The College of Graduate Studies and the College of Engineering Cordially Invite You to a

PhD Dissertation Defense

Entitled

DEVELOPMENT OF PIEZOELECTRIC SENSORS AND METHODOLOGY FOR NONINVASIVE SIMULTANEOUS DETECTION OF MULTIPLE VITAL SIGNS

by

Areen Abdallah Allataifeh

Faculty Advisor

Dr. Mahmoud Al Ahmad, Department of Electrical Engineering
College of Engineering

Date & Venue

11:00 AM
Thursday, 28 February 2019
Room 2022, F1 Building

Abstract

The activity of piezoelectric material linked the applied electric field with the strain generated that can be translated in to geometrical variations. Flexible steel substrate exhibits fascinating mechanical properties which will enable their integration into the emerging field of flexible microelectronics. This work presents an extended technique based on capacitance-voltage dependency to extract the geometrical variations in thin film piezoelectric materials deposited in flexible steel. A 50 µm flexible steel sheet has been sandwiched by two PZT film layers, each of 2.4 µm in thickness deposited by sputtering. Aluminum layer of 370 nm has been deposited above each PZT layer to form the electrical contact. The steel sheet represents the common electrode for both PZT structures. Gamry references 3000 analyzer was used to collect the capacitance voltage measurements then estimating piezoelectric charge constant. Experimental work has been validated by implementing the same method on a bulk piezoelectric film. Results showed that the measured capacitance varies by 1% due to dielectric constant voltage dependency. On the other hand, 99% of capacitance variations depend on the change in physical dimensions of the sample via piezoelectric effect. Further to that, this thesis explore the utilization of piezoelectric based sensors to collect a corresponding representative signal from the chest surface. The subject typically needs to hold his or her breath to eliminate the respiration effect. This work further contributes to the extraction of the corresponding representative vital signs directly from the measured respiration signal. The contraction and expansion of the heart muscles, as well as the respiration activities, will induce a mechanical vibration across the chest wall. This vibration can be converted into an electrical output voltage via piezoelectric sensors. During breathing, the measured voltage signal is composed of the cardiac cycle activities modulated along with the respiratory cycle activity. The proposed technique employs the principles of piezoelectric and signal-processing methods to extract the corresponding signal of cardiac cycle activities from a breathing signal measured in real time. All the results were validated step by step by a conventional apparatus, with good agreement observed.

Keywords: Blood pressure , breathing, charge constant, capacitance-voltage, cardiac cycle, heartbeat, dependency, piezoelectric constant, piezoelectric materials, piezoelectric sensor, signal processing, respiration cycle, thin film, flexible sensors, voltage constant.