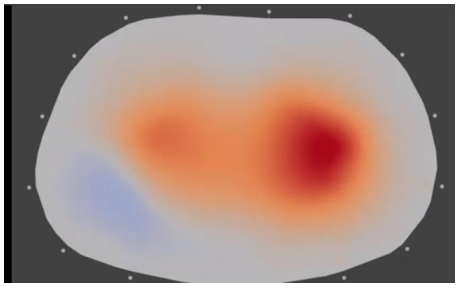
Non-invasive, Radiation-Free, Portable Imaging With EIT

Electrical impedance tomography is an experimental noninvasive medical imaging technique in which the electrical impedance of a part of the human body or other object is inferred from surface electrode measurements and used to produce a tomographic sliced image.

Electrical Impedance Tomography (EIT) is a non-invasive, radiation-free, portable/bedside imaging technology that maps regional tissue conductivity—especially for lung ventilation and perfusion—by applying weak alternating currents via surface electrodes. It provides real-time, high temporal resolution images of physiological changes with limited spatial resolution. It is an imaging technique that visualizes conductivity or impedance distributions both in 2D and in 3D and over time. World leading scientists in the field are using EIT solutions both in research and in practical applications, ranging from the classical medical (lung ventilation and limb monitoring), and industrial applications (pipe system monitoring and contamination tracking) to state-of-the-art chip based EIT for biosensing applications.

Key Aspects of EIT:

- **Applications:** used for continuous monitoring of lung ventilation and perfusion in ICU patients (especially during mechanical ventilation, as shown in this YouTube video), managing respiratory failure (e.g., PEEP titration), and assessing regional lung recruitment.
- **How it Works:** Often, a set of 16 electrodes is placed around the chest. It injects low-amplitude electrical currents (<5mA) and measures resulting boundary voltages to reconstruct electrical conductivity images of the lungs.
- **Advantages:** Non-invasive, no radiation, high temporal resolution (up to 50 frames/sec) and enables continuous, real-time bedside monitoring.
- **Disadvantages & Limitations:** Offers poor spatial resolution, is sensitive to sensor movement/skin contact quality and generally provides "differential" rather than absolute images.
- **Cost:** Specific commercial systems vary in price, though some open-source or wearable options have been documented for lower costs.



EIT acts as a valuable tool for visualizing lung recruitment maneuvers, such as identifying if a lung is collapsing or opening up over time. For Lung Imaging, ScioSpec has a LungEIT Kit, an all-in-one solution that provides everything needed to start exploring lung imaging with ease and precision, whether for preliminary research or developing new diagnostic tools.

In contrast to most other tomographic imaging techniques, EIT does not apply any kind of ionizing radiation. Currents typically applied in EIT are relatively small and well below that which would cause significant nerve stimulation. The frequency of the alternating current is sufficiently high not to give rise to electrolytic effects in the body and the power dissipated is small and diffuse, easily handled by the body's thermoregulatory system. These properties qualify EIT to be continuously applied in humans, e.g. during mechanical ventilation in an intensive care unit. Because the equipment needed in order to perform EIT is much smaller and less costly than in conventional tomography, EIT qualifies for continuous real time visualization of lung ventilation right at the bedside. EIT's major disadvantage versus conventional tomography is its lower maximum spatial resolution (approximately 15% of electrode array diameter in EIT compared to 1 mm in CT and MRI). However, resolution

can be improved using 32 instead of 16 electrodes. Image quality can be further improved by constructing an EIT system with active surface electrodes, which significantly reduce signal loss, artifacts, and interferences associated with cables as well as cable length and handling. In contrast to spatial resolution, temporal resolution of EIT (0.1 milliseconds) is much higher than in CT or MRI (0.1 seconds) and the cost is significantly lower.

Sciospec Scientific Instruments (Germany) specializes in research solutions for electrical impedance spectroscopy, impedance tomography, electrophysiological and electrochemical techniques. Their products are used by research institutions and universities worldwide. Products offered include **Impedance Analyzers, precise LCR meters, and Electrical Impedance Tomography instruments**. Their Medical Research ISX-3 impedance spectroscopy instruments are used in medical research applications that require ultimate patient safety. Their scalable and flexible technology platform allows for precise, customizable, yet cost-effective lab-bench impedance analyzers, with three standard instruments being available with some powerful options to perfectly fit individual applications. Sciospec stands for Electrical Impedance at its best. Their Electrical Impedance Tomography (EIT) is a novel imaging technique that visualizes conductivity or impedance distributions both in 2D and in 3D. Sciospec has partnered with world leading scientists in the field to deliver solutions that enable using EIT both in research and in practical applications.

Primary applications are bio-analytics, medical research, material science and component testing. From small scale biochip and point of care solutions over multichannel biochip-readers up to massive-multichannel solutions for fully automated industrial process control or high content screening for pharmacological testing. Sciospec technology in the form of OEM modules is at the heart of countless products for bioanalytical and medical applications. Their highly customizable solutions enable turn-key research, power the next generation semiconductor manufacturing, and enable new levels in scalability for automated component test applications all over the world.

Sciospec instruments are used in a wide and fascinating range of research fields. Saelig is their USA technical distributor: https://www.saelig.com/category/sciospec.htm