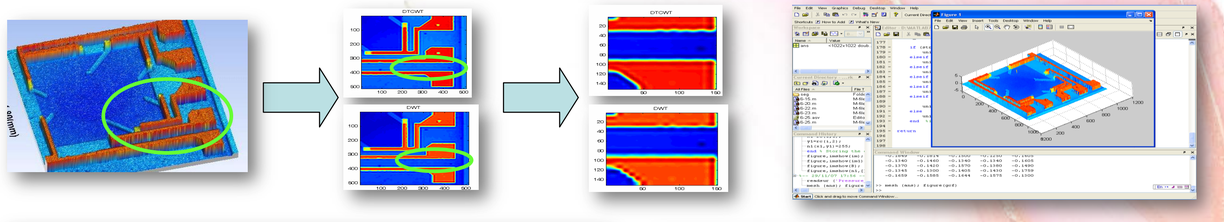


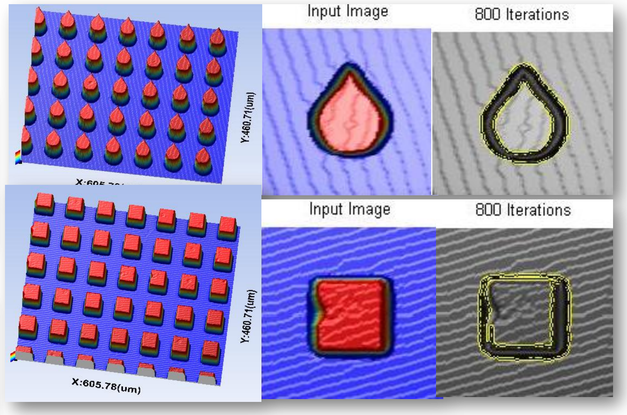
Micro-structured Optical Arrays

Experimental Results

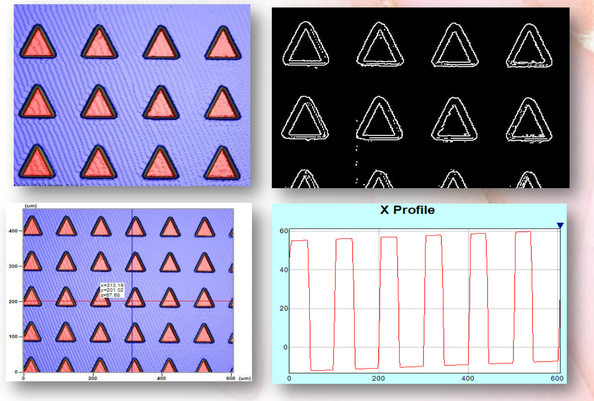
A new method for extraction of direction/objective morphological features of surfaces is proposed using a biorthogonal dual tree complex wavelet transform. It attempts to give affine invariance, with independence of the reference frame for the measurements, and also perfect reconstruction, limit redundancy and have efficient computation.







Micro-scale Features Extracted by Active Contour



Edge Detected by Sobel Operator

Conclusions

- A practical measurement scheme is designed for micro/nano scale structured surface, learned the instrumentation operation skill, especially Talysurf CCI System.
- A characterisation method based on wavelet transform is developed and used in surface analysis successfully.
- Established the characterisation method of micro/nano scale structured surface and establish the geometrical fundamental of typical micro/nano structures.
- Some techniques based on the image processing was investigated in surface analysis, for example, edge detection based on Sobel operator.

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