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PWCT - Pan-Cellular Whole-organism MicroCT as a foundation for computational phenomics

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Genes and environment can influence any cell type at any developmental stage. The comprehensive study of those influences in a multicellular organism therefore requires the ability to visualize, identify, and characterize every cell type in the entire organism across all life stages, at cell resolution. The most common medical implementation of cell imaging, histology, is achieved by cutting tissue sections of about 5 micron thickness, differential color staining of cell components such as nucleic acid and protein, and optics with resolutions in the range of 1 micron. The destructive and tedious nature of histology limits our ability to study hundreds of thousands of samples, as required to study the functions or effects of tens of thousands of genes or chemicals. We are working towards the ideal of imaging and characterizing all cell types in whole organisms using a form of imaging that is immune to the opacity of pigmented cells and mature tissues based on its use of X-rays: microCT. Pan-cellular stains, fields of view, and phase contrast through use of monochromatic X-rays as possible at the Advanced Photon Source at Argonne National Labs, have allowed us to create 3D images of whole zebrafish at larval and juvenile stages at cell resolution. We propose that high-throughput adaptations of pan-cellular, whole-organism microCT can be used as a powerful foundation for a computational phenomics that can be used to probe the function of all genes (genetic phenomics) and the effects of environmental manipulations including chemical exposures (chemical phenomics).

Biography

Keith C. Cheng, Director of Experimental Pathology and Distinguished Professor of Pathology at Penn State, earned his B.A. in biochemical sciences at Harvard, M.D. at NYU School of Medicine and Ph.D. in molecular genetics at the Fred Hutchinson Cancer Research Institute. He was a postdoctoral fellow and became board certified in Anatomic Pathology at the University of Washington, and is best known for work on oxidative DNA damage, the genetics of human skin color, the development of zebrafish as a model for personalized medicine, and the pursuit of computational phenomics based on pan-cellular whole-animal 3D imaging of zebrafish using synchrotron microCT.