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GoFigure and The Digital Fish Project: Open tools and open data for an imaging based approach to systems biology

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As part of the Center of Excellence in Genomic Science at Caltech, we have initiated the Digital Fish Project. Our goal is to use in toto imaging of developing transgenic zebrafish embryos on a genomic scale to acquire digital, quantitative, cell-based, molecular data suitable for modeling the biological circuits that turn an egg into an embryo. In toto imaging uses confocal/2-photon microscopy to capture the entire volume of organs and eventually whole embryos at cellular resolution every few minutes in living specimens throughout their development. The embryos are labeled such that nuclei are one color and cell membranes another color to allow cells to be segmented and tracked as they move and divide. The use of a transgenic marker in a third color allows a variety of molecular data to be marked. In toto imaging generates 4-d image sets (xyzt) which can contain >100,000 images per experiment. We are developing a software package called GoFigure to visualize, segment, and analyze these very large image sets. GoFigure uses a MySQL database back end for managing storage of images (by reference) and segmented objects and uses VTK and ITK for visualization and segmentation. Our goal is to use in toto imaging to digitize the complete expression and subcellular localization patterns of thousands of proteins throughout zebrafish embryogenesis. This genomic data, our zebrafish lines, and GoFigure will be distributed following the Open Data/Open Source model.