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A Fast Algorithm for Morphological Filters

Shan Lou, Prof. Xiangqian Jiang and Prof. Paul Scott
Centre for Precision Technologies, Computing and Engineering

University of HUDDERSFIELD

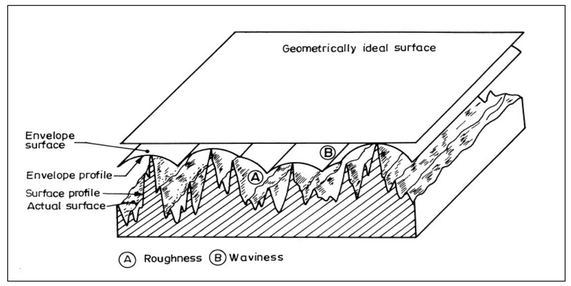
Introduction

Morphological filter, as one of filters in surface metrology, is done by rolling a disk (a ball) over profile (surface).

Compared to other filters, morphological filters are believed to give better results in function prediction of surface finish in the analysis of surfaces in contact.

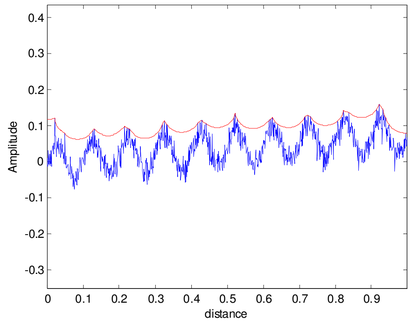
Merits

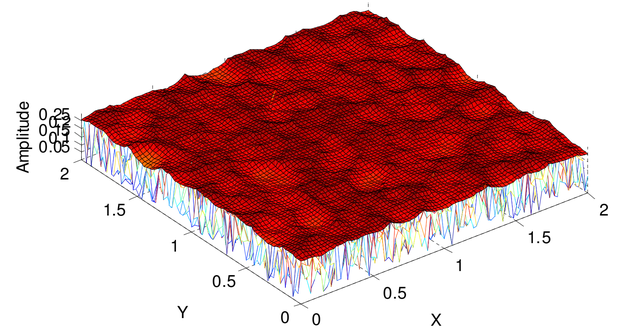
- Definition of mechanical surface.
- Simulates contact phenomena.
- No need to remove form.
- Random data spacing possible.
- Faster than Gaussian.



Examples

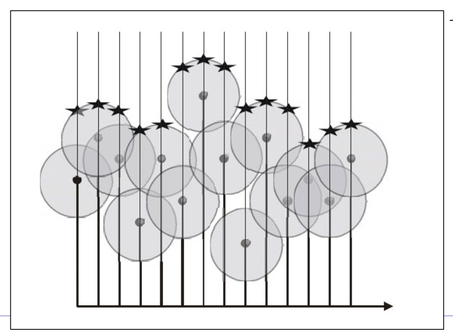
Two examples are presented to demonstrate the morphological closing filters on the profile and the surface. The running time data shows that the proposed algorithm is much faster than the naive algorithm.





Naive algorithm

The naive algorithm is done by putting the origin of the structuring element at every sampling positions[1], as illustrated for a few positions of a circular structuring element for dilation in the figure. Extreme value at each sampling point is then collected and these are reported as the output.



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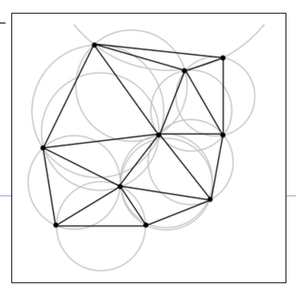
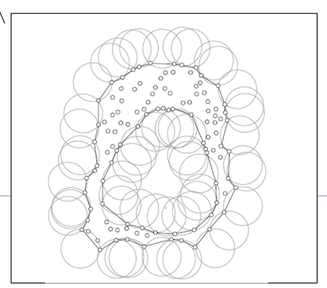
Fast algorithm

The proposed fast algorithm employs alpha shape[2] as the basis of the computation. The boundary of the hull obtained by rolling the alpha ball over the point set is identical to the closing/opening envelope in theory. The steps are listed as follows:

i. Pre-process.
ii. Delaunay triangulation.
iii. Alpha shape.
iv. Envelop calculation.





Conclusion and feature work

A fast algorithm for morphological filter is proposed. The data shows the fast algorithm is much efficient than the naive one.

Feature work includes:

- Develop the continuous algorithm.
- Apply morphological filters to wolf pruning.

References

[1] ISO/DTS 16610: Geometrical Product Specification (GPS)-Filtration, 2005.
[2] H. Edelsbrunner, E. P. Mucke. Three-dimensional alpha shapes. ACM Trans. Graph., 13, 1994.