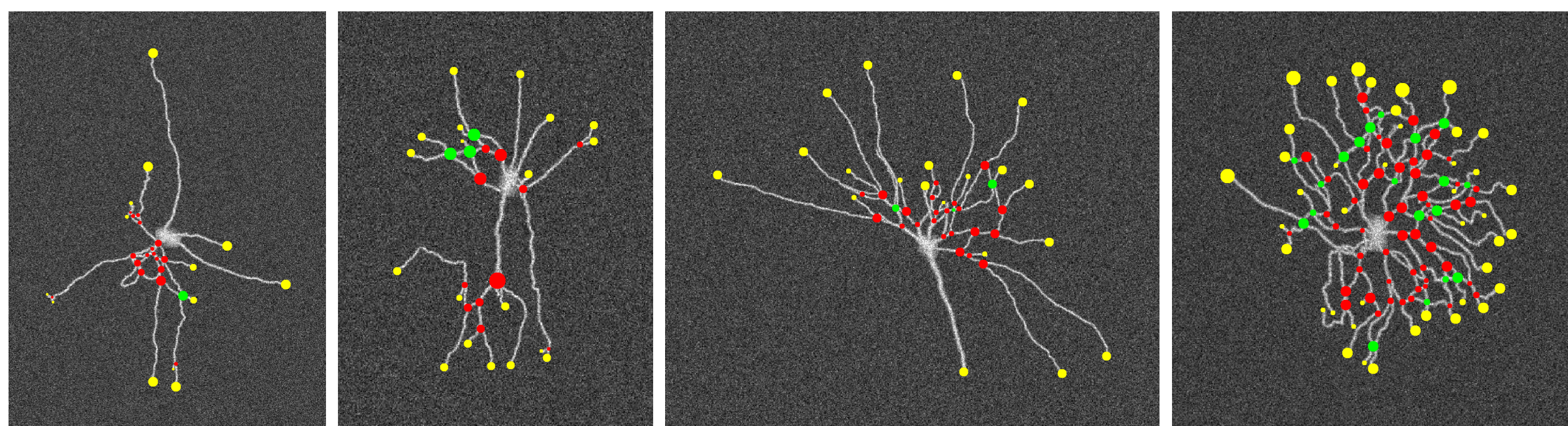


# A NOVEL METHOD AND OBJECTIVE EVALUATION OF CRITICAL POINT DETECTION IN NEURON MICROSCOPY IMAGES

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## Introduction

Neuronal morphology carries important information on the functionality of the neuronal network. The development of methods for reconstructing neuronal morphology is an ongoing challenge [1]. Important clues in extracting and representing the tree-like structures of neuronal cells are junctions and end-points.

