# Comparative Ultrastructural Anatomy of Dendritic Spines


## Abstract

The synaptic weight, a central concept in numerous neuroscience studies, is still lacking a proper biophysical foundation at the level of macromolecular assemblies. Given their intrinsic morphological plasticity, dendritic spines are prime candidates to modulate synaptic weights. Understanding the structural dynamics of spines is thus key to understanding synaptic transmission and plasticity. So far, electron microscopy tomography (EMT) is the only imaging method that provides an isotropic resolution that is sufficient to study the ultrastructural anatomy of these ubiquitous structures. Applying an advanced topological segmentation-algorithm (Günther et al., Computer Graphics Forum 31, 2012) to analyze EMT image stacks, we were able to extract the entire actin cytoskeleton of individual spines from the mouse cerebellar and hippocampal formations. Here, we present results of this methodological pipeline, focusing on the cytoskeletal organization as morphological alterations of dendritic spines are always driven by changes of the underlying macromolecular structure that provides their mechanical stability.



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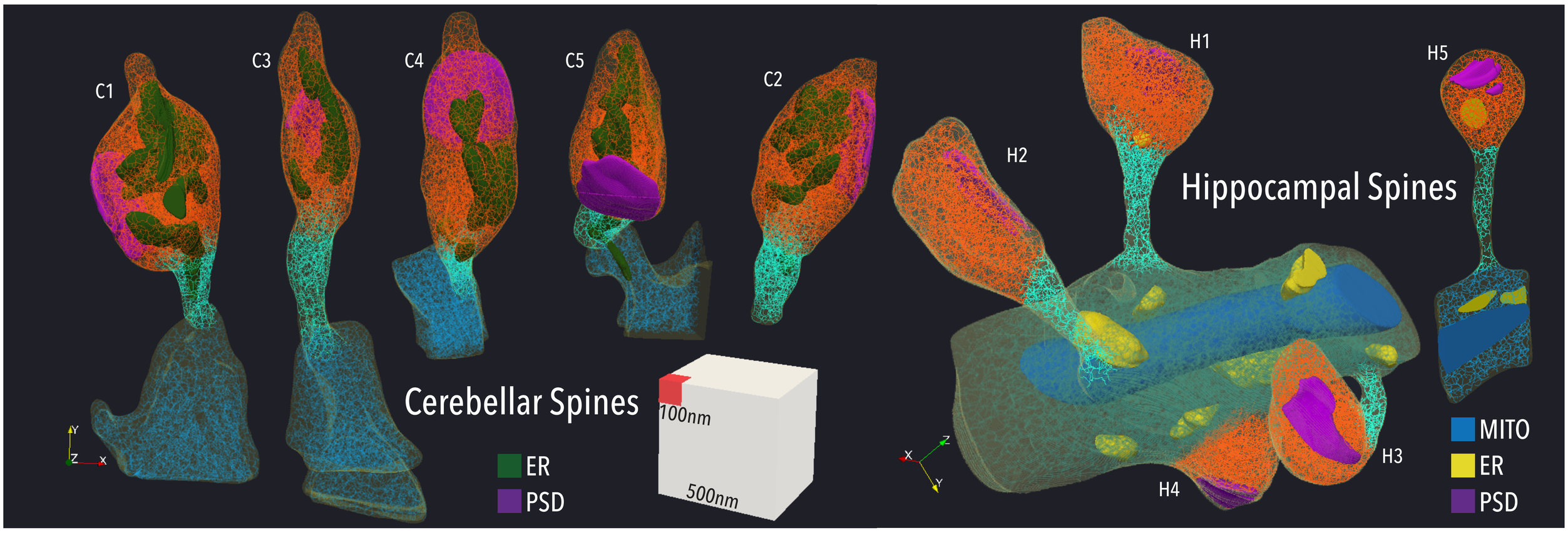
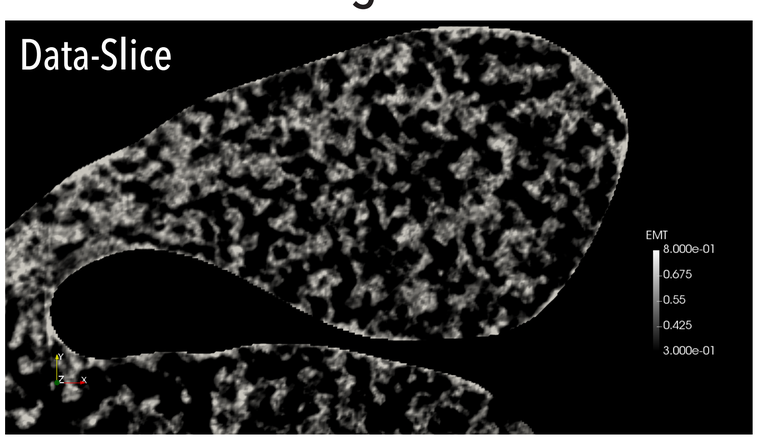
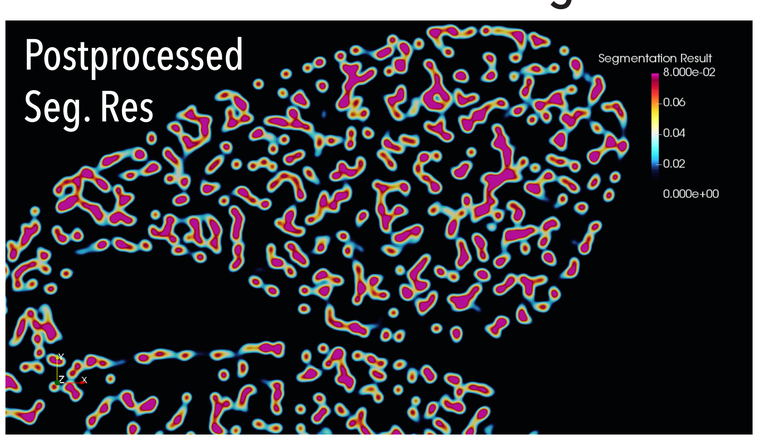
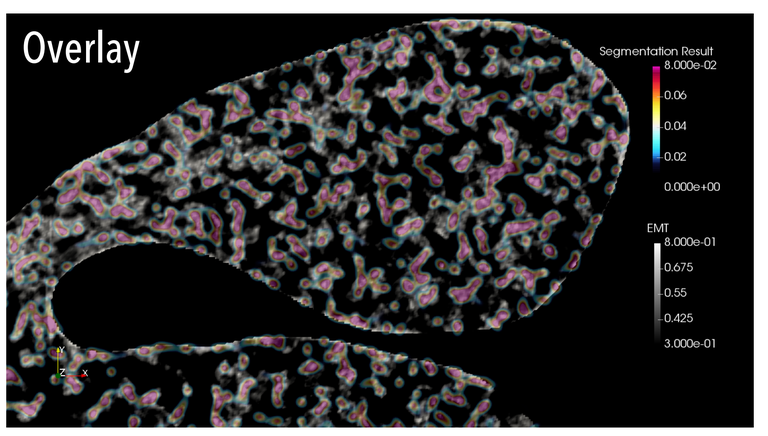



