

Harnessing the Power of the Crowd for Bioimage Analysis

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Many different imaging modalities now routinely produce huge amounts of data thanks to increased acquisition speeds and extensive automation. Whilst computational image analysis techniques are constantly improving, it is often necessary to use manual analysis to some degree, in particular to provide ground truth annotations in order to train machine learning systems such as convolutional neural networks.

Volume electron microscopy techniques, such as serial block face SEM (SBF SEM), focused ion beam SEM (FIB SEM) and array tomography (AT) [1], produce datasets in the terabyte regime. In many cases, much of the analysis is still performed manually, which represents a major bottleneck in the workflow, restricting the amount of information that can be extracted from these rich datasets. Furthermore, single manual annotations may be prone to subjectivity that is not meaningfully encoded in the binary segmentation. To attempt to address these problems, we collected benchmark volume EM data from resin-embedded HeLa cells [2], and built a citizen science platform ‘Etch a Cell’ [3] on the Zooniverse platform [4] to procure segmentations from a distributed set of volunteers. So far, the project has over 5000 contributors from around the world, with over 100,000 individual segmentations. By aggregating several non-expert contributions per image, we are able to reconstruct expert-level segmentations with additional information about the confidence of each pixel identification. The project will provide a set of general tools that will enable other labs to incorporate crowdsourcing into their workflows for segmentation and other types of image analysis.

Beyond the research applications, we have also found the project to be an effective outreach and education tool, letting students and non-experts gain an insight into the scientific process at the raw data level [5].

References:

[1] CJ Peddie and LM Collinson, *Micron* **61** (2014), p. 9.

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[3] Etch a Cell, tinyurl.com/etchacell (accessed March 6th, 2019).

[4] C Lintott et al., *Mon.Not.Roy.Astron.Soc.* **389** (2008), p. 1179.

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Etch a Cell

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Welcome to Etch a Cell. Help us learn more about the structures that make up cells!

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"Going Nuclear" has 10 nanometre pixel size from a serial block face SEM. "Going Nuclear: Zoom!" has 5 nanometre pixel size from a serial block face SEM. "Going Nuclear: Stay Focused!" has 5 nanometre pixel size from a focused ion beam SEM

Going Nuclear Going Nuclear: Zoom! Going Nuclear: Stay focused!

4 people are talking about Etch a Cell right now.

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ETCH A CELL STATISTICS

57% Complete

5,322	116,143	5,251	2,670
Volunteers	Classifications	Subjects	Completed Subjects

Figure 1. The Etch a Cell interface on the Zooniverse platform, which currently hosts three projects whose aim is to segment the nuclear envelope from HeLa cells imaged using SBF SEM and FIB SEM.