# Title: CellRemorph: a computational toolkit for deciphering the relationship between cellular morphology and function

**Authors:**
*Laura Keto, Tiina Manninen*

**Keywords:**
Neuroscience, bioinformatics and computational biology, cell morphology, software, calcium dynamics

## Abstract
Cells with intricate morphologies, like astrocytes, influence brain function in ways that are not yet fully understood. We introduce CellRemorph, a Blender-based toolkit (Keto & Manninen, 2023; https://github.com/lauraketo/CellRemorph), designed to tackle the unique challenges of creating morphologically detailed astroglial models that reflect their complex and functionally significant nanoscale architecture. The first tool in the CellRemorph toolkit allows for the precise selection of nanoprocesses from polygonal surface meshes or surface point clouds. The second tool converts polygonal surface meshes into surface point clouds and vice versa. The third tool slices morphologies into segments of equal volume or surface area. Each tool's functionality was rigorously tested and evaluated using various astrocyte morphologies from databases. We utilized the toolkit alongside NEURON (Carnevale & Hines, 2006) and ASTRO (Savtchenko et al., 2018) to construct a detailed model of a Bergmann glial cell. This model featured a stem tree (Lippman et al., 2008) populated with nanoscopic processes (Grosche et al., 1999), enabling us to analyze calcium signaling patterns throughout the entire cell morphology. The toolkit's applications extend beyond astroglial cells, potentially aiding in the construction of detailed models for other less-studied brain cell types, such as microglia and oligodendrocytes.

Acknowledgements
We are very grateful to Prof. Helmut Kettenmann for providing us the video file of Bergmann glial morphology. The work was supported by the Research Council of Finland (Nos. 326494, 326495, 345280, 355256).