Announcing the Final Examination of James Humphries for the degree of Doctor of Philosophy

Time & Location: June 29, 2016 at 10:00 AM in Harris Engineering Center (HEC) 450
Title: Passive, Wireless SAW OFC Strain Sensor and Software Defined Radio Interrogator

Surface acoustic wave (SAW) devices have exhibited unique capabilities to meet the demands for many applications due to the inherent properties of SAW devices and piezoelectric materials. In particular, SAW devices have been adapted as sensors that can be configured to operate both passively and wirelessly. Because the sensors are passive, a radio transceiver is required to interrogate the sensor and receive the reflected response that has been modulated by the SAW device. This dissertation presents the design of a passive, wireless SAW OFC strain sensor and software defined radio (SDR) interrogator.

A SAW strain sensor has been designed and tested using orthogonal frequency coding (OFC) on YZ-LiNbO3. OFC for SAW devices has been previously developed at UCF and provides both frequency and time diversity in the RFID code as well as providing processing gain to improve the sensor SNR. Strain effects in SAW devices are discussed and two sensor embodiments are developed. The first embodiment is a cantilever structure and provides insight on the strain effects of the SAW device. The second embodiment bonds the SAW die directly to a test structure to measure the strain on the structure. A commercial wired foil strain gage provides a performance comparison and shows that the SAW sensor performs comparably.

A commercial-off-the-shelf SDR platform has been employed as the SAW sensor interrogator. The Universal Software Radio Peripheral (USRP) B200 is utilized as the RF transceiver platform. Custom FPGA modifications are discussed to fully utilize the USRP B200 bandwidth (56MHz) and synchronize the transmit and receive chains. External hardware has also been introduced to the B200 to improve RF performance, all of which are incorporated into a custom enclosure. Post-processing of the SAW sensor response is accomplished in Python using a matched filter correlator routine to extract sensor information. The system is demonstrated by interrogating wireless OFC SAW temperature and strain sensors at 915MHz.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Electrical Engineering, BS, 2010, University of Central Florida
Master’s of Electrical Engineering, MS, 2012, University of Central Florida

Committee in Charge:
Donald Malocha, Chair, Electrical & Computer Engineering
Arthur Weeks, Electrical & Computer Engineering
Samuel Richie, Electrical & Computer Engineering
Kalpathy Sundaram, Electrical & Computer Engineering
Haripada Saha, Physics

Approved for distribution by Donald Malocha, Committee Chair, on June 14, 2016.

The public is welcome to attend.