

VRCellLabeler (VCL): Immersive labeling of Platynereis embryo's cell lineage trees in Virtual Reality

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Introduction

The cell lineages are being researched by both biologists and computer scientists to understand the complexity of organism. Although 3D microscopy data provides an overview of the dynamic formation process of cells and tissues, it generates an enormous amount of data which is difficult to process and contains an abundance of noise. However, machine learning approach requires a lot of ground truth. Therefore, VCL offers a labeling tool that allows reading orthogonal slices with smooth navigation in space and time with 90fps.

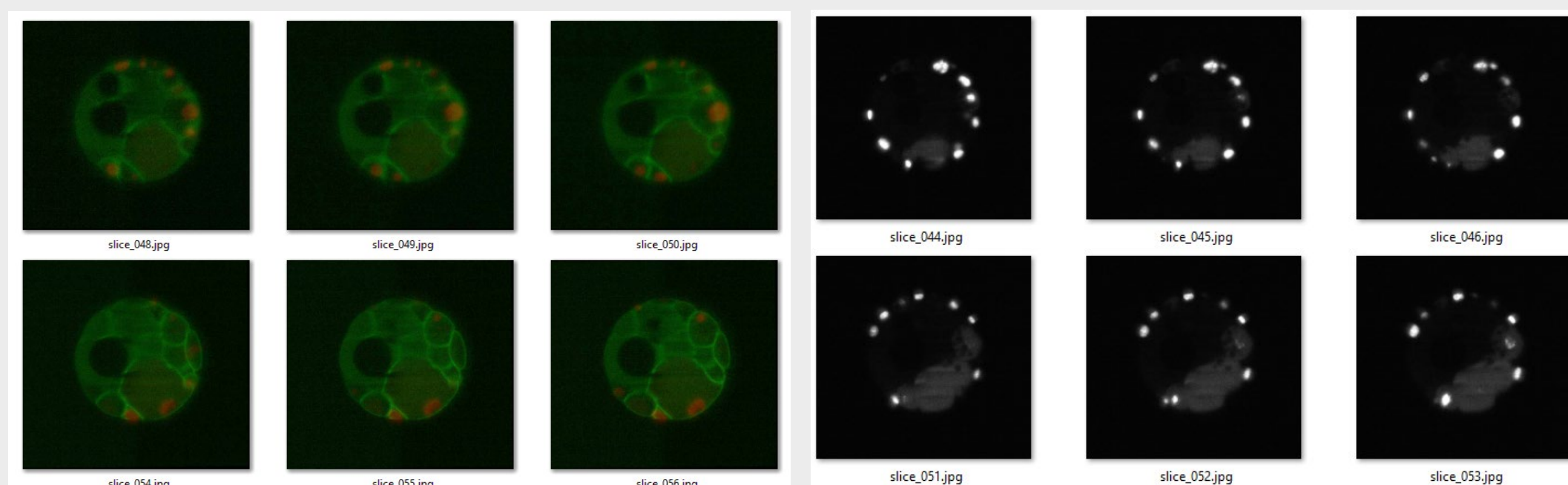
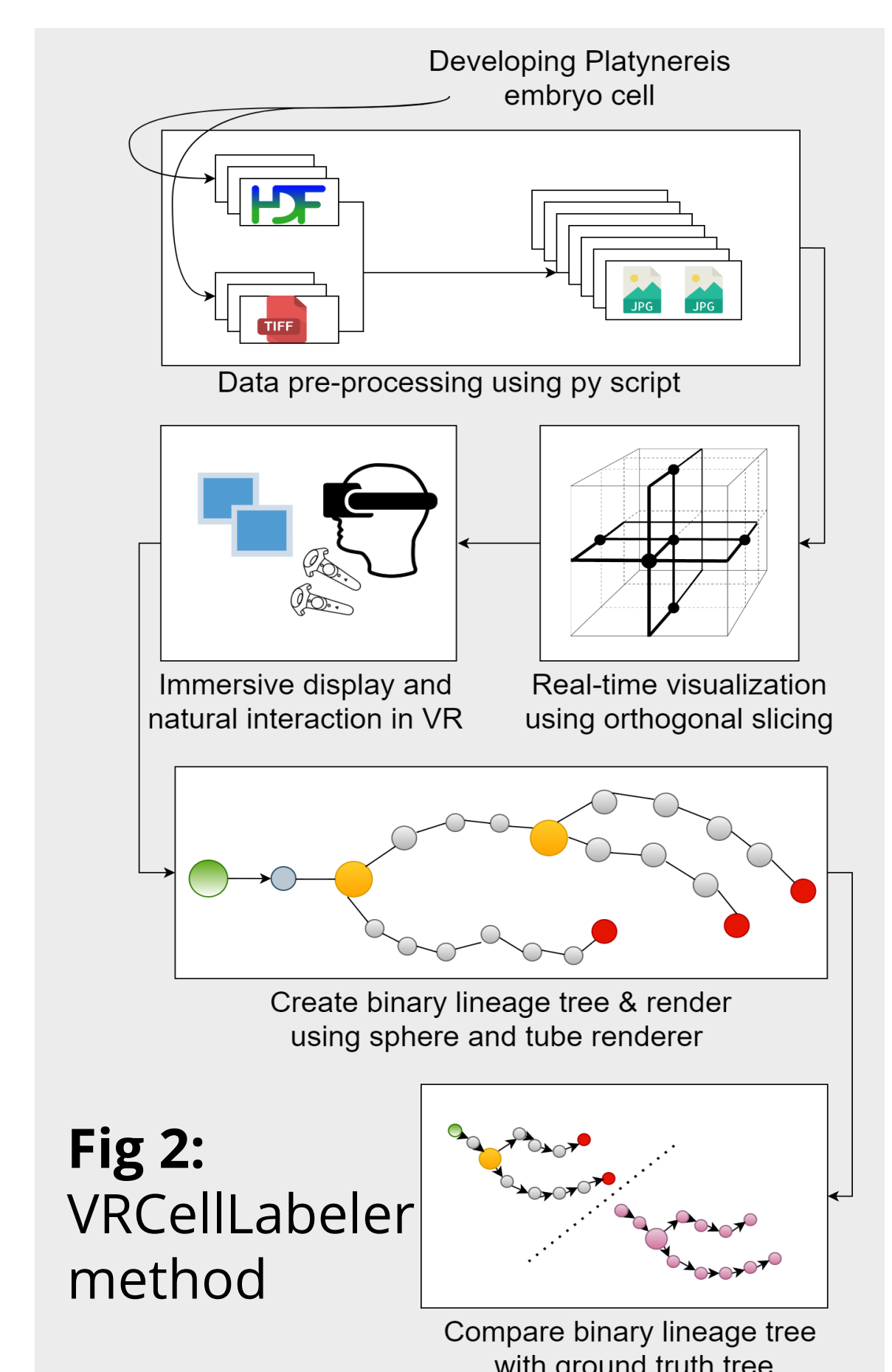


