Title: Tumor Vascular Perfusion and Oxygenation through Computational Modeling and High-Resolution Imaging

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Tumor-associated angiogenesis is an indispensable factor for the progression of solid tumors beyond a minimal size (1-2 mm3). The unprecedented advances in automated microscopic imaging allow the accurate 3D visualization of the morphology of individual vessels in tumors and the description of their function. Therefore, it is crucial to elucidate the dynamics of tumor blood flow to understand its role in drug delivery. This also provides a great opportunity to use computational modeling to estimate hemodynamic properties in a great detail compared to bulk estimates for the whole-tumor vasculature. High-resolution techniques such as μCT (micro-computed tomography) can provide these 3D data with high fidelity, and pave the way for the use of blood flow models in translational and personalized medicine. We describe a novel bioimage informatics methodology for the reconstruction of high-resolution wide-area 3D vessel geometry from μCT data. Computational modeling allows the generation of detailed and discretized blood perfusion and oxygenation maps for the entire tumor vasculature. The comparison of morphological and hemodynamic indices among regions of interest gives insights into perfusion heterogeneity and hypoxia in solid tumors.