## Morse-Smale Segmentation of Actin Filaments from Electron-Tomograms

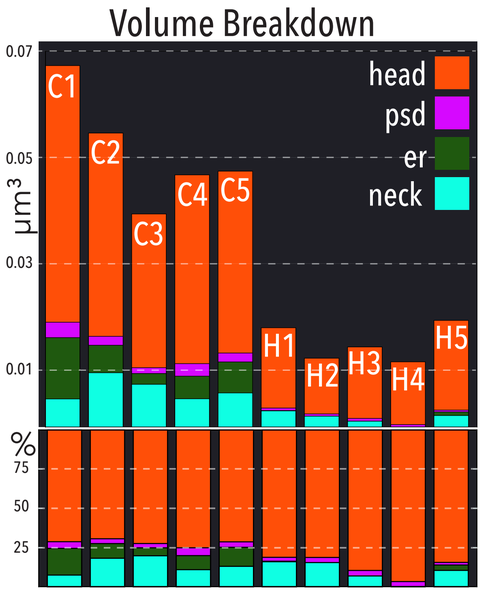


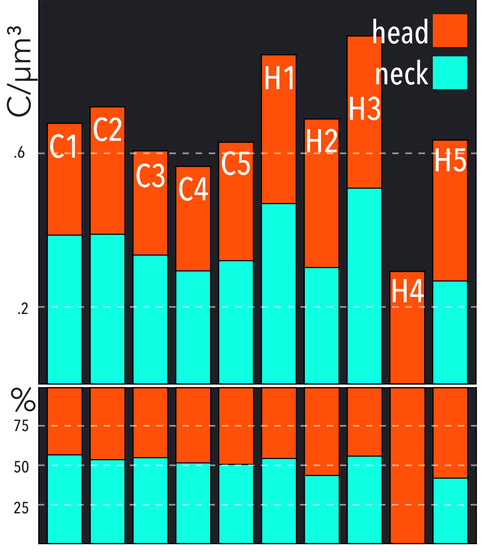




## Results

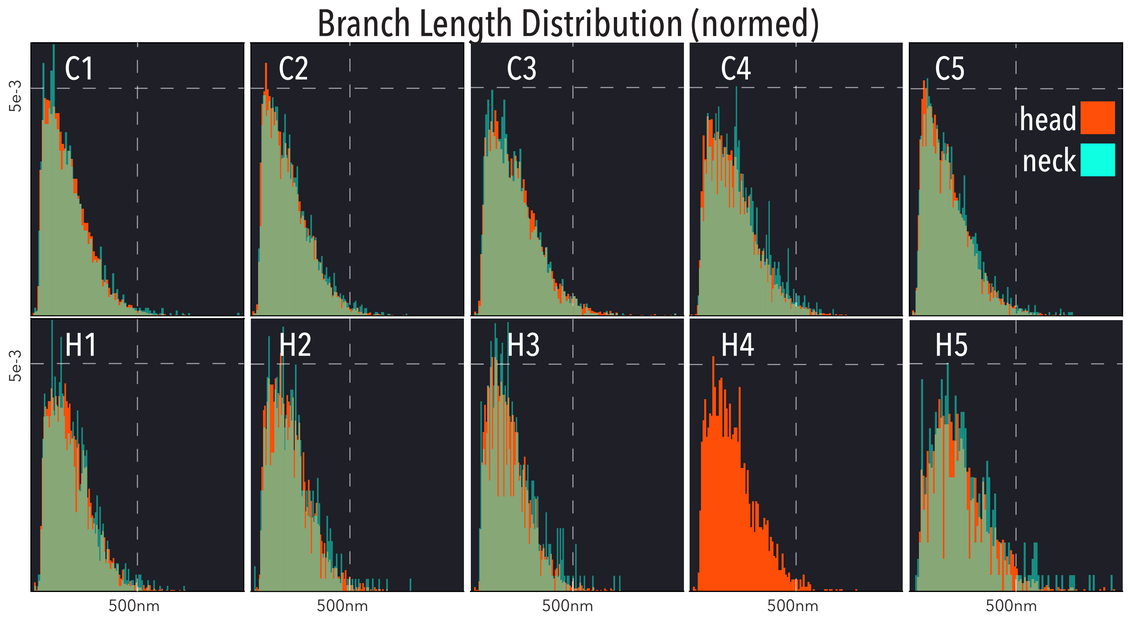
### Volume Breakdown



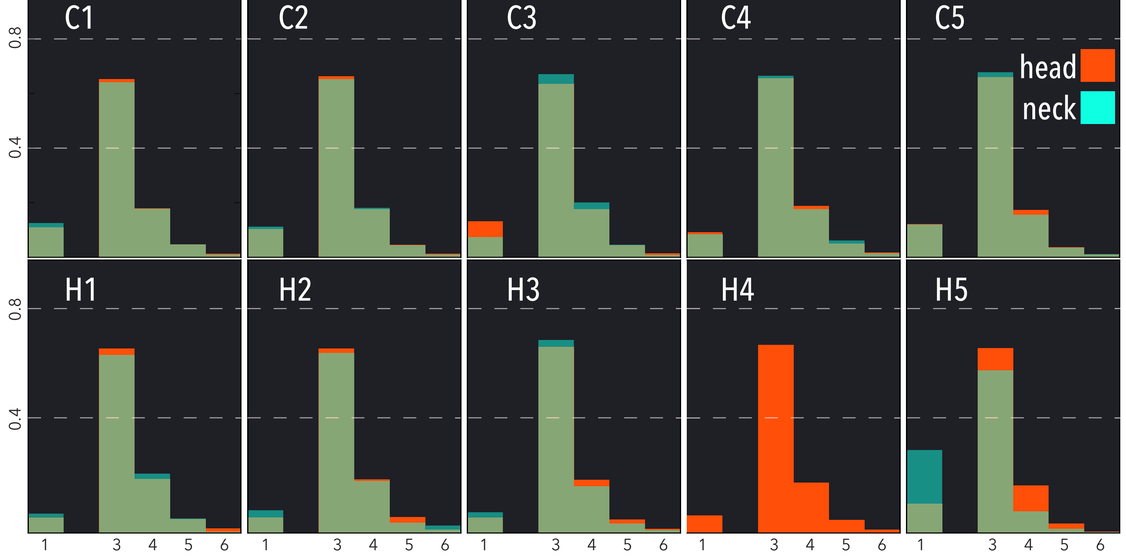

