

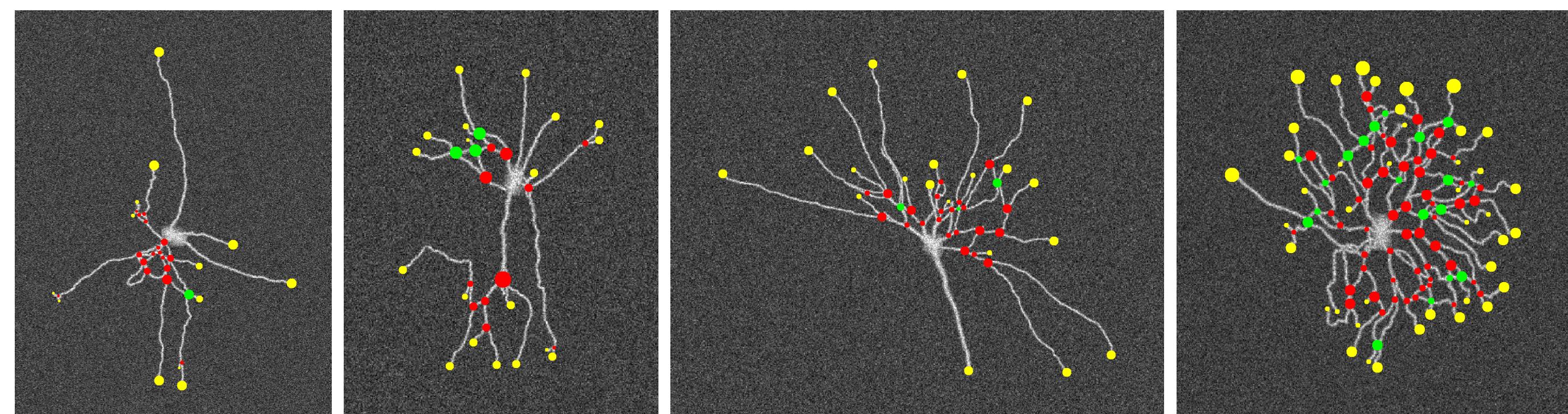
A NOVEL METHOD AND OBJECTIVE EVALUATION OF CRITICAL POINT DETECTION IN NEURON MICROSCOPY IMAGES

Miroslav Radojević, Ihor Smal, Erik Meijering

Biomedical Imaging Group Rotterdam, Departments of Medical Informatics and Radiology
Erasmus MC – University Medical Center Rotterdam, The Netherlands

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.

