Touch sensor for rehabilitation

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Sensor technology
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This work is carried out with a start-up company, active in the rehabilitation of elderly people, which has developed a medical device that simulates the movement of walking in the spine while the user is lying.

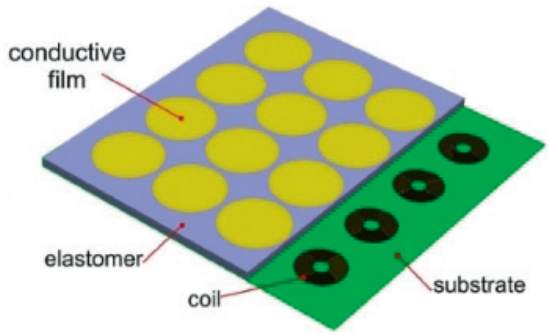
The goal is to create a 4x4 array of inductive tactile sensors that allows to determine the force applied to the surface of the medical device and assess the success of the therapy.

Motivation

Due to chronic lack of physical activity, more than 4 million senior citizens in Germany, Austria and Switzerland suffer from such severe spinal conditions that they have lost their autonomy.
The medical device offers a completely digitalized service around spine care for patients, care- givers and care management by simultaneously diagnosing, treating & reporting.
It instantly relieves pain, enhances mobility and secures or restores autonomy of elderly & dependent citizens. The device is portable, reduces workload and self-measures the effectivity in order to meet the policy of the Health Insurance Act according to “effectiveness, usefulness & cost-efficiency”.
To improve the effectiveness of the product it is necessary to set the correct speed to prevent the back from stiffening and creating even more pain due to sudden movements of the device
The creation of a sensor and analytic system for measuring the back footprint on the device is therefore crucial to determine the right speed of the device’s movement and the correct positioning of the patient’s back on the device, to maximize effectivity, efficiancy and benefit of the spine care.

Principle

To understand the operating principle, it is important to understand what the sensor is made of. This consists of three main parts: the coil, a conductive film and a structure made from an elastomer between the two parts mentioned before.
The functioning principle is mainly based on the Eddy currents that are created when an alternating electromagnetic field generated by a coil passes through an external metal object.
The Eddy currents in turn create an electromagnetic field that interferes with that of the coil. The closer the metal object is to the coil, the larger the ddy currents will be. As Eddy currents increase, there are increasing changes in phase and amplitude of voltage at the ends of the coil. A change in coil inductance can also be observed. These changes are used to determine the distance between the coil and the conductive film. If one wants to know the applied force and therefore the weight per pixel, one need to know the behaviour of the elastic structure between the coil and the conductive film, which is the mathematical curve of the deformation based on the applied force.



Inductive sensor array structure

Objectives

The main objective of this work is to create a 4x4 array of inductive sensors. The first objective is to have an elastic structure that is the most reactive in the necessary weight range, and then perform the second main objective which is the realization of a distance measurement by means of a coil and a conductive film. These two objectives will be used to realize the grid of sensors. This prototype will be completed with electronics (multiplexer, commercial readout electronics, µC controler,...) will be tested to define the reproducibility of the measurements, the long term duration and will also have to be affordable. These objectives will be used to see whether the sensors produced can be applied to a future product or whether other technologies need to be found to take measurements.

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