



ReguAarity – An open-source software for the quantification of the regularity of periodic surface structures

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The precise laser-based surface structuring on the micro- and nanoscale allows to create functional properties for innovative applications, e.g., in medicine, optics and biology [1]. Among the various types of surface structures, *laser-induced periodic surface structures* (LIPSS) are characterized by their versatility and the relatively simple manufacturing process. However, the fabrication of highly regular LIPSS patterns remains challenging.

The systematic investigation of LIPSS formation, as well as of the resulting functional properties requires a precise evaluation of the surface morphology, especially with regard to periodicity and regularity [2]. Existing quantification methods such as Fast Fourier Transformation (FFT) tend to lack automation and objectivity, especially when dealing with large data sets and multi-scale structures. Although automated approaches exist with the Gini coefficient [2] and the P³S method [3], their limited availability restricts a broader scientific use.

We therefore introduce *ReguAarity* as an innovative open-source software solution for objective, rapid and reproducible evaluation of structured surfaces concerning their regularity. In order to provide comprehensive surface morphological analysis, our software uses advanced image-processing techniques and integrates the already developed tools such as P³S method, Gini coefficient, FFT analysis, and the calculation of DLOA (Dispersion of LIPSS Orientation Angle). The software allows to evaluate any relevant image format as provided, e.g., by standard scanning electron micrographs. An intuitive PyQt5-based interface, enhanced by multi-threading capabilities, facilitates efficient data processing. Interactive features such as region-of-interest selection and plotting provide flexible adaptation to diverse applications. *ReguAarity* offers a robust analysis tool that will contribute to the further development of precise laser-based surface structuring and to the optimization of the desired functional properties in both research and industry.

Acknowledgements: This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project Number 530345255.

References:

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