

Center of Excellence in Wireless and Information Technologies (CEWIT) Healthcare and Medical Technologies Division

To best capitalize on the IT revolution, spur economic growth, advance scientific research and develop the technologies of tomorrow, the Center of Excellence in Wireless and Information Technology (CEWIT) was created in 2003. The Center is a next generation research and educational facility whose mission is three-fold: become recognized as a world leader in interdisciplinary research in the emerging, critical technologies of the information age, address the skilled technology worker shortage, and foster new enterprise development. CEWIT has more than 70 associated faculty members, and more than 400 Ph.D./M.S. students engaged in research. The Center has created a powerful intellectual property portfolio resulting in numerous patents. Since its inception, the Center has worked hard to build strategic alliances and business partnerships among the academic, scientific, and business communities. Our partners include some of the world's best known and most sophisticated giants of wireless and information technology. The Center is building on these achievements and has laid the foundation for R&D partner-ships with its partners and sponsors, and with other internationally known research institutions.

American medicine defines the cutting edge in most fields of medical research, training, and practice worldwide. U.S.-based manufacturers of medical devices, medical equipment and drugs, are among the most innovative and competitive in the world. In addition, technical talent and material resources are beginning to be devoted now to improve and optimize the operations, in order to enhance the quality and productivity of the overall U.S healthcare system. The \$2 trillion healthcare sector is presently mired in crisis related to safety, quality, cost, and access that pose serious threats to the health and welfare of many Americans.

Intellectual Merit: The use of wireless technology is rapidly increasing in most sectors of the US industry and health care. Now, more than ever, advances in wireless access, the Internet, mobile technologies, social networks, etc. have become relevant to the medical world. Wireless health is opening up many new fronts in addition to simply carrying sensor signals over wireless links. Widely used mobile devices such as smartphones carry significant contextual information related to the activity of the user. These activities can often be medically relevant, and can be garnered easily using sensors attached to the device. This can range from detecting physical activities such as exercise or sleep or fall, social activities such as getting in touch with multiple people, food habits, etc.

Yet, there is considerable room for growth. For example, recent statistics show that only 15% of the 560,000 doctors in the United States use the internet to order medication, and only about 5% of patients communicate with their health care providers through email. That these trailing edge e-medicine applications are so little used suggests that the promise of wireless medicine is only now being hinted at. Innovation in wireless medicine presents significant opportunities for advancement not only in diagnosis and treatment, but also in the use of medical information for the health and education of the patient, the physician and the healthcare provider.

Broader Impact: The Center of Excellence for Wireless and Information Technology (CEWIT) has created its Medical Division to link between researchers and practitioners in both academia and industry, on digital, inter-networked wireless medical systems. The main vision of CEWIT is that of a holistic end-to-end infrastructure with the following specific impacts:

- Develop the research, educational, and industrial infrastructure for the next generation of digitally-driven wireless health monitoring, including emergency and triage facilities, as well as implantable and free-floating wireless patient sensors.
- Evaluate existing medical wireless systems and design a set of recommendations aimed at maximizing the beneficial immediate impacts of existing information technologies in medical systems.
- Explore, prototype and validate designs for tomorrow's personal electronic medical records (EMR) infrastructure.
- Act as a public resource providing expertise to the healthcare and government communities as well as the public, on technological advances in digitally-driven wireless medicine systems.
- Widely disseminate our research to enable future infrastructures to benefit from the center's work.
- Educate and dramatically impact both undergraduate and graduate curricula, through a multi-disciplinary approach.

CEWIT Medical Division

Recognize the dominant role of Information Technology and Wireless Technology in modern medicine, the Medical Division was established in 2008. The Goal of CEWIT Medical Division (CEWIT-MD) is to conduct research and development leading to the building, prototyping and marketing of medical devices, products and technologies that support patients and clinical care providers. CEWIT-MD designs and implements solutions that can solve real health-care problems, simplify clinical IT operations and, ultimately, help improve patient care. The Division research areas are diverse and cover wireless medicine, the cardiovascular system, radiology, Clinical Pharmacology, imaging modalities, virtual reality, telemedicine, wireless tracking, wireless ad hoc networks, home-care medicine, computational genetics and protein docking, implantable sensors and evidence-based medicine.

CEWIT-MD combines related programs which are being researched and investigated on the campuses of the SUNY system and its Medical Centers. CEWIT-MD scientific staff advises on the wireless infrastructure, regulation guidelines and market survey for its programs. As a result of our activities, we are establishing the **Institute of Wireless Medicine** to advance the knowledge, research and technologies in this most important branch of modern medicine.

Selected Current Projects

- **E-Health and Developing Countries**
 - Patients monitoring technology is built into home monitors, providing better management of chronic disease and reducing costs & future hospital visits.
- **Wireless and Information Technology Emergency Center**
 - Wireless monitoring makes diagnosis certain, vital signs could be automated and early warning system helps faster decisions.
- **RFID Tracking**
 - End-to-end tracking (minimizes human element) with active RFID tag, combining RFID and Wi-Fi solutions
- **Medicaid Utilization Threshold Modernization**

- Customize thresholds at the beneficiary level based on clinical information: Claims information, Diagnostic information, Pharmacy information, other relevant criteria (procedures, age, gender, etc.)
- **Automatic Identification of Lost Dentures**
 - Every year tens of thousands of dentures are lost because the patients misplace them. We have built a system in which an RFID device is embedded in the denture and RFID reading monitors are installed in central locations of the facility (hospital, nursing home or home).
- **Implantable Sensors**
 - Design and implementation of implantable sensors that are extremely small, yet they can be activated on demand and wirelessly transmit vital information.
- **Field Deployable Biosensors**
 - Developing medical biosensors and sensor networks with integrated, real time, dynamic wireless data transfer capabilities in order to address the new challenges and meet the critical need of improved health care at low cost.
- **Computational Systems to Support Clinical Practice**
 - We are developing health service infrastructures that benefit from the revolutionary advances in computing and information processing systems.
- **Patient Monitoring in Emergency Units**
 - We are building the next generation of emergency and triage facilities, through the simultaneous development of attached sensors and miniature, implantable and free floating sensors. We are also building the multi-hop wireless sensor networking technology, enabling efficient large-scale data processing in the sensor network itself.
- **Evidence Based Medicine**
 - Our new methods and systems examine the evidence presented in medical reports and data. Application of scientific methods to clinical practice ensures the best prediction of outcomes in medical treatment.
- **Non-invasive electrolyte monitoring**
 - Development of sensor systems to measure, non-invasively $[K^+]$ and/or $[Ca^{2+}]$ concentration using optical and biochemical techniques, thus evaluating an electrolyte imbalance.
- **Health Management Systems**
 - We are focusing on information exchange of medical records across multiple organizations. We have become the driving force behind the wave of electronic information conversion, and a showcase for every improvement in information transmittal.