Physiological activity monitoring (PAM) has become one of the key observation methods in healthcare industry. PAM usage allows patients, senior citizens, sports players, and soldiers to benefit from the real-time feedback from their personal physical efforts and to improve/maintain their performance. While motion sensors are utilized to monitor directional or sudden movements, drops, and falls by gathering data from accelerometers, temperature and humidity sensors provide a real time human body condition tracking. Integrated Circuit (IC) design techniques and Micro Electro Mechanical Systems (MEMS) fabrication methods are combined to build such miniature hybrid sensor structures.

Dr. Kaya Lab’s mission is to develop sensor systems that are;

- on the order of **millimeters** in size,
- capable of transmitting its sensed data **wirelessly**,
- and embedded with **custom-made** batteries,
- which will be used in **physiological activity monitoring** applications.

With Dr. Kaya’s leading, different disciplines (including electrical and mechanical engineering, physics, chemistry, and business) have successfully been merged under one big motivation: **developing sensor devices that can be used to monitor human health condition and notify the local health support unit if needed**. Different sensing mechanisms are in interest such as temperature, humidity, and motion. Each sensor is designed to be compatible with microfabrication processes that allow integrating individual sensors. Therefore, MEMS and IC design and fabrication techniques are highly incorporated in the group. (i) Temperature sensing is achieved through IC design where semiconductor’s electrical parameter changes with temperature are detected and converted into digital data. (ii) Relative humidity is sensed through a parallel-plate capacitor whose value varies significantly due to the change on the dielectric constant of the polymer layer between electrodes (polymer acting as a dielectric layer). Capacitors are fabricated via MEMS fabrication techniques and interface circuits are designed to convert the capacitance change into voltage or frequency. (iii) Motion sensor relies on a cantilever-based capacitive accelerometer design. A simple design allows to sense x, y, z directed acceleration as well as tilting, which results a six degree of freedom in motion. Thin-film rechargeable battery structures are also studied to eliminate bulky power sources. Dr. Kaya will present his research methodology on how he incorporates top-bottom and bottom-top design techniques. Each project will be explained briefly and potential challenges will be described.
Short Bio: Dr. Tolga Kaya currently holds a joint Assistant Professor position in the School of Engineering and Technology and the Science of Advanced Materials program at Central Michigan University (CMU). Prior to joining CMU, Dr. Kaya was a post-doctorate associate at Yale University (2007-2010), a research and teaching assistant at ITU (1999-2007), a consultant at Brightwell Corp. (2007), Istanbul, a senior VLSI analog design engineer and project coordinator at Microelectronics R&D Company, Istanbul (2000-2006), and a visiting assistant in research at Yale University (2004-2005). Dr. Tolga Kaya received BS, MS and PhD degrees in Electronics Engineering from Istanbul Technical University (ITU), Istanbul, Turkey. His research interests in electrical engineering and applied sciences are analog VLSI circuit design and testing, MEMS sensor design, fabrication and testing, micro batteries and passive/active RFID systems. His research is also involved in biomedical engineering where bacterial hydrodynamics are studied under various shear flow regimes to enlighten the bacterial infections in catheterized patients.

All students, faculty, and public are welcome.