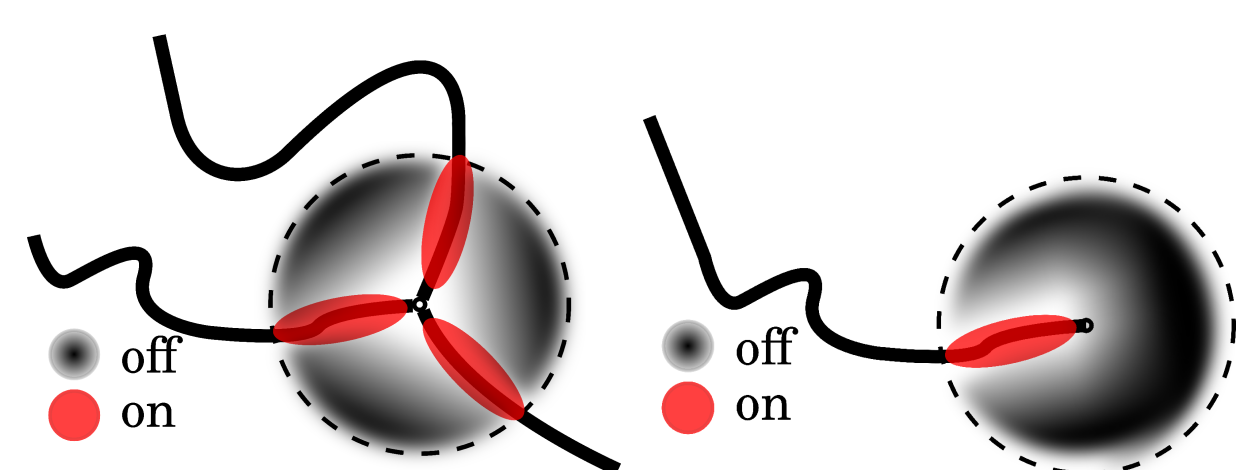
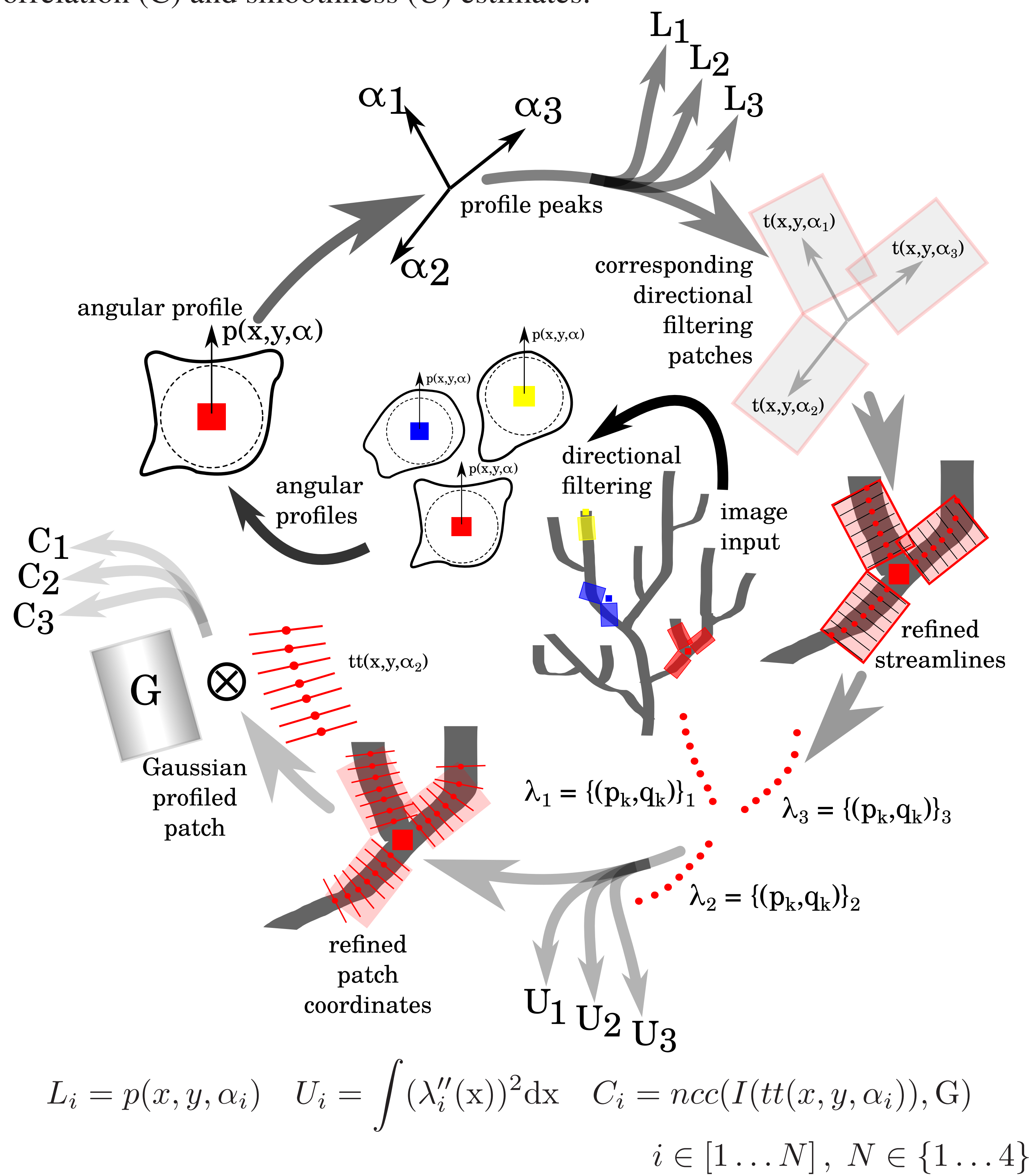


Critical points (CP): junctions (**bifurcations, cross-overs**), **end-points**.

