

# Spatial point pattern analysis of neuron somata in the rodent somatosensory barrel cortex

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We study cellular organisation in different layers of rodent barrel cortex using three-dimensional point data gathered with an automated method of counting neuron somata. The neuron distributions are analysed for aggregation and repulsion patterns using methods from spatial point process theory.

Quantifications of the topographical organization of neurons can show structure-function relationships at the level of microcircuits. Examples of anatomical features that have been quantified with regard to the spatial distribution includes the bundling of the apical dendrites from layer 5 pyramidal cells, the vertical organization of cell bodies in human cortex, and amacrine cells in the retina. These studies give examples of how the analysis of the spatial distribution of neurons is important for testing hypothesis on development, pathological reorganization and information processing in a cortical barrel column.

We consider the soma distributions to be non-marked stationary point processes. Aggregation and repulsion patterns in the data are analysed by computing three-dimensional second-order functions, the Ripley's K-function, the L-function and the pair-wise correlation function. The values are compared to complete spatial randomness (CSR) for indications of clustering or regularity. Furthermore, we analyse cellular organisation changes in different layers and compare results from different cortical barrel columns.

## References

[1] M Oberlaender, VJ Dercksen, R Egger, M Gensel, B Sakmann, H-C Hege. Automated three-dimensional detection and counting of neuron somata, *Journal of Neuroscience Methods* (180) pp. 147-160, 2009.

[2] H Meyer, R Egger, J M Guest, R Foerster, S Reissl, M Oberlaender. Cellular organization of cortical barrel columns is whisker-specific, *PNAS* (110), 19113-19118, 2013.

[3] M Jafari-Mamaghani, M Andersson, P Krieger, Spatial Point Pattern Analysis of Neurons Using Ripley's K-Function in 3D. *Front Neuroinform* 21;4:9, 2010

[4] G Gangarossa, J Espallergues, P Mailly, D De Bundel, A de Kerchove d'Exaerde, D Hervé, JA Girault, E Valjent, P Krieger. Spatial distribution of D1R- and D2R-expressing medium-sized spiny neurons differs along the rostro-caudal axis of the mouse dorsal striatum. *Front Neural Circuits*. 29;7:124. 2013