CONSTRUCTION OF SENSOR INSOLES FOR PRESSURE AND TEMPERATURE MEASUREMENT

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INTRODUCTION: Plantar pressure measurements are used to quantify static and dynamic pressures as a measure of foot function during gait[1]. In spite several technologies of plantar pressure measurement have been developed in the last years[1], most are costly specialized equipments that present some limitations, such as short life time (corrosion or damage of the base circuit during use), operational complexity and measurement errors caused by the (high) thickness of sensor insoles. In addition, concomitant measurement of temperature is not possible at commercial equipments. This work describes the development of a sensor insole system for the measurement of plantar pressure and temperature, in real time.

METHOD: The sensor system consists of a thin sensor insole (produced with a polyimide film on which a copper circuit was electrodeposited) divided in parts following foot anatomy. Each part contains a *sensor element* deposited on an electrical contact point of the circuit by compression moulding. In addition, three temperature sensors (thermo resistors) are placed at different points of the insole. The s*ensor element* is a cast composite film prepared with rubber (KELTAN® 5508, DSM Co.), conducting filler (CPMCB, Eeonix Co.) and crosslinker (Vulcaresen PA 510® - Hoechst). *Data conditioning system* is a transistorized amplifier in common emitter. The software for data acquisition was programmed in C++ language (data acq.: 100 kHz). Five calibration experiments were conducted placing standard weights on a 500 N reference load cell. Each dynamic experiment consisted of six cycles of compression/decompression in a stress-strain machine (EMIC, DL 3000). The potential difference produced at the sensor by the applied force was acquired at by a PCMCIA PC CARD, DAS 16/16 – AO - *Computer Boards*®, A/D converter (16 bits, 16 channels, bipolar input: ± 1.25V - ± 10V).

RESULTS AND DISCUSSION: The linearity of the reference load cell is of $r^2 = 0.99999$. Preliminary dynamic experiments showed that the sensor response is similar to the reference, even at different acquisition rates and at several cycles. Temperature data obtained at the thermo resistors will be used to monitor the temperature inside de shoe. Experiments of applied pressure at different temperatures will be conducted in order to obtain a function and calculate a correction factor, to compensate temperature effects at the sensors readings. Experiments of calibration (pressure and temperature) at different parts of the insole, precision and repeatability over time are still in progress.

CONCLUSION: The sensor insoles show a nearly linear dynamic response, compared to a reference system. This system presents the concomitant pressure and temperature measurement in real time as technology innovation.

REFERENCES:

Putti, A B *et al*. (2006) The Pedar1 in-shoe system: Repeatability and normal pressure values. *Gait and Posture*, 25 401-405.