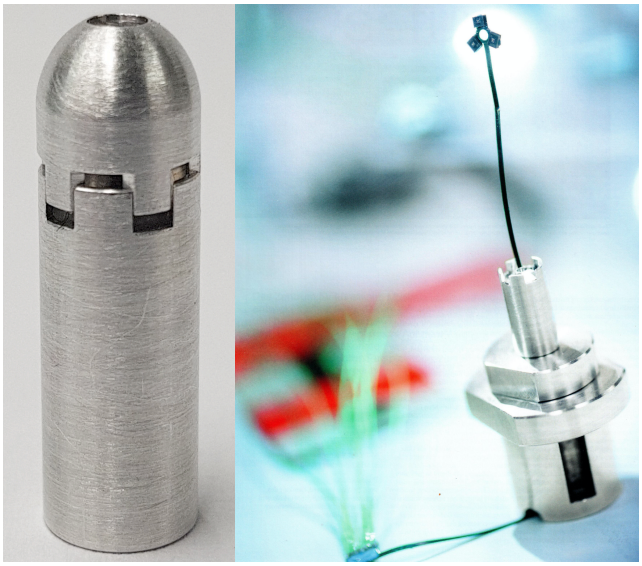
University of Basel

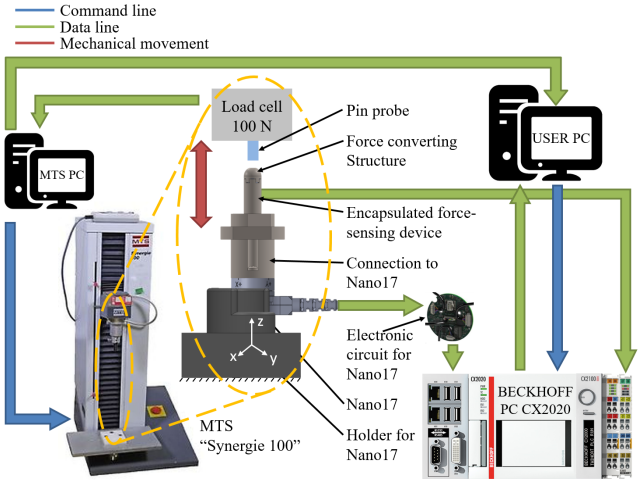
Department of Biomedical Engineering

Development of an Encapsulated Force Sensor for Endoscopic Palpation



(a) (b)

(a) Assembled encapsulated tri-axial force sensor for soft tissue palpation in neurosurgery (picture: Luca Marco Pavone), (b) Printed circuit board with the force sensors mounted on it - the core of the encapsulated force sensor (picture: WSS/F Brüderli Longhini)



The interaction of the different systems used for the characterization of the encapsulated force sensor and the data flow (picture: Luca Marco Pavone).

Master Thesis by Luca Marco Pavone (Eidgenössische Technische Hochschule Zürich – ETHZ) at BIROMED-Lab.

A minimally invasive examination is a technique which allows medical doctors or surgeons to examine inner tissue of the human body using endoscopes. However, surgeons can only base their examination on visual observations of structures, color, and shape of the tissue. Further, the possibility of endoscopic palpation thus a precise investigation of tissue mechanical properties (e.g. tissue stiffness) is infeasible in comparison with open surgeries where surgeons use their fingers to perform palpation. To reestablish the sense of touch to the surgeons in endoscopic procedures, we first aim to measure contact forces in three directions (one normal and two shear forces) at the tip of the endoscope. Additionally, the possibility of force measurement between the surface of endoscopic devices and tissue may increase safety in endoscopic procedures. If forces between endoscope and tissue exceed a certain threshold, a surgeon would be notified and possible tissue damage during both guiding and palpation phases may be avoided.

The aim of this thesis is the improvement of the encapsulated force-sensing device reported by Ivan Susic *et al.* (1) and its redesign for enabling soft tissue palpation in neurosurgery. The focus is on improving the mechanical robustness, enabling compliance, and reducing the outer diameter from 10 mm to 6.8 mm in order to comply with dimensions of endoscopes used in neurosurgery.

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References:
(1) I. Susic, A. Zam, P.C. Cattin, G. Rauter, "Versatile, force range-adjustable, tri-axial force sensor with integrated micro camera for the tip of endoscopic devices". The Hamlyn Symposium, 2018.