

# Learning Split and Merge Errors in Electron Microscopy Cell Segmentations to Assist Connectomics Proofreading

Daniel Haehn<sup>1,2</sup>, Verena Kaynig-Fittkau<sup>1,2</sup>, James Tompkin<sup>1</sup>, and Hanspeter Pfister<sup>1,2</sup>

<sup>1</sup> Harvard Paulson School of Engineering and Applied Science, and

<sup>2</sup> Harvard Center for Brain Science, Cambridge MA 02138, USA

**Abstract.** Automatic image segmentation methods for cells can lead to *split errors*, where one cell is accidentally labeled as two or more, and to *merge errors*, where two or more cells are accidentally labeled as one. We develop two classifiers which, given an input image and a candidate set of cell labelings, are able to identify split and merge errors in the segmentation. These classifiers are informed by supervised training of a convolutional neural network: from expert-labelled ground truth segmentations, and their corresponding input images and edge probabilities, we synthetically generate plausible split and merge errors as training. We design a new network architecture which is able to determine a true edge with high accuracy by considering a wider uncertainty region around an edge as an additional input to the network. We demonstrate the application of this approach to proofreading of electron microscopy image segmentations for connectomics, where our system is able to automatically correct many errors, and otherwise prioritize a list of edges to which a human should direct their attention for manual correction.

**Keywords:** Segmentation, convolutional neural networks, connectomics.

## 1 Introduction

## 2 Related Work

People tried this for 3D! [?].

## 3 Method

## 4 Evaluation

## 5 Application

## 6 Discussion

## 7 Conclusion