SURF-FIT: A universal fitting method for structured surfaces

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Abstract

Most existing fitting methods are designed for two-dimensional profiles or they are task-specific, e.g., they are often designed for one specific type of surface. In this paper, we present SURF-FIT, a universal fitting method for structured surfaces. SURF-FIT is a generic method that can be universally used for any type of structured surface (sinusoidal, triangle, square, cylindrical, spherical, to name a few), as long as the surface is deterministic and can be represented digitally (generally using point cloud data). The structures can be repeated in one or two dimensions. The SURF-FIT method can fit the measured three-dimensional point clouds to find the best-fitted surface defining parameters such as pitch, height and radius that are used to define the structured surfaces. With the information on the fitted surface defining parameters, we can potentially have a better understanding of both the manufacturing and the measurement processes. Moreover, the fitted parameters can lead to more accurate results than those obtained using the nominal values, and potentially gain improved performance in actual applications. Using a relatively large surface, the proposed method can also provide global information on the surface defining parameters, as opposed to just providing local values, by examining the parameters from a specific profile or single feature. Hence, the results include statistical features of the surface rather than just a single profile or a specific part of the sample. By combining measurement noise and outlier removal methods, the proposed method gives more accurate and reliable results for further characterisation and analysis of the surfaces. The method can also be used to evaluate parameters for complex multiscale structured surfaces. SURF-FIT will be designed as standalone software, integrated into commercially available software, or as an add-on function added to the software that comes with surface measurement instruments. The integration of this method in the measurement pipeline will allow the evaluation of the surface defining parameters conveniently, after the measurements from the instruments, without additional processes.
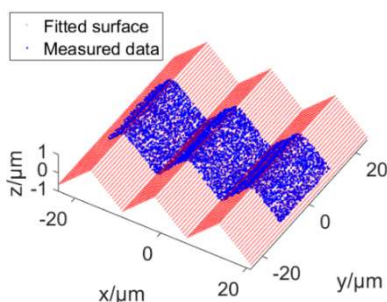
Figure 1: An example of a fitted structured surface using measured AFM data, the structured surface is a sawtooth grating, the fitted pitch and height of the sawtooth grating are 14.92 µm and 1.51 µm, respectively, where the nominal values provided by the manufacturer are 15 µm and 1.6 µm, respectively.