Fig 1: Processed data of Platynereis dumerilii's developing embryo's cell (dataset 1 & dataset 2) as 2D image stack (representing cell membrane as green channel and cell nuclei as red channel in the left image; similar in single channel in right image).

Methods

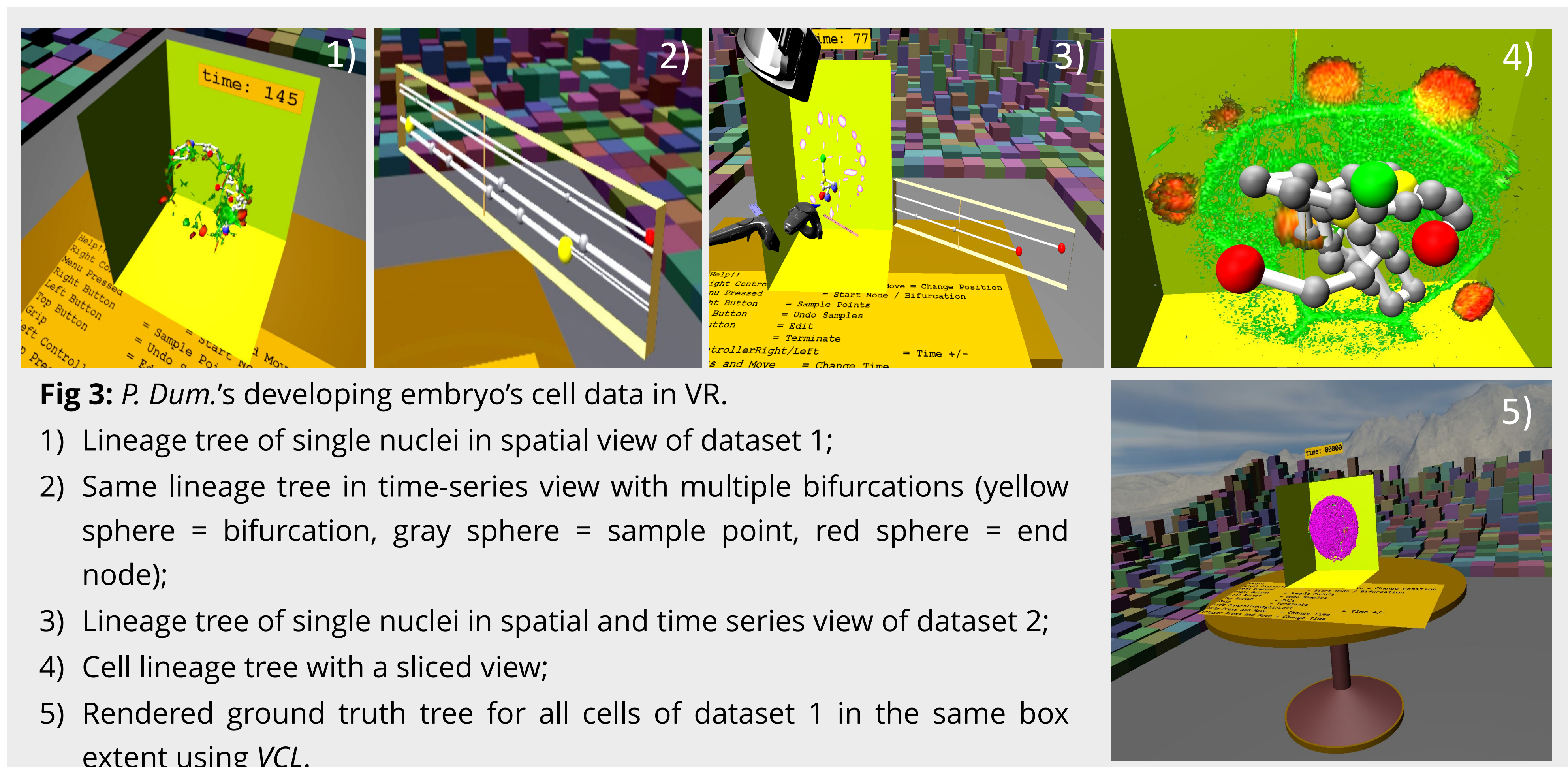
- Pre-process raw data from a 3D time-lapse dataset with two different color channel(dataset 1) and from a single channel timepoint dataset (dataset 2) to 2D image stack using python script.
- Apply indirect volume visualization for real-time navigation using orthogonal slicing.
- Visualizes the Platynereis's dataset in VR using the C++ framework (CGV) plugin.
- Build binary lineage tree from user tracing cell nuclei, using spheres & tubes for visualizing traces on-the-fly.
- Validate VCL by comparing ground truth tree with user generated cell lineage trees.



- HTC vive headset help users to immersively engage with Platynereis dataset in VR and controllers help users to follow single cells over time and create the cell lineage tree one-cell-at-a-time, providing better understanding of the dataset.

Results

The goal of this work is to introduce a labeling tool that provides a better understanding of cell lineage trees with a view to making complex life formation understanding easier and support ground truth in machine learning. Figure 3 represents the visualization of two different datasets of Platynereis dumerilii's developing embryo's cell's lineage trees in spatial and time series view. The figure also includes the rendered ground truth tree for dataset 1. With the further improvement, VCL might be an asset to connect large scale microscopic data to scientific visualization.



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