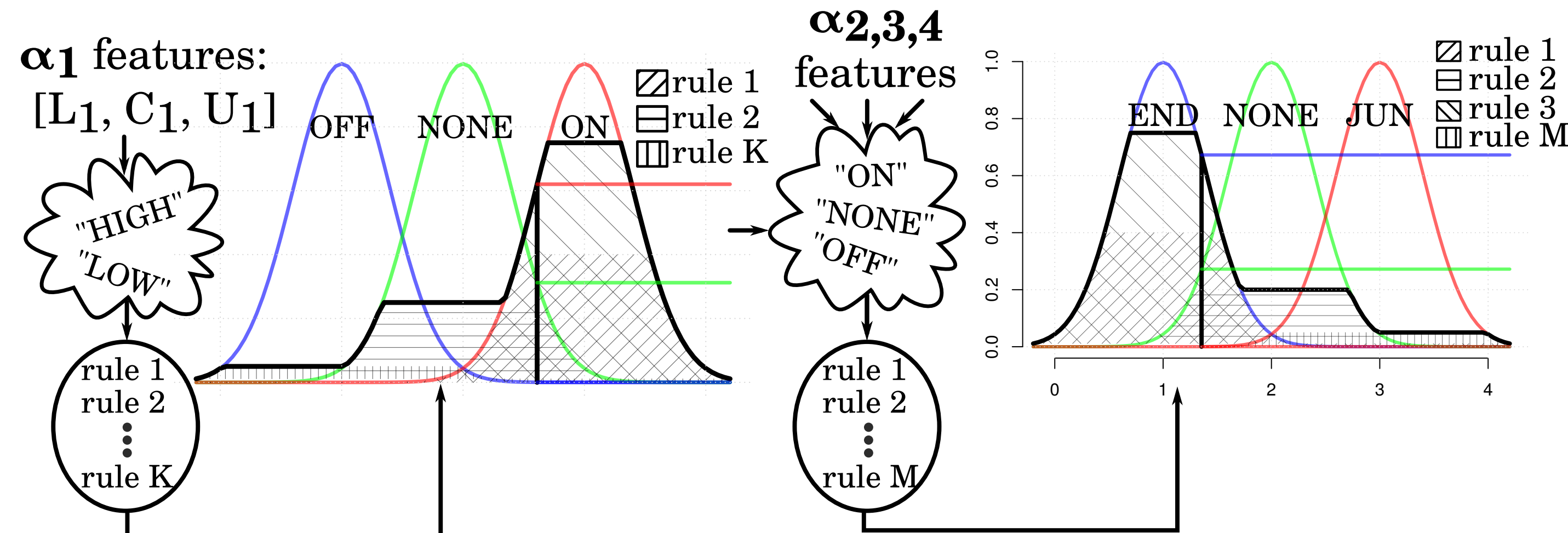
We propose novel **detection method** and novel **scheme for objective performance evaluation**.

## Detection Method

**Feature extraction:** directional filtering and optimization yield likelihood ( $L$ ), correlation ( $C$ ) and smoothness ( $U$ ) estimates.

