



1 Use case: *Sitting pressure sensing in a wheelchair.* Photo: Dirk Mahler, Fraunhofer IFF

TEXTILE SENSORS FOR SURFACE PRESSURE SENSING

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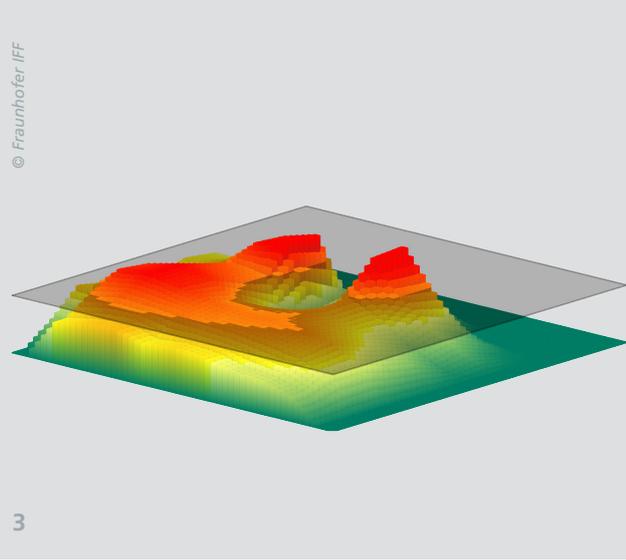
Motivation

Sitting and lying are basic human postures. The majority of body weight always rests on the same parts of the body, e.g. the buttocks or thighs. Stresses on certain body parts intensify whenever an individual stays seated largely unmoving, as office workers, truckers or people with illnesses or limited movement frequently do. Areas of skin and connective tissue on which body weight rests are compressed, the oxygen and nutrient supply is impeded, and the transport of metabolic products slows. Lengthy immobility in one position causes pain and stresses skin. Poor posture is preprogrammed in healthy individuals, but can damage cells and tissue and even cause decubitus ulcers in individuals dependent on care. While independent and active changes of sitting posture counteract the problem, such dynamic sitting is impossible

in many situations. Sensors and actuators can be employed here as support systems that relieve the stress on specific body parts. To this end, the pressure on the point of contact between a body and seat system has to be measured and the seat system has to be adjusted to an individual's body shape depending on the situation.

Solution Approach

A technology developed at the Fraunhofer IFF determines pressure and force distribution on surfaces on the basis of textile materials and manufacturing methods. The use of textile components for sensing delivers beneficial features such as good haptics, high flexibility and breathability. The ingenious design and a suited data analysis system make it possible to sense pressure distributions in high resolution and over



large areas. The sensor design employs materials already present in the upholstery of seats and beds without altering their properties noticeably. The modular design of the textile and electrical components makes it easy to configure a sensor mat for different applications.

Method of Measurement

The method of measurement developed is based on sensing the deformation of textile upholstery and cushioning materials as a function of force. Based on the sensor principle employed, a change in distance, e.g. caused by sitting on the mat, causes a change in the electrical capacitance or resistance. Smart data analysis electronics detect changes in the measured signal and present the pressure online by intensity and location.

Features of the System

The use of common, textile materials to qualify sensors makes low-cost, spatially resolved sensing of pressure and force possible. The completely flexible and stretchable sensor mat can be fit to curved surfaces and thus integrated in existing interiors very easily. Dimensions, shape, spatial and force resolution, sensor thickness and covering material can be configured based on the use case. The use of standard textile manufacturing methods delivers low-cost solutions with high sensing performance that are interesting for large-scale use.

Applications

- Comfort and ergonomics: Ascertainment of pressure distributions during sitting and lying to adjust and regulate support contours
- Medicine: Bed systems for decubitus prevention and therapy
- Safety: Contact and collision detection, seat occupancy detection
- Human-machine interaction: tactile input devices

Our Products and Services

In projects, we develop and implement custom system solutions on the basis of textile sensor components. System solutions consist of custom sensor systems with integrated electronics and corresponding methods and systems for calibration, data capture and analysis.

2 Textile sensor mat customized for a wheelchair. Photo: Dirk Mahler, Fraunhofer IFF

3 Color coded representation of a seat impression and visualization of critical pressure zones.