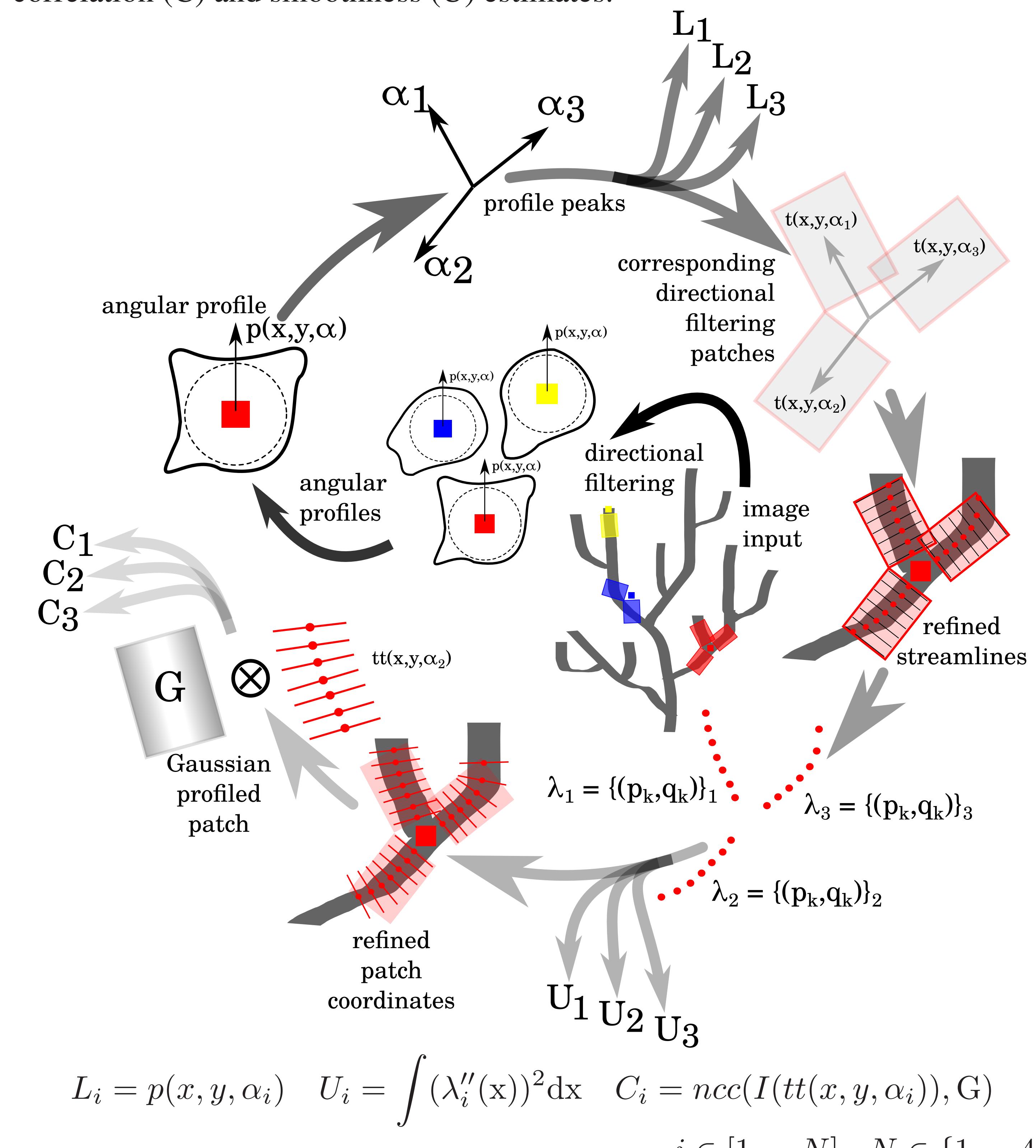


Critical points (CP): junctions (bifurcations, cross-overs), end-points.

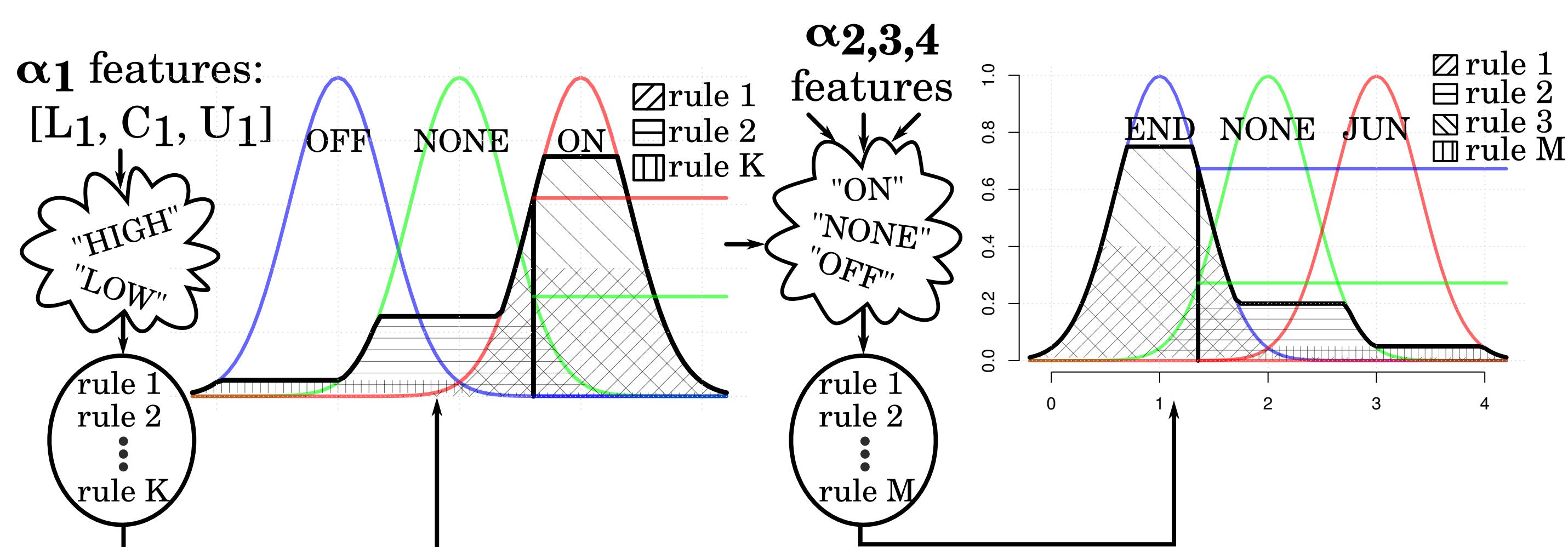
We propose novel **detection method** and novel **scheme for objective performance evaluation**.

