BIOMEDICAL ENGINEERING
Carnegie Mellon University

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Doherty Hall A302

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Quantitative Methods for Cell and Tissue Imaging

Abstract: Building on recent advances in computer vision and machine learning we are now in the position to monitor complex biological environments and events in the same way are analysing natural scenes. While challenges remain, algorithms for cell segmentation and tracking have matured significantly and can now be used in more routine high-throughput settings. Improved microscopy and imaging platforms not only allow us to image subcellular events at high spatial and temporal resolution, we can now image large tissue sections and capture how various different proteins modulate the cellular microenvironment. Enabled by advances in cell culturing technologies 3D cultures can restore specific biochemical and morphological features that are similar to their in vivo counterparts. This holds the potential for improving relevance of in vitro studies, improving our ability to predict what occurs in vivo.

We are now working towards establishing the spatial and temporal context for biological events and processes. Quantitative image analysis methods are necessary for monitoring the tissue formation process and enabling longer duration time-lapse imaging. One such example will be the modelling of cellular behaviour. Our current research focuses on analysing cellular viability, the interaction of epithelial cell populations and the evolution of organoid cell cultures. Similarly, we are now in a position to demonstrate the value digital pathology could bring. Taking oesophageal cancer as an example, I will illustrate how these quantitative image analysis methods can enable a research programme that takes information from multiple scales to advance our understanding of disease and aims to change patient management.