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Lessons learned in the past for a brighter future for pressure ulcer prevention and management

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ABSTRACT BOOK

STINTS10

LOW FREQUENCY ULTRASOUND DIAGNOSTICS SENSOR FOR PRESSURE ULCERS

Elis Marina Sales de Castro[1], *Betty Lemaire-Semail*[1], *Frédéric Giraud*[1], *Michel Amberg*[1]

1 *Université de Lille, Arts et Metiers Institute of Technology, Lille, France*

Introduction: Mechanical properties of skin are a clue for the diagnostic of pressure ulcers (PU) [1]. This project proposes a low-frequency ultrasound (LFU) device to identify the mechanical impedance (MI) of skin in different sites. The device's goal is to identify the evolution of MI of skin over time and link it with the development of PU.

In literature, studies involving LFU and PU focus on debridement through LFU cavitation [2]–[3]. Use of LFU on PU often present reduced pain and faster recovery. Although LFU for PU treatment is widely documented, the use of LFU for diagnosis is unexplored.

Thus, a Langevin transducer (LT), with 60kHz of resonance frequency is proposed for PU detection. It is a high efficiency LFU device, based on the piezoelectric effect.

Methods: A set-up consisting in a host PC, a microcontroller, power supply and a LT was implemented (Figure 1). A vector controller [4] was designed to maintain the vibration velocity controlled.

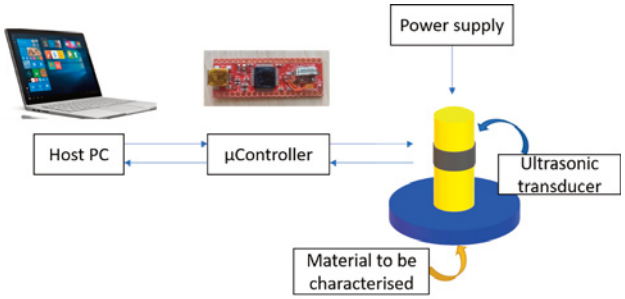

Figure 1. Set-up of the system

To achieve skin analysis, first we assessed the mechanical reaction force from skin in different body sites. Then, identified the tested skin site through this measurement, so the device can be validated as tool to characterise skin MI.

For this test, a ramp-like vibration is demanded from the device. The tests are performed at a no-load condition and in-contact condition. Due to the control, the vibration is the same for both tests. However, the effort to keep this vibration is reflected in the input voltage ($v_{(in\text{-}contact)}$ and $v_{(no\text{-}load)}$). The skin force is then calculated by the equation:

$$f_r = N(v_{(in\text{-}contact)} - v_{(no\text{-}load)})$$

Where f_r is the force imposed by the skin and N is an LT intrinsic constant.

Results: Due to the structural difference, the forearm and the palm of the hand were tested. Figure 2 presents the results from 3 subjects (1 female).

From the results, it is possible to identify the tested body spot by its response curve. Further studies are needed to validate the device.

Conclusions: The characterisation of skin by its mechanics is the initial step for this research. We hope to stablish a link between these characteristics and PU, to use this device for early stage PU diagnostic.

References:

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