Bhupesh Bharat Patil, Instrumentation for impedance cardiography, M. Tech. Thesis, Department of School of Biosciences & Bioengineering, Indian Institute of Technology Bombay, 2009.

Supervisor(s): P. C. Pandey

Abstract - Impedance cardiography is a non-invasive method for estimating the stroke volume and cardiac output by sensing the variation in thoracic impedance during the cardiac cycle. The project objective is to develop an impedance cardiograph, based on earlier reported developments as well as by investigating new circuits for improving the performance. The impedance cardiography hardware involves new approaches to the excitation source as well as the demodulator for sensing the small variation in thoracic impedance. Modified Howland current source is used for the voltage-to-current conversion. For stable sinusoidal excitation with a selectable frequency, a DDS chip is used. Two DDS chips are synchronized to provide outputs with settable phase shift, one DDS providing input to the voltage-to-current converter while the output of the other DDS is used as reference for synchronous demodulation. For high sensitivity, low distortion, and low noise demodulation, a slicing amplifier and sample-and-hold based circuit is devised and tested. The overall circuit is controlled by a microcontroller, providing flexibility in selection of the frequency, current level, the phase shift of the demodulator reference, and the base impedance to be subtracted from the sensed impedance. A thorax simulator for testing and calibration of an impedance cardiograph using microcontroller and digital potentiometers has been developed and prototyped.