Design of a Motion Compensated Tissue Resection Catheter for Beating Heart Cardiac Surgery

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Cardiac catheters allow clinicians to minimally invasively interact with the beating heart without stopping the heart or opening the chest. However, the fast motion of the intracardiac structures makes it difficult to modify and repair the tissue in a controlled and safe manner. To enable surgical procedures on the inside of the beating heart, we have developed an ultrasound-guided catheter system that virtually freezes the heart by compensating for the fast cardiac motions. The device presented in this paper is a resection tool that allows the catheter system to cut moving tissue, a key surgical task required for many intracardiac procedures including valve and leaflet repair. The motion tracking system is demonstrated in vivo and the tissue resection tool is evaluated by resecting tissue mounted on a cardiac motion simulator. The motion compensated catheter is shown to greatly improve the resection cut quality on the moving tissue target while reducing the forces experienced by the tissue by almost 80%.

Learning the Art of Disciplined Innovation

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We describe a specific implementation of the Biodesign process explained by Zenios et al. and how it may be adapted for use in small teams in an academic or corporate setting. This adaptation is termed disciplined innovation to place emphasis on the rigorous information mining that must occur to truly understand the problem prior to contemplating design solutions. We provide a roadmap with links to online resources for the purpose of navigating the initial stages of the Biodesign process, specifically "Needs Finding" and "Needs Screening."