ROBOCAST

ROBOt and sensors integration for Computer Assisted Surgery and Therapy

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The goal of ROBOCAST is to develop ICT scientific methods and technologies for robot assisted minimally invasive neurosurgery. A modular system, ,will be developed with two robots and one active bio-mimetic probe, able to cooperate among themselves in a biomimetic sensory-motor integrated framework. A gross positioning 6-axis serial robot will support a miniature parallel robot holding the probe to be introduced through a small opening on the skull of the patient. Optical trackers mounted on the probe end effector and on the patient skull, and electromagnetic position and force sensors mounted on the probe will extend robot perception by providing the control system with position and force feedback from the operating tools, and with visual information of the surgical field.

Key issue 1: A small footprint of the robot will be achieved by external sensor data integration and feedback. Small footprint is a key requirement for the acceptance of robotic devices in operating room.

Key issue 2: A Biomimetic flexible probe will give the proof of concept that curvilinear trajectories, in addition to the traditional linear trajectories, are possible within the brain allowing complex operations and opening new horizons for new diagnostic and therapeutic techniques.

Key issue 3: Path planning outside and inside the body will be autonomously performed by the control system by processing of preoperative diagnostic information. The path inside the brain will be planned on the basis of a “risk atlas” reproducing a fuzzy representation of a brain atlas, relating structures to a “level of danger”. Construction of the atlas will rely on cognitive learning, where the system will be able to provide the surgeon with explanations for any suggested action. Semi-autonomous plan updating, following unforeseen changes occurring during surgery and based on processing of information gathered intra-operatively (e.g. ultrasonic images), will be negotiated between the system and the surgeon, where the latter will be allowed to specify any additional constraints to the planner. Ex- ante- and final path plan inside and outside the body will thus stem from the interaction between the surgeon and the intelligent core of the system.

Key issue 4: The interface between the system and the user will require minimal interaction while providing maximum information i.e. an intuitive interface which relies on context-based interpretation of surgeon commands. Interface is a key point for smooth integration of robotic and image-based devices in the already “technology crowded” operating room.