Robotic platform

- Novel untethered micro-robotic platform developed for minimally invasive ultra-selective microsurgical procedures and targeted drug delivery: Preliminary characterization of tissue response to intraparenchymal navigation in ovine brain
- Treatment Plan Comparison Between Self-Shielding Gyroscopic Radiosurgery and Robotic Radiosurgery
- Minimally Invasive Robotic-Guided Facetectomy and Laminectomy for Transforaminal Lumbar Interbody Fusions: Feasibility, Workflow, and Early Results
- The 3D-Robotic Exoscope Compared With the Microscope in Cochlear Implant and Translabyrinthine Surgery
- A Computational Framework for Automated Puncture Trajectory Planning in Hemorrhagic Stroke Surgery
- Stiffness evaluation of continuum robots based on the energy method and castigliano's second theorem
- Multimodal imaging platform for enhanced tumor resection in neurosurgery: integrating hyperspectral and pCLE technologies
- Characterizing the complication profile of spinal robotic systems: A MAUDE analysis of device failures and associated complications by device manufacturer and brand name

A robotic platform refers to a combination of hardware and software systems designed to assist in performing specific tasks autonomously or semi-autonomously. In the medical field, especially in neurosurgery, robotic platforms are utilized to enhance the precision, efficiency, and safety of procedures. These platforms are often integrated with imaging technology and navigation systems to allow surgeons to perform delicate tasks that require high accuracy.

Key Components

Robotic Arm:

This is the mechanical part of the platform responsible for performing tasks like positioning, drilling, or inserting instruments with precision. The robotic arm mimics the surgeon's movements or follows pre-programmed paths based on surgical planning.

Control System:

The control system includes a computer interface that allows surgeons to plan the procedure and control the robotic movements. It typically integrates with imaging data such as MRI or CT scans to provide real-time guidance. Navigation System:

The navigation system helps the robotic platform accurately position tools or implants. It uses preoperative imaging data to create a 3D map of the patient’s anatomy and provides real-time feedback on the location of surgical tools relative to this map. Software:

The software enables the robotic platform to function, guiding the system through the planned tasks, tracking the position of tools, and helping with decision-making. The software can integrate artificial intelligence (AI) for advanced analysis and learning.

Imaging Integration:

Robotic platforms are often integrated with imaging modalities like MRI, CT, or fluoroscopy to ensure real-time visualization and navigation during surgery. This allows for more precise and minimally invasive procedures. Types of Robotic Platforms in Medical Applications: Surgical Robotic Platforms:

Used in various types of surgeries including neurosurgery, orthopedics, urology, and general surgery. Examples include da Vinci® Surgical System (used for laparoscopic surgeries) and ROSA® (used in neurosurgical procedures like SEEG and brain tumor resections). Diagnostic Robotic Platforms:

These are used for diagnostic procedures, such as biopsies, where precision is crucial. Robotic platforms assist in reaching difficult-to-access areas with high accuracy, minimizing tissue damage. Therapeutic Robotic Platforms:

Platforms like CyberKnife are used for non-invasive treatments like radiation therapy, where they help deliver precise doses of radiation to tumors while sparing healthy tissue. Rehabilitation Robotic Platforms:

In rehabilitation, robotic platforms assist patients with recovery after injury or surgery. These robots help in physical therapy, guiding patients through repetitive motions to regain mobility. Popular Robotic Platforms in Neurosurgery: ROSA® (Robotized Stereotactic Assistant):

Used in neurosurgical applications, particularly for electrode placement in epilepsy (SEEG), tumor resections, and deep brain stimulation (DBS). Mazor X™:

Primarily used in spinal surgery, it helps plan and execute the precise placement of implants, screws, and other hardware. Neuromate®:

A robotic platform designed for stereotactic procedures in neurosurgery. It supports accurate placement of surgical tools for brain biopsies, electrode insertions, and other interventions. iSys1:

A compact robotic platform designed for stereotactic neurosurgical procedures. It allows for high-precision tasks like deep brain stimulation and biopsies. Benefits of Robotic Platforms in Surgery: Precision: Robotic platforms offer sub-millimeter accuracy, crucial for surgeries in delicate areas like the brain or spine. Minimally Invasive: They enable surgeons to perform procedures through smaller incisions, reducing recovery time and risk of complications. Consistency and Efficiency: Robots can perform repetitive or highly detailed tasks more consistently than humans, reducing variability in surgical outcomes. Reduced Surgeon Fatigue: Automation and robotic assistance help reduce physical strain and fatigue for surgeons, especially in long and complex surgeries. Future Trends in Robotic Platforms: AI Integration: The incorporation of artificial intelligence and machine learning will further enhance decision-making capabilities, predictive analytics, and real-time intraoperative adjustments. Tele-surgery: Robotic platforms may enable remote surgeries, where surgeons operate on patients from different locations via robotic systems. Improved Haptics: Future platforms may provide surgeons with better tactile feedback, enhancing the sense of touch through robotic systems. Robotic platforms are revolutionizing surgery by increasing precision, improving patient outcomes, and expanding the boundaries of minimally invasive techniques.