Section: **Mechatronik**

ID: 24

Abstract-Title:
TACTILE SENSORS FOR DETERMINATION OF ELASTIC CONSISTENCY DIFFERENCES IN BRAIN TISSUE MIMICKING PHANTOMS

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Abstract-Text:
Introduction:
In spite of the outstanding importance of neuronavigational techniques the neurosurgeon has still highly to rely on his visual as well as tactile sense and his experience in distinguishing tumor tissue from intact brain parenchyma. All the more, - as neuronavigation is based on preoperative imaging scans - considerable brain shift that may occur during surgery will lead to erroneous results. Furthermore, the surgeon looses his tactile sense during endoscopic surgery. Therefore control of tissue manipulation is limited today to the fiberoptic images, possibly ensured by neuronavigational supervision or haptic feedback systems. In robotic guided surgery tactile sensing will be crucial among other sensor systems to reach a maximum of operating safety. However human sense of touch is a highly complex sensory perception comprising epicritical and propiozeptive information processing. Further it comprises proportional, velocity and acceleration sensors, moreover in an enormous high resolution. Therefore providing a tool for intraoperative tactile perception will be a highly challenging task. Material and Method:
Different sensor concepts (strain gauge and resonant piezo) have been set up and adapted to distinguish elasticity differences in soft tissue mimicking gel phantoms. The strain gauges have been applied to two beams of different bending stiffness. The two tips of the beams act both on the material to be tested. The measurement of the two deflections allows for the calculation of the phantoms' stiffness. In contrast to this differential sensing concept, the piezoelectric sensor, which is driven at its resonance, measures stiffness and damping of the phantoms by evaluating frequency or phase shift and amplitude change. Gelatine gels of different concentrations (5%, 10%, 20%) have been used for a characterization of the sensor elements and their sensitivity to elasticity distinctions. Results:
Using the hand-guided strain gauge sensor differentiation of gel elasticity could be performed with high reliability [fig 1]. Under constant mechanical load also the piezoelectric sensor presented a linear dependency of tissue elasticity [fig 2]. Discussion:
As free hand guided tool the strain gauge system is usable by the human neurosurgeon. However, further miniaturizing is necessary to reach a sufficient spatial resolution. Moreover spring constants have to be adjusted to get reliable results by a gently tissue contact. The resonant piezoelectric sensor shows to a certain extent a load dependency of the phase shift caused by the operator. Hence the bimorph could be favoured in robotic guided applications in conjunction with a force-torque sensor. Though additional technical

optimisation of these systems is an inevitable need for in vitro and in vivo tests, further development of tactile sensor components will be promising.

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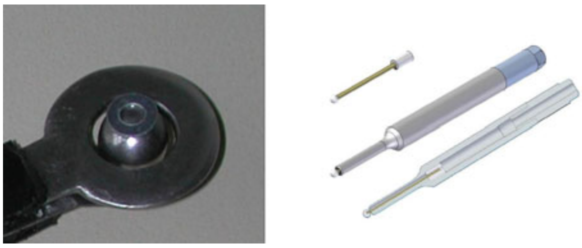

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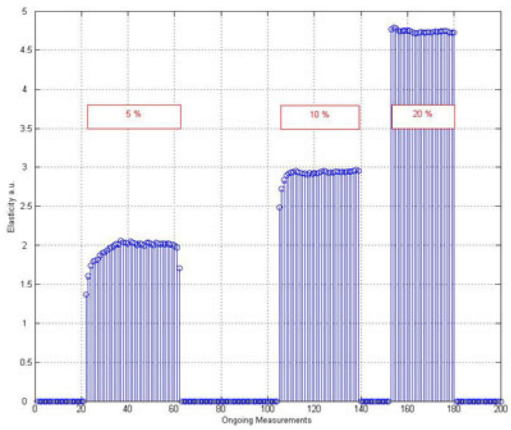

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