

## **WormGUIDES: an Interactive Informatic Developmental Atlas at Subcellular Resolution**

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Source code URLs:

<http://www.wormguides.org/open-source-software>

<http://sourceforge.net/projects/starrynite/>

CytoSHOW in the public domain. WormGUIDES, Starrynite and Acetree are released under the GNU GPL.

The BRAIN initiative aims to achieve a systematic understanding of human brain structure and function. To achieve this goal, there is a need for software to support creation of large-scale neural atlases. Open-source efforts like CATMAID provide important tools for annotating and sharing large electron microscopy image sets. However, live multi-dimensional fluorescence image acquisition and the goal of mapping the developmental dynamics of the nervous system present unique challenges and opportunities in data sharing and visualization. WormGUIDES EmbryoAtlas is an interactive developmental atlas designed to fulfill this need to explore the emergence of neural structures. Ultimately it will combine cell position information and detailed neurite-growth tracking to present the emergence of neural wiring in the model organism *C. elegans*. Cell identities, as well as the spatio-temporal details of cell's morphogenesis and other developmental behaviors, will be explorable within an augmented reality-inspired interface combining three dimensional image data, geometric annotation and hypertextual information in a unified 3D interface. WormGUIDES integrates data generated by three of our other open source development efforts: 1) CytoSHOW, a web-deployed interface that allows metadata-enhanced exploration of large multi-D imaging data sets; 2) AceTree, an interface for visualizing cell positions and lineages, and 3) Starrynite, robust cell tracking software that generates the cell position and identity information contained in WormGUIDES. Together, these programs run to 218,000 lines of open source code, including a customized version of the open source ImageJ libraries.

WormGUIDES will be the first developmental atlas that captures the entirety of a metazoan embryogenesis: every cell's behavior at minute-level time resolution. The *C. elegans* connectome, currently the only complete "wiring diagram" of a nervous system, has been a prime model in neuroscience. WormGUIDES will fill in a critical gap by showing how this invariant connectome arises during embryogenesis ("the living connectome") and facilitating inspection of *in toto* cell biological dynamics during development. Currently within WormGUIDES, nuclei of embryonic cells are plotted within a freely rotatable, time-animated model of the developing embryo. Each nucleus can be queried by the user for its identity and for information about its ancestry, fate, function, and genome-activity pattern. Any scene can be instantly shared with collaborators or published as a URL. This functionality is currently available in Android and iOS apps. An expanded desktop version and support for detailed annotation of 3D cell morphology are forthcoming. Open source since their inception, we hope to expand these projects into a truly collaborative development effort, and we welcome new partners and contributors.