IJAE
Vol. 122, n. 1 (Supplement): 178, 2017
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

The quest for the third dimension: from the Electron Microscope to the 3D printer

Mario Raspanti, Marcella Reguzzoni and Marina Protasoni

Dipartimento di Medicina e Chirurgia, Università dell'Insubria, Varese

Conventional light microscopy (LM) and transmission electron microscopy (TEM) are meant to image planar sections, i.e. bidimensional specimens, and are therefore constrained into a bidimensional world. In contrast, the scanning probe microscopy (SPM) and scanning electron microscopy (SEM) are able to image surfaces, i.e. three-dimensional subjects. Of these techniques, SPM has the additional advantage of directly obtaining three-dimensional datasets from three-dimensional specimens, although this ability is seldom exploited. The SEM is *per se* limited to 2D pictures of 3D subjects, but its flexibility and performance make possible to re-obtain the third dimension indirectly.

A first, simple, time-proven approach is stereophotography. This makes possible an immediate visual appreciation of depth and volume but does not allow quantitative measurements.

A subsequent approach is represented by shape-from-stereo reconstruction, which builds a quantitative computer model of the specimen. This is now a consolidated technique and several solutions, both hardware- and software-based, are readily available. Although limited to the development of 2 ½ dimensions, rather than real 3D, this technique is simple and effective and for several years the authors have used a proprietary package [1] featured in a number of published papers.

More recently a new generation of shape-from-motion or shape-from-video photogrammetric software [2] makes possible the full recovery of the third dimension, complete with undercuts and texture mapping.

All these techniques are now complemented and extended by the availability of inexpensive three-dimensional printers. Going beyond visual appreciation and beyond computer graphics, this technique makes possible to obtain a tangible, material model of the specimen. 3D printing is already in use for educational purposes but can be effectively deployed also in morphological research, making possible to obtain highly magnified, accurate copies of microscopic structures such as molecules, cells and interfaces, adding to the visual appreciation the immediacy of the tactile experience. A few examples are shown.

References

[1] M.Raspanti et al., Microscopy Research & Technique 67, 1-7, 2005
[2] https://en.wikipedia.org/wiki/Comparison_of_photogrammetry_software.

Keywords

Microscopy, photogrammetry, 3D reconstruction, 3D printing