Optical Coherence Tomography-Based Particle Image Velocimetry

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Abstract: Doppler optical coherence tomography (DOCT) is a noninvasive imaging technique commonly used in visualizing and quantifying blood flow, however, it has several limitations for this application. To address these problems, we introduced the combination of optical coherence microscopy (OCM) and micro-particle image velocimetry (μPIV) to measure particle flow using the conventional intensity OCT signal, instead of phase-sensitive detection as used in DOCT. The implementation of OCM in combination with Bessel illumination greatly extends the focusing range of the OCM system, allowing us to embrace the advantages of both imaging modalities for our application. Micro-beads of 10 μm diameter in micro channels of 100 μm diameter were used as the measured object to model a blood flow. This model allowed for the construction of velocity maps using self-scripted software. The results of this study show that compared with DOCT, this system embraces the advantages of obtaining both higher resolution and lower image noise. We plan to apply this newly-developed imaging technique to explore blood flow in developing embryonic chick hearts.