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Multimodality smart surgical probe for breast cancer detection

Goal – Application of intelligent software with advanced multimodality sensors to provide real-time breast tissue characterization.

The software solutions and tools from this medical application will lead to the development of better real-time minimally invasive smart surgical tools for 1) space biological research and 2) medical care and treatment on long duration space flights.

The smart surgical probe is being designed to ‘characterize’ a suspicious lump in a breast in high dimensional space, using multimodality sensors to measure tissue parameters such as pO2, optical reflectance, stiffness, pH, etc.

NASA is collaborating with Stanford University School of Medicine (Dr. Stefanie Jeffrey, Chief of Breast Surgery) to develop the smart surgical probe for breast cancer diagnosis.

A commercial company, Bioluminate, licensed the technology and is conducting clinical tests of a prototype at UCDavis School of Medicine.

Robotic neurosurgery testbed

Goal - Application of intelligent software with advanced multimodality sensors and robotics to provide real-time tissue identification.

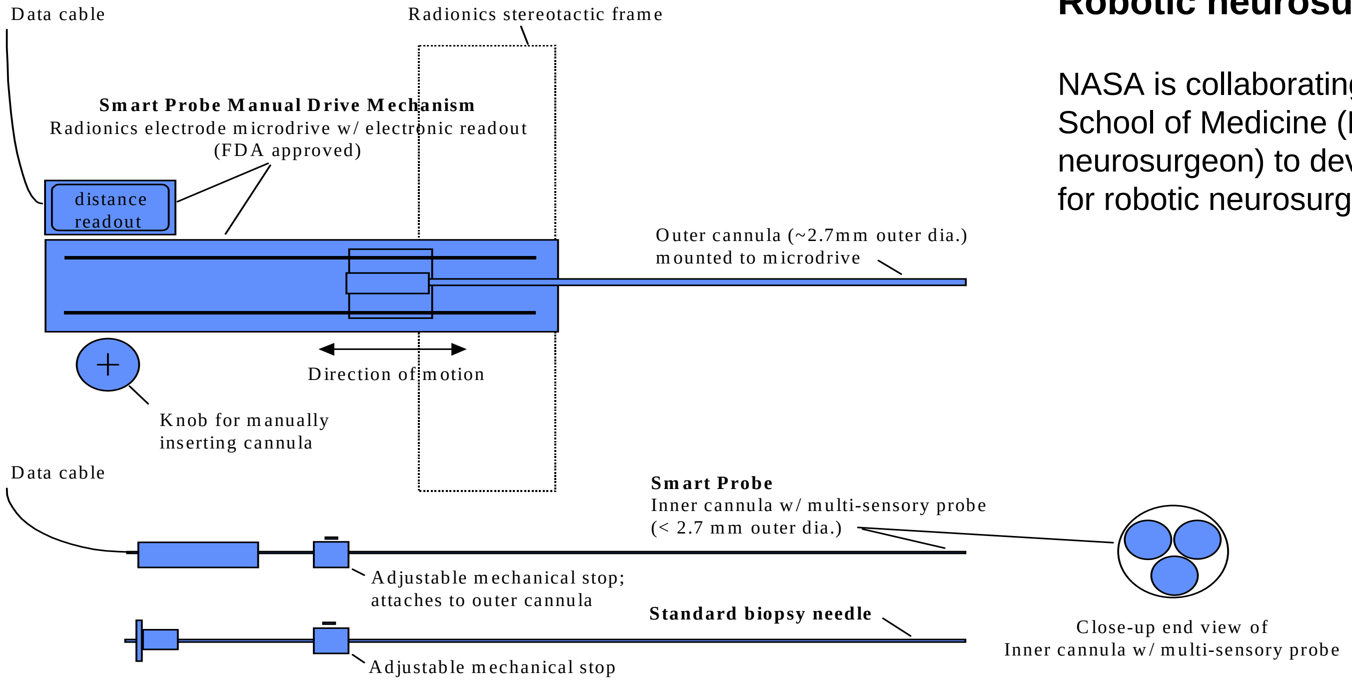
Stereotactic CT- or MRI-guided brain biopsy involves placement of a frame on the patient's head (under local anesthesia) followed by a CT or MRI scan.

In the standard technique, the biopsy needle is advanced manually to the appropriate depth; the present study uses a robotic or manually-operated microdrive. The multisensor probe is inserted in the outer cannula (see next slide) until it is at the tip. The cannula+probe is then advanced in one mm increments, i.e. the technique used for electrophysiological localization in functional procedures such as deep brain stimulation. Data acquisition is made every one mm until the cannula+probe reaches the depth for the first biopsy. Biopsy specimens are taken by removing the smart surgical probe and inserting a standard biopsy needle/forceps. The multisensor probe is reinserted if deeper biopsies are to be taken, and the cannula-probe advanced in one mm steps until the next biopsy (e.g. 5 mm deeper).

Although most tumors will be gliomas or metastases, we anticipate evaluating meningiomas also – in part because their distinctness on several parameters should make identification easier. The number of tissue types to be identified initially is seven (gray matter, white matter, blood vessel, low-grade glioma, high-grade glioma, metastasis, and meningioma).

Robotic neurosurgery testbed (con't)

NASA is collaborating with Stanford University School of Medicine (Dr. Russell Andrews, neurosurgeon) to develop the smart surgical probe for robotic neurosurgery.



Schematic Diagrams of Smart Probe Manual Drive Mechanism, Smart Probe, and Standard Biopsy Needle