Using Real-Time Three-Dimensional Ultrasound to Characterize Mitral Valve Motion

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Real-time 3D ultrasound has become a promising new tool for diagnostic and interventional cardiac procedures. In particular, full volume analysis of cardiac structures is now possible because of ultrasound's high tissue/blood contrast and a temporal resolution capable of capturing fast-moving cardiac structures. The temporal resolution of three-dimensional ultrasound is particularly attractive because it captures the movement characteristics of highly dynamic structures within the heart. Our results aim to fully characterize the four-dimensional (3D + time) movement of the mitral valve for better understanding of its behavior prior to surgical interventions, such as mitral valve repair. A behavior model of both healthy and pathological valves is made available. Such results are of immediate relevance for the visualization, characterization, and tracking of heart tissue, whether from an imaging or mechanical point of view. In this study, the mitral valve of healthy and pathological subjects was imaged using a real-time 3D US system (Live 3D Echo, Philips Medical Systems). Features of the mitral valve were manually segmented in each frame for one cardiac cycle. Displacements, velocities, and movement profiles were obtained for a number of structures within the mitral valve (i.e. annulus, commissures). In addition, beat-to-beat and patient-to-patient variations were examined.