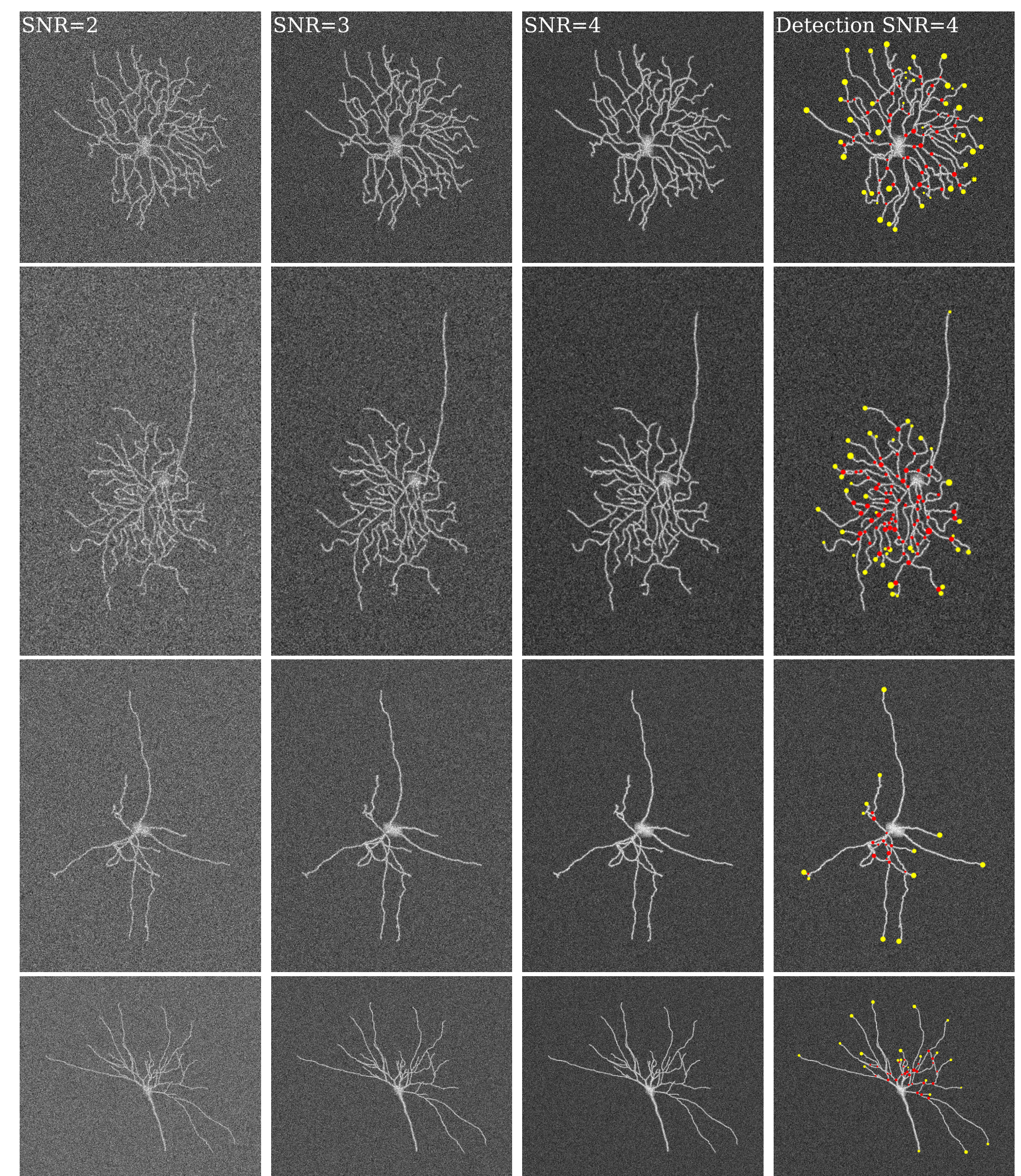


**Detection:** Fuzzy-logic system [3] employs the set of rules to fully automatically find and classify the critical points