Detection Method

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

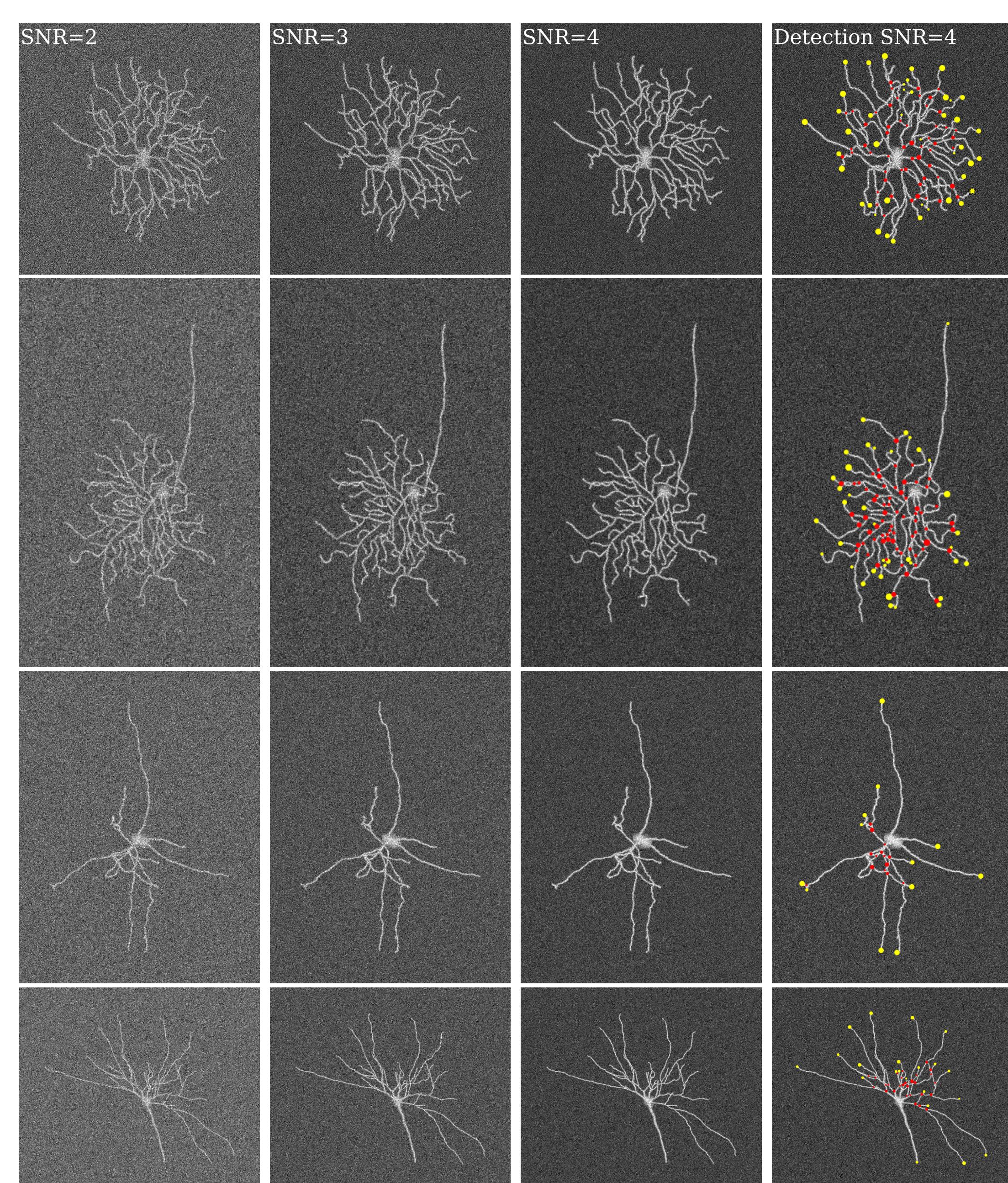


Detection: Fuzzy-logic system [3] employs the set of rules to fully automatically find and classify the critical points



