Contribution ID : **31** Type : **Poster**

Analysing 3D cell dynamics in the developing zebrafish inner ear

The labyrinthine structure of the vertebrate inner ear is vital for the perception of gravity, and linear and angular acceleration, to help control balance. The formation of this complex organ involves dynamic changes in cell shape and movement in the otic epithelia during embryo development. Optical sectioning microscopy, in particular light-sheet fluorescence microscopy coupled with the generation of transgenic lines, have made it possible to follow these developmental processes in the relatively transparent zebrafish (*Danio rerio*) embryo [1]. Analysing the large volumes of multi-dimensional data acquired through light-sheet microscopy has, however, been a significant challenge [2]. Additionally, while software solutions have been developed for semi-automated 3D segmentation and obtaining volumetric data from such images [3,4], tools for analysing cell shape have continued to be limited to 2D image information [5]. We present an image analysis pipeline for fully automated 3D cell segmentation using 3D-UNet (a Deep Learning Convolutional Neural Network) [6], and measurement of 3D cell shape and membrane dynamics, including apicobasal asymmetry (without labelling for cell polarity descriptors), in the zebrafish otic epithelium. Such 3D analysis of cell shape during epithelial folding and remodelling is a critical step forward in understanding organ formation events in embryogenesis across study organisms.

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Terms and Conditions

Yes

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Session Classification : Posters