### Fixed Charge Density



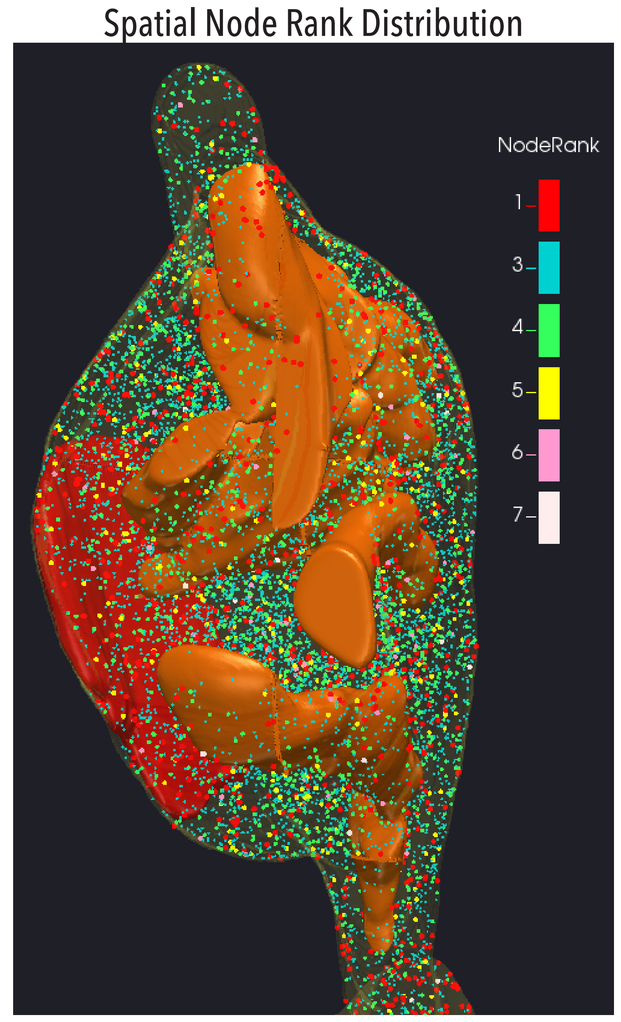

### Branch Length Distribution (normed)




### Node Rank Distribution (normed)




### Spatial Node Rank Distribution

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