# Simulation of Cardiac Ultrasound Fields

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**Introduction:** Therapeutic ultrasound treatments for cardiovascular disease are being developed as a way to non-invasively deliver drugs to affected arteries. These treatments require ultrasound insonification of target arteries at a certain pressure over a calculated time period. A method for targeting coronary artery segments and computationally simulating the resultant ultrasound field in patient's chests was designed to further the development of this technology.

**Methods:** Thirty-five cardiac and fifteen respiratory gated chest CT scans were selected in collaboration with the UC Radiology Department. Segments of the the Right Coronary Artery and Left Anterior Descending Artery were labelled for treatment simulation. CT scans were loaded into MATLAB to generate three dimensional density models of the patient's chests. Simulations of the ultrasound propagation through the chest model were calculated based on the speed of sound, the attenuation at each point in three dimensional space, and the position of the ultrasound transducer. Transducer positioning was optimized in order avoid lungs and sternum, and to target specific segments of the coronary arteries.

**Results:** Non-contrast respiratory gated CT series yielded accurate ultrasound field simulations because they allowed timing of ultrasound pulses during expiration where the acoustic window was the largest. The simulations demonstrated that focal insonification of the coronary arteries is possible if path of the transducer is placed in a subcostal position and angled upwards toward a targeted segment of a coronary artery.

**Conclusion:** This study was a proof of concept for ultrasound field simulation in the chest using 3D respiratory gated CT series.

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