

This paper presents a survey of three undergraduate research projects being developed jointly by the Electrical and Computer Engineering and the Mechanical Engineering Departments of the University of Puerto Rico. The projects consist in the development of wireless sensor circuits designed to monitor the health condition of mechanical components. Our aim is to provide students with an introduction to the area of sensors and instrumentation by performing a meaningful research experience. The research objective is to develop the technology to integrate sensors into composite structures to monitor performance and structural health during operation.

Emphasis is placed on developing low-cost circuits on plastic substrates to assure compatibility with ball bearings and similar devices. The circuits are powered by an RF signal, and therefore can operate without batteries. The measured quantity is transmitted to a receiver, or reader, in a short-range wireless fashion. Thus wires are not needed to connect the components attached to the moving part. Our focus is on measuring temperature and strain. However, the technology can be used to measure other mechanical or structural variables.

Three undergraduate research projects are discussed in this document. In the first, a circuit to measure strain was developed. In the second project, students developed a circuit that uses a capacitive transducer and an oscillator to sense and transmit temperature information. In the third project students developed a circuit that replaces the oscillator with an ultra-low power microcontroller. To transmit the information, the microcontroller changes the inductance of the power-receiving coil. The reflected impedance of the power-transmitting coil is monitored in order to read the temperature.

The article first provides a general introduction. Next, the three sensor circuits are described in detail and experimental results are presented. Finally, we discuss our conclusions and plans for future work.