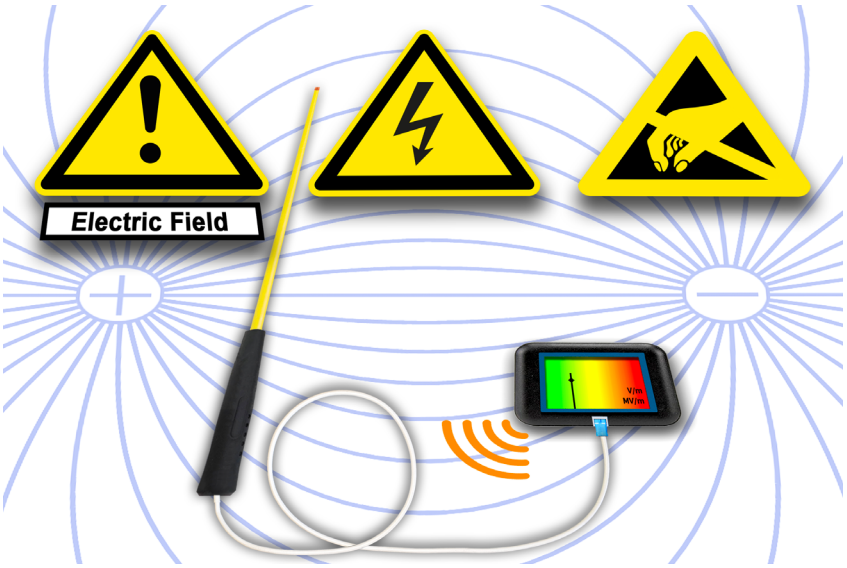
TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

Institute of Sensor and Actuator Systems
Gusshausstr. 25-29
1040 Vienna
Austria
www.isas.tuwien.ac.at/EN

New microsensors for electric field strengths

Measure electric fields and voltage with a safe, mobile, robust and contactless device

The fundamental physical parameter of electric field strength was discovered over two hundred years ago, but until recently, no reliable method was available to measure it quantitatively. Static and low-frequency fields of up to about 10 kHz have proved particularly difficult to measure; they are liable to be disrupted by the measurement or sensor itself. An earthed lead, changes in the surroundings, or metal components can all strongly distort them. As a result, until now measurements of such fields have been of very limited utility. With the current methods, reliable measurements can only be conducted under well-controlled conditions and in many cases do not even allow reliable measurements to be made. At present, measurements of this type are time-consuming, because systems can't be calibrated prior to being emplaced. Currently available measurement systems consist of mostly electro-mechanical components, which make them error-prone. Apart from that, they are often bulky and heavy, which places strong limitations on how and where they can be used.



Critically important measurements of static fields and low-frequency alternating fields or direct current fields are available for the first time in a practical and reliable form

Objective

"To develop sensors that are small, light, reliable, simple and safe to use", this was the goal targeted by Prof. Franz Keplinger and his research group at the TU Wien, together with colleagues from the Danube University Krems.

Solution

The new sensors are based on microstructures that make them both highly reliable and capable of an extremely fine level of resolution of detail. These structures convert electric field strength into mechanical oscillations that are subsequently optically analysed, avoiding any of the usual repercussions of measurement. The sensor can be used in an active or passive mode, according to the application. Electrical excitation necessary for implementation of the active mode is transmitted directly to the microstructure without any electrical earth connection – meaning the field being measured is hardly disrupted. For that reason, the measurement system can be pre-calibrated, is portable and uncomplicated to use.

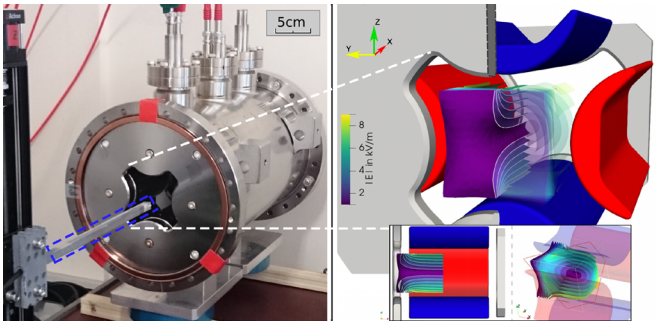
Results

The sensor is about 6x6x1 mm³ in size. It is equipped with robust optoelectronics, and is connected by a fibre-optic cable to a compact data processor, powered by a small battery.

So far, deployment of the new measurement technique has yielded excellent results: the technique makes it possible to measure even small field distributions with a high degree of accuracy, and the new system produces reliable results. As an example, at the European Council for Nuclear Research (CERN), the device measured the electrical fields of components used to manipulate particle streams to a previously unreachable degree of precision.

The technology used to fabricate the microstructures is proven and results in extremely reliable, robust systems (MEMS). Scale-up of production is highly cost-effective.

The new E-field sensors are distinguished by a whole series of unique characteristics. Their special new properties allow them to perform analyses in areas for which there have historically been no satisfactory solutions.



Probe (blue dotted line) with sensor at the tip during measurement of the field in a device used to focus particle streams at CERN, and the results of measurement (right)

Notes

Applications

- warning device for high voltage (“Geiger- counter“ for electric fields) – for employees working in or near substations and power lines, for cranes, lifting platforms, airplanes, helicopters, drones, etc.
- electrostatic discharge warning (ESD-protection)
- prevention of dust explosions (i.e. flour, wood shavings)
- display of residual charge (i.e. in high voltage lines taken off-line)
- monitoring of actual exposure-limits for electric fields (direct and alternating current lines, hybrid lines, substations, etc.)
- storm- and lightning warnings
- display of remaining charge for batteries and accumulators – contactless
- contactless recognition of objects

Advantages

- sensor for contactless measurement of electric fields
- contactless measurement of direct and alternating current (DC, AC)
- suitable for high, middle, and low voltage
- suitable for both mobile and stationary applications
- very high sensitivity – advance warning from a large distance
- highly safe, high quality measurements
- robust and long-lived
- no earthed leads – potential-free system
- no on-site calibration necessary – testing can begin on arrival
- simple to use – no special training necessary
- inexpensive customisation is available

Contact

Prof. Dr. Franz Keplinger
TU Wien –
Institute of Sensor and Actuator Systems
www.isas.tuwien.ac.at/EN
+43 1 58801 36640
franz.keplinger@tuwien.ac.at, rema@tuwien.ac.at