Reliable intraoperative delineation of tumor from healthy brain tissue is essentially based on the neurosurgeon's visual aspect and tactile impression of the considered tissue, which is-due to inherent low brain consistency contrast-a challenging task. Development of an intelligent artificial intraoperative tactile perception will be a relevant task to improve the safety during surgery, especially when-as for neuroendoscopy-tactile perception will be damped or-as for surgical robotic applications-will not be a priori existent. Here, we present the enhancements and the evaluation of a tactile sensor based on the use of a piezoelectric tactile sensor.

METHODS: A robotic-driven piezoelectric bimorph sensor was excited using multisine to obtain the frequency response function of the contact between the sensor and fresh ex vivo porcine tissue probes. Based on load-depth, relaxation and creep response tests, viscoelastic parameters E1 and E2 for the elastic moduli and η for the viscosity coefficient have been obtained allowing tissue classification. Data analysis was performed by a multivariate cluster algorithm.

RESULTS: Cluster algorithm assigned five clusters for the assignment of white matter, basal ganglia and thalamus probes. Basal ganglia and white matter have been assigned to a common cluster, revealing a less discriminatory power for these tissue types, whereas thalamus was exclusively delineated; gray matter could even be separated in subclusters.

CONCLUSIONS: Bimorph-based, multisine-excited tactile sensors reveal a high sensitivity in ex vivo tissue-type differentiation. Although, the sensor principle has to be further evaluated, these data are promising [1].

[1]
Stroop R, Nakamura M, Schoukens J, Oliva Uribe D. Tactile sensor-based real-time clustering for tissue differentiation. Int J Comput Assist Radiol Surg. 2018 Oct 6. doi: 10.1007/s11548-018-1869-5. [Epub ahead of print] PubMed PMID: 30293172.