Photogrammetry to create 3D images from a 2D scanning electron microscope

Richena, M.[1] and Harland, D.[1]

[1] AgResearch, New Zealand

Three-dimensional (3D) imaging is an important part of structural analysis. While scanning electron microscopy (SEM) gives an impression of a sample's external morphology, it is not true 3D data.

A new approach was developed to obtain 3D imaging using a manual tilt-rotate stage inside a standard benchtop SEM. Various biological samples (e.g., wool fibres and arthropods) were prepared as for routine SEM imaging. That is, attached to conductive metal stubs with carbon tape and sputter coated with gold. Secondary electron images were obtained using a benchtop TM3030Plus (Hitachi, Japan) scanning electron microscope, operating at 15 kV. Multiple micrographs were acquired from different directions and angles, using a small tilt-rotate stage. Then virtual 3D models were reconstructed from upwards of 150 separate micrographs by matching individual points from multiple images in 3D space using photogrammetry software. The resulting 3D models could be then analysed to measure specific 3D aspects of morphology or even edited to allow us to 3D print giant versions of microscopic structures! This new approach can contribute in different research topics, for example, studies of along-fibre variation in human hair and wool, analysis of plant-endophyte interactions and food structure analysis.