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Colorado State Hosts World's Leading Scientists in Electrical Impedance Tomography, a Novel Medical Imaging Technology

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Electrical impedance tomography is an innovative imaging technology that is improving the way medical procedures are conducted and could eliminate the need for many painful, invasive, radioactive or expensive diagnostic procedures. Colorado State University is hosting the world's leading researchers in this field for the inaugural Mummy Range Workshop in Electrical Impedance Tomography August 1-7 at the school's main campus and at its Pingree Park Campus (located in the Mummy Range Mountains) west of Fort Collins.

Jennifer Mueller, professor of mathematics at Colorado State and a renowned leader in EIT, is co-organizing the international conference that includes more than 50 prominent physicians, engineers, computer scientists and mathematicians from 10 different countries. The five-day conference will focus on improving all aspects of the science, including enhancing equipment, processes and the mathematical algorithms that render electrical data into two- and three-dimensional images.

"Electrical impedance tomography is a relatively new technology with a potential to greatly enhance medical imaging procedures. Two important applications are the early detection of breast cancer and the diagnosis of pulmonary embolus (a blood clot in the lung)," said Mueller. "There is a strong interplay in EIT between engineering, mathematics and medical science. This conference brings together the world's leaders in EIT from all of these fields so we can work together and continue advancing this effective and beneficial medical technology."

While x-rays measure tissue density and ultrasounds measure the tissue's acoustic properties, EIT technology provides information about an additional tissue property, the conductivity of the tissue.

Electrical impedance is a measurement of how electricity travels though a given material. Every tissue in the body has different electrical impedance determined by its molecular composition. For example, a breast tumor by the nature of its cellular makeup has a different electrical conductivity than normal breast tissue. Tissue that is malignant has a much lower electrical impedance, or conducts electricity much better, than does normal tissue or benign tumors.

Electrical impedance tomography is a non-invasive imaging technique that uses measurements of electromagnetic fields outside the body to reconstruct and display approximations to the electrical conductivity inside the body. Compared to other imaging methods, EIT is cheaper and the technique requires no radiation or invasive procedures. The technology is not painful for patients and is safe for long-term monitoring.

A medical professional utilizing EIT attaches electrodes to a patient's skin and the EIT system applies low-level electrical currents through the electrodes. The resulting voltages on the electrodes are measured and processed by a specially developed reconstruction algorithm that computes the conductivity and permittivity distributions within the body. A separate algorithm then maps the output into real-time images.

The technology can be utilized to examine a wide variety of medical conditions: the pumping action of

the heart or lungs can be examined; respiratory measurements of the lungs can be analyzed; and measurements of gastric emptying inside the stomach can be imaged and investigated. Other applications being investigated include the measurement of pharyngeal transit times, diagnosis of swallowing disorders, respiratory screening to look for emphysema and pulmonary emboli, and the measurement of cardiac output. Electrical impedance imaging is currently used most extensively in the medical field for breast cancer examinations.

Conference participants are working to improve EIT systems, miniaturize equipment and develop mobile imaging diagnostic capabilities that can extend a doctor's or paramedic's ability to make quick decisions about a patient's care. The researchers are also analyzing ways to develop enhanced hardware and more complicated reconstruction algorithms to produce higher resolution images.

The conference will take place on Colorado State's main campus August 2 before moving to the Pingree Park campus for the remainder of the workshop. For more information about the Mummy Range Workshop in Electrical Impedance Tomography, visit the Web at www.eitworkshop.org.

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