The 1st JAIST World Conference (JWC2018)
at JAIST, February 27-28, 2018

3D acquisition and physical replication of biological microstructures

JOSEPHINE GALIPON[1,*]

[1]*Keio University Institute for Advanced Biosciences (IAB), Tsuruoka, Yamagata, 997-0017, Japan*
*e-mail: jgalipon@ttck.keio.ac.jp

Keywords: microscopy, 3D printing, biomimetics, bioprinting, data visualization

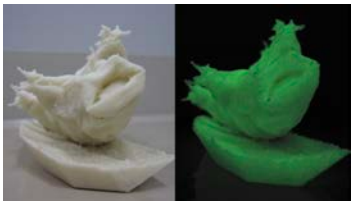

Figure 1. 3D printed microCT[2] data of *Milnesium tardigradum* in a phosphorescent material, mimicking the experience of using a fluorescence microscope.

Recent technology has enabled high-resolution analysis of microscopic structures in 3D[1], for example laser confocal scanning, 3D structured-illumination (SIM), scanning electron (SEM) microscopy, X-ray microtomography (microCT), or even nanoCT. On the other hand, most publications do not append raw data files for other scientists to re-use. Therefore, in the long term, this data is mostly lost to the next generation of scientists. This is already happening to data from older techniques such as the microtome, that acquires physical micro-sections of samples. Here, we propose 3D printing as both a solution to the data sharing problem, and a portal to advances in the fields of biomimetics, haptics, and science education.

Microscopy data is generally displayed in 16-bit greyscale or full-scale RGB color, but it is necessary to convert this data to binary to for material deposition by a 3D printer. Furthermore, microscopy data may come in a variety of formats depending on the technology used. Accurate models were successfully 3D printed from laser confocal scanning, SEM, and microCT data and the corresponding data transformations and applications will be presented. Another subject that will be discussed is 3D printing of large models containing sub-millimeter features. Finally, we are also working on the reconstruction of older microtome-based microscopy data using machine learning, and will present some of our latest results.

Acknowledgement This project is financially supported by research funds from the Yamagata prefectural government and the City of Tsuruoka, a GPU Seed Grant from Nvidia, and generous donations to our crowdfunding campaign (Academist.jp). We also thank Ultimaker, Inc. for awarding us the 2017 Ultimaker Education Challenge prize related to this research.

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