P. S. Rajath Bhat, Development of an Impedance Glottograph, M. Tech. Thesis, Department of Electrical Engineering, Indian Institute of Technology Bombay, June 2012.

Supervisor(s): Prof. P. C. Pandey

*Abstract:* Impedance glottography is a noninvasive method to monitor the degree of contact between the vibrating vocal folds. Time-varying electrical impedance, measured by placing a pair of electrodes on either side of the thyroid cartilage, is used for diagnosing voice disorders, estimation of pitch, and speech training aids. The objective of the project is to develop (a) a laryngeal impedance simulator for testing the sensitivity and frequency response of the impedance glottograph instrument, and (b) an impedance glottograph instrument using novel circuits for improving the frequency response and noise rejection.

A laryngeal impedance simulator, using a microcontroller, analog switches, and digital potentiometer is developed and tested. Simulation parameters (frequency, basal resistance and change in basal resistance) are set through serial port. An impedance glottograph instrument, consisting of a sinusoidal source, voltage-to-current converter, voltage sense amplifier, and synchronous demodulator, has been designed and tested. A voltage, in the frequency range of 50-500 kHz, generated using a direct digital synthesizer (DDS) is given as input to a voltage-to-current converter with complementary current outputs, designed using a pair of transconductance amplifiers to output a low amplitude (< 5 mA) current. This current is injected using a pair of electrodes held in contact with the skin on both sides of the thyroid cartilage. The resulting amplitude modulated voltage is amplified using a voltage sense amplifier and given to the demodulator. Synchronous demodulation with current steering and baseline restoration circuit is used to get the demodulated waveform, representing the impedance variation. Sampling of the demodulator waveform in synchronism with the peaks of the excitation waveform is used for improving ripple rejection.