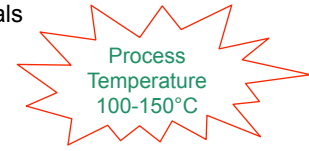


Investigation of Polymer Thick-film Piezoresistors for Medical Wrist Rehabilitation and Artificial Knee Load Sensors

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Motivation :

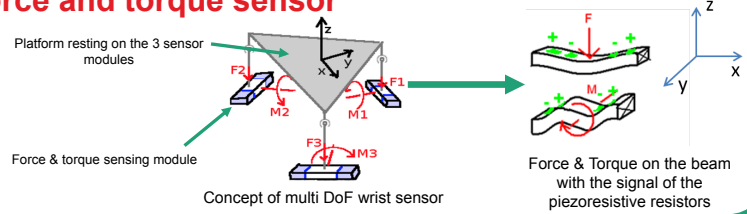
- Equip surgical instruments and implants with load sensors to monitor patient recovery and implant degradation
- A new solution for medical force sensors : Low-cost commercial polymer-based composite materials
 - Elastic substrate : glass fibre-reinforced epoxy (FR4) / PCB
 - Thick-film material : resin-carbon resistor and silver-epoxy conductor compositions



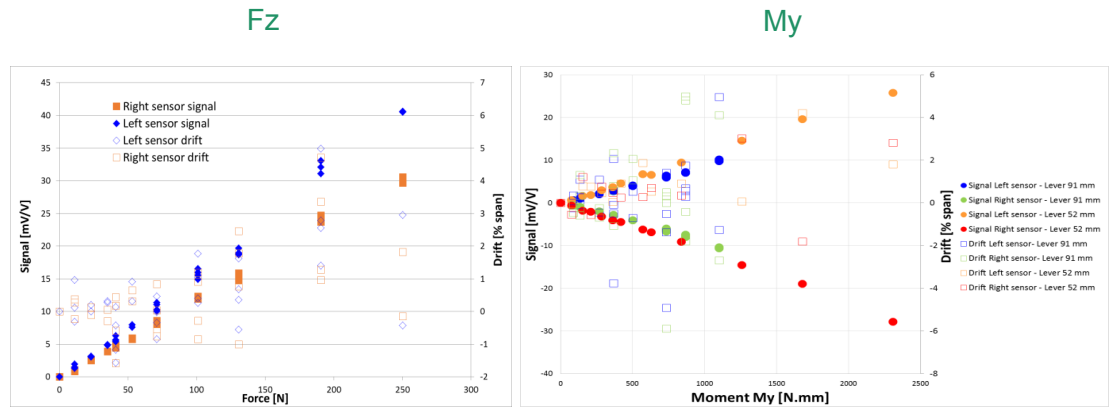
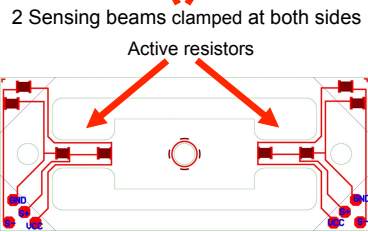
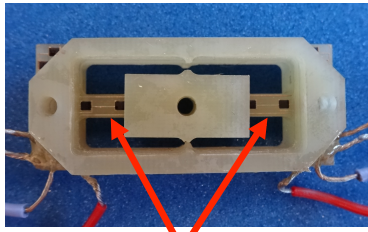
Most of medical sensors do not require excellent long-term stability against drift as industrial ones

Medical wrist rehabilitation : Concept of 6 DoF force and torque sensor

- 3 forces (F_x, F_y, F_z) + 3 Moments (M_x, M_y, M_z)
Obtained by combination of 3 force + bending moment sensors
- Each sensing element $\rightarrow F_z$ & M_y



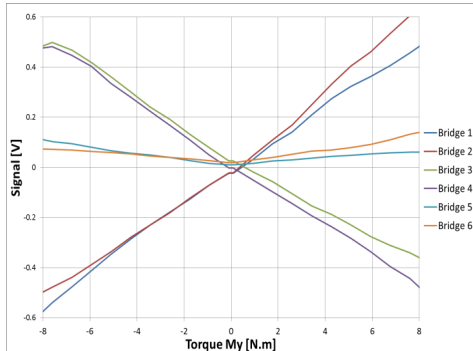
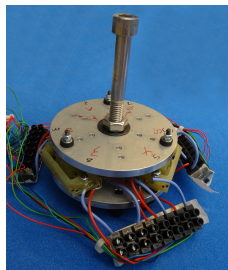
Force & Torque Sensor : Signal and drift of one module



- Span @ 250 N : 40 and 30 mV/V for of the left and right sensor
- Drift < 5 % of span
- Span @ 2.3 N.m : 25 mV/V
- Drift < 6% of span

Signal of the 6 DoF sensor

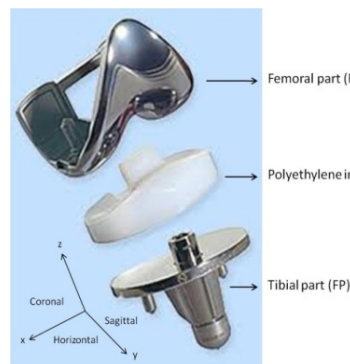
Response of 6 DoF sensor towards the bending torque M_y



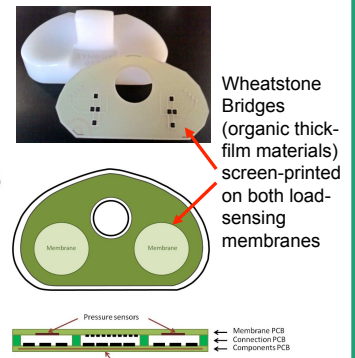
3 sensing elements fixed between 2 platforms. This configuration allows taking up all 6 forces and moments in a controlled manner.

- 2 element sensors in flexion and in opposition direction
- 1 element sensor in torsion \rightarrow very low signal

Artificial knee implant : Wireless prosthesis force sensor



F.I.R.S.T knee prosthesis by Symbios SA, Switzerland



Concept of combined PCB for load-sensing and wireless power + communications.

