 https://doi.org/10.1051/bioconf/202412902001

SEM-micro-photogrammetry and stereo reconstruction on the Tescan Amber X electron microscope

Evgenii Modin[1], Andrey Chuvilin
[1]CIC NanoGune BRTA, San Sebastian, Spain

Three-dimensional imaging techniques are widely demanded in various fields including science, medicine, engineering, architecture, and art [1,2]. Combining these techniques with scanning electron microscopy capabilities yields interesting results and extends the capabilities of scanning electron microscopy beyond two-dimensional imaging, opening up new applications. In our lab, we are exploring the potential of scanning electron microscopy to investigate the three-dimensional surface morphology of a variety of complex objects, from the surface of construction materials to the spatial geometry of micromachined parts and marine organisms.

One of the methods of three-dimensional reconstruction is photogrammetry, which has been actively used in recent decades, especially in the field of geodesy. Another method under study is stereoscopy, which uses a sophisticated algorithm to calculate the surface profile from a pair of images acquired at different tilt angles.

We use automatic data acquisition on the Tescan Amber X instrument thanks to the support of Python scripts (Shark SEM Advanced). It is shown that even quite large objects are suitable for correct scanning without the need for image stitching. Further, the Structure from Motion photogrammetry methodology implemented in AliceVision Meshroom and AgiSoft Metashape software packages is used to calculate three-dimensional models. However, it should be noted that this method requires not only an accurate dataset, but also significant computational resources. Ongoing work in this area explores the use of neural network-based neural radiance fields (NERFs) for on-the-fly reconstruction [3].

The stereoscopic method reconstructs the surface profile from two photographs taken at different sample angles, typically ±5 degrees or close to it. Unlike the implemented algorithms available in the literature and well-known commercial packages, our software can use gigapixel images, allowing the characterization of millimeter-scale regions with nanometer resolution and thus meeting and exceeding the ISO 4287-1997 standard in surface topography characterization.

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

1. Drofova, I.; Guo, W.; Wang, H.; Adamek, M. Use of Scanning Devices for Object 3D Reconstruction by Photogrammetry and Visualization in Virtual Reality. Bull. Electr. Eng. Inform. 2023, 12, 868–881.
2. Scianna, A.; La Guardia, M. Survey and Photogrammetric Restitution of Monumental Complexes: Issues and Solutions—The Case of the Manfredonic Castle of Mussomeli. Heritage 2019, 2, 774–786.
3. Pepe, M.; Alfio, V.S.; Costantino, D. Assessment of 3D Model for Photogrammetric Purposes Using AI Tools Based on NeRF Algorithm. Heritage 2023, 6, 5719-5731.

Keywords:

3d, surface reconstruction, photogrammetry