Uncertainty evaluation for three-dimensional scanning electron microscope reconstructions based on the stereo-pair technique

3D-SEM is a method, based on the stereophotogrammetry technique, which obtains three-dimensional topographic reconstructions starting typically from two SEM images, called the stereo-pair. In this work, a theoretical uncertainty evaluation of the stereo-pair technique, according to GUM (Guide to the Expression of Uncertainty in Measurement), was carried out, considering 3D-SEM reconstructions of a wire gauge with a reference diameter of 250 µm. Starting from the more commonly used tilting strategy, one based on the item rotation inside the SEM chamber was also adopted. The latter enables multiple-view reconstructions of the cylindrical item under consideration. Uncertainty evaluation was performed starting from a modified version of the Piazzesi equation, enabling the calculation of the z-coordinate from a given stereo-pair. The metrological characteristics of each input variable have been taken into account and a SEM stage calibration has been performed. Uncertainty tables for the cases of tilt and rotation were then produced, leading to the calculation of expanded uncertainty. For the case of rotation, the largest uncertainty contribution resulted to be the rotational angle; however, for the case of tilt it resulted to be the pixel size. A relative expanded uncertainty equal to 5% and 4% was obtained for the case of rotation and tilt, respectively.

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