Performance Evaluation Scheme

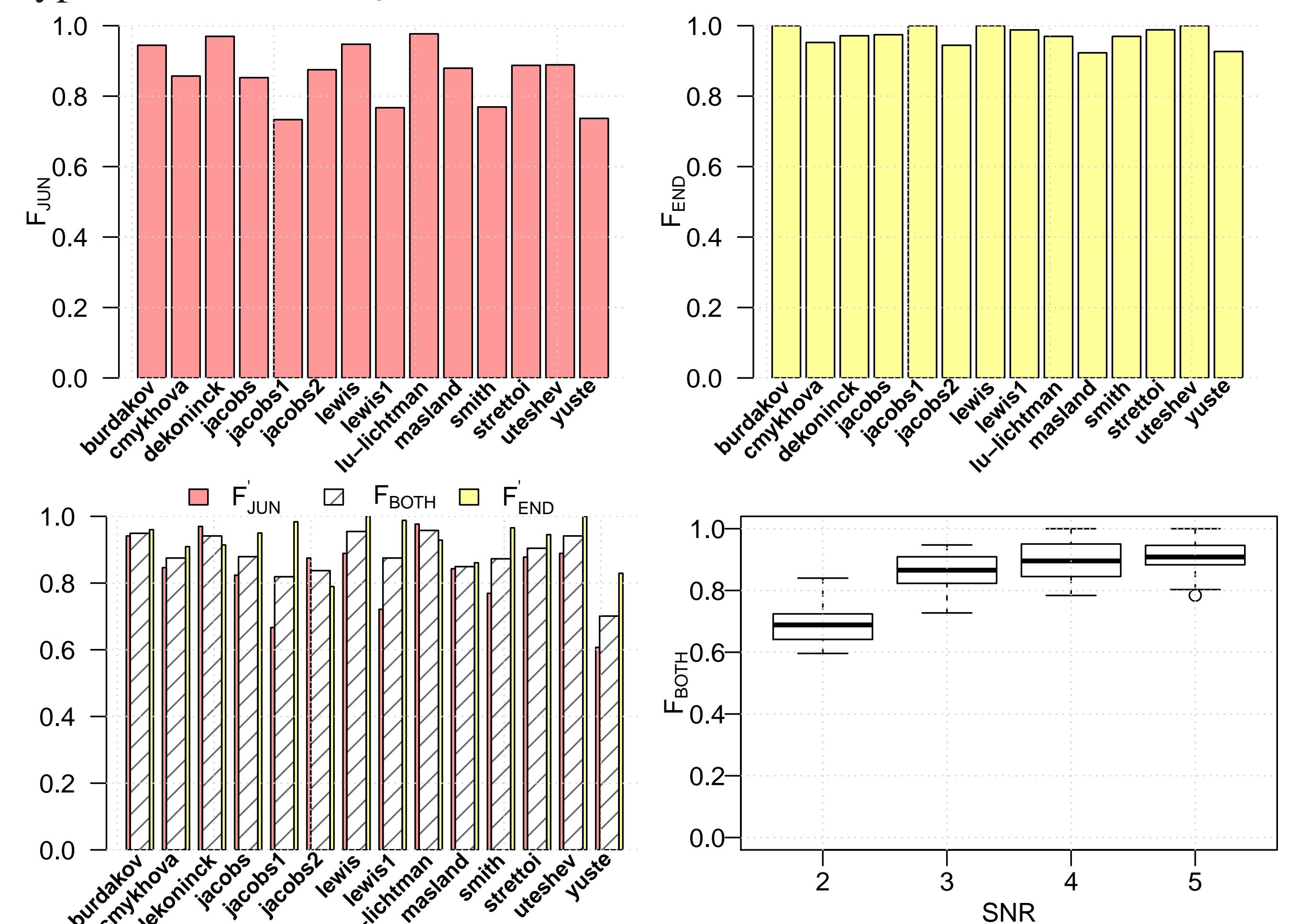
Real neuron images often exhibit high complexity, limited resolution, and low SNR. Hence the detailed manual annotation becomes subjective and error-prone.



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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