Finite Element Modelling of the human foot: a tool for the design and assessment of podiatry interventions

Bucki M., Vuillerme N, Cannard F., Diot B., Payan Y.
TIMC-IMAG, UMR UJF CNRS 5525 (La Tronche, France), TXS (Montceau-les-Mines, France), AGIM Laboratory, CNRS FRE UJF (La Tronche, France), IDS (Montceau-les-Mines, France).

Orthotic device conception faces an important issue when it comes to objective evaluation of its adequacy to the patient's morphology. The fit of an orthosis can be quantitatively assessed through the measurement of surface pressures at the device-body interface which subsequent analysis may lead to a sensible design improvement. Unfortunately pressure sensors are often expensive, lack versatility and can be difficult to integrate within the device without affecting the measurements accuracy.

The novel TexiSense pressure sensing fabric overcomes these issues and allows robust pressure acquisition at the orthosis interface in everyday wear conditions. The contributions of this technology can be foreseen in a wide range of application: from amputees to posture control. Here, we illustrated its use in the field of podiatry where the inner sole and outer shoe design is driven by the pattern and magnitudes of internal tissue stresses measured during gait. To this end a TexiSense pressure sensor was coupled to a real time Finite Element biomechanical model of the patient's foot. This system is able to perform a continuous estimation of internal peak pressures and accumulated stress dose in normal wear conditions. From these data objective criteria can be derived to enhance the orthosis design.