## Performance Evaluation Scheme

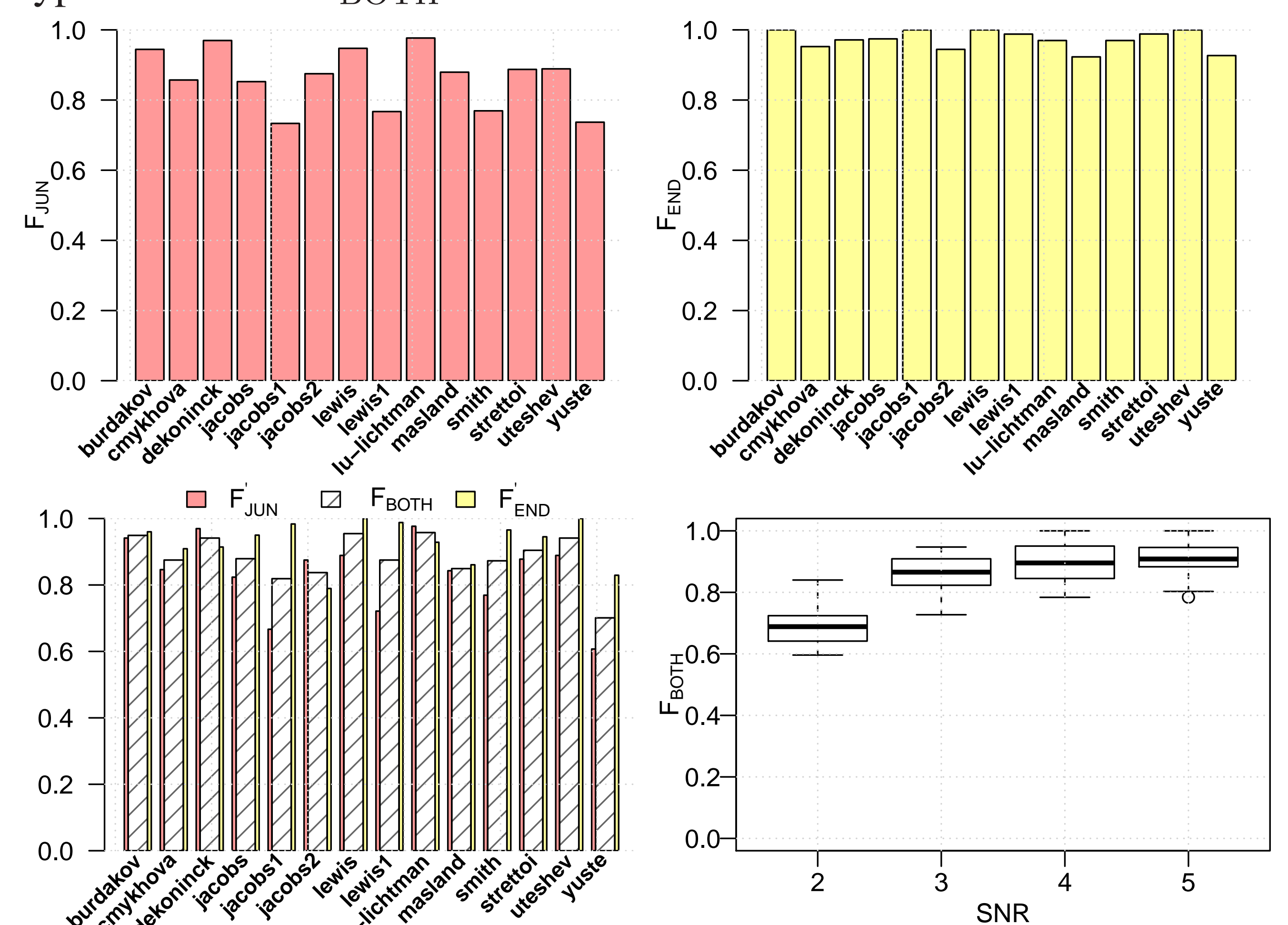
Real neuron images often exhibit high complexity, limited resolution, and low SNR. Hence the detailed manual annotation becomes subjective and error-prone.



Neuron images are formed using existing reconstructions and simulating the imaging process. Expertly curated reconstructions are publicly available from NeuroMorpho.Org [2]. Fluorescence microscopy imaging can be simulated at different SNR levels, resulting in highly realistic neuron images with exact ground truth.

## Results

Counting the number of hit/missed critical points at SNR=4, we found that our detection scheme has a median F-score of 0.87 for junctions and 0.97 for end-points if detected separately. Combined detection (both types in one go) F-score is  $F_{BOTH} = F(F'_{JUN}, F'_{END})$  where  $F'$  denotes the component F-score for one CP type. Median of  $F_{BOTH}$  is 0.88.



## References

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- [3] J. M. Mendel, "Fuzzy logic systems for engineering: a tutorial," *Proceedings of the IEEE*, vol. 83, no. 3, pp. 345–377, 1995.