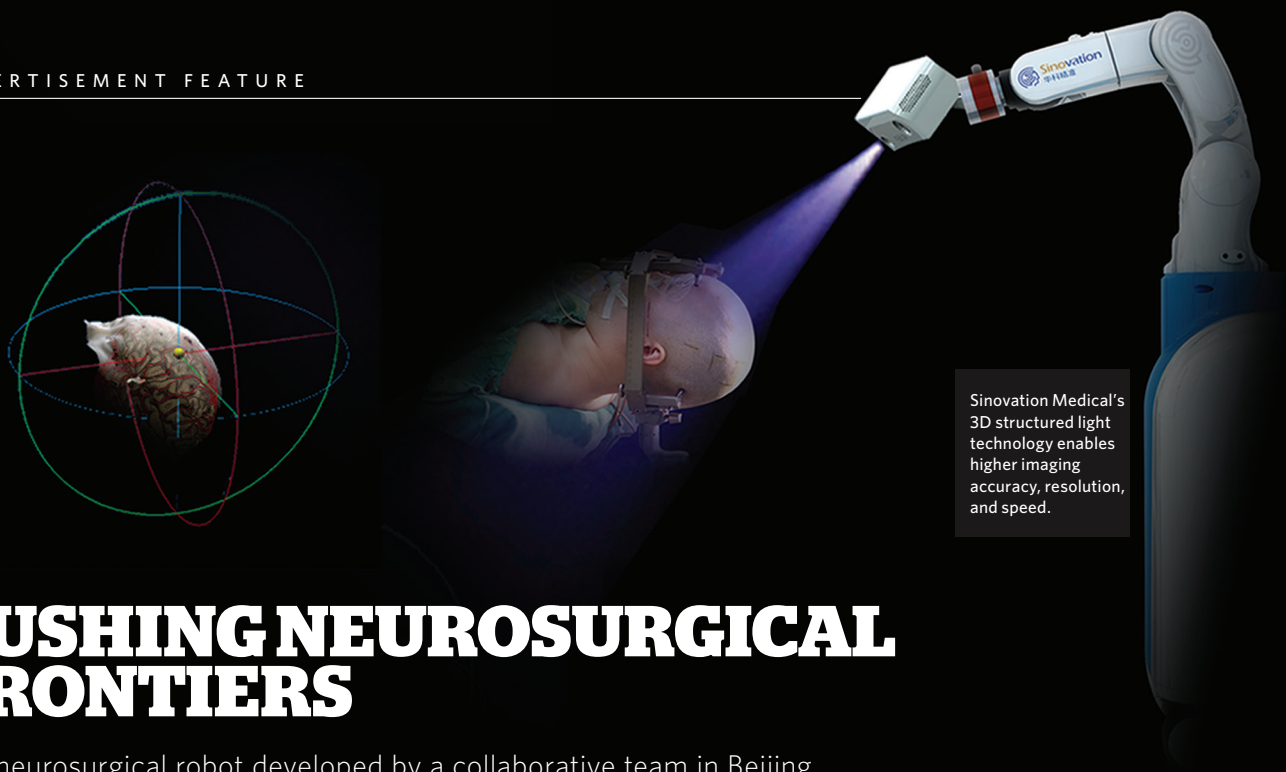

Sinovation Medical's 3D structured light technology enables higher imaging accuracy, resolution, and speed.

PUSHING NEUROSURGICAL FRONTIERS

The neurosurgical robot developed by a collaborative team in Beijing ENHANCES PRECISION AND SAFETY for surgery.

The anatomical complexity of the brain, and difficulties and risk associated with brain surgery, have hastened the rise of robot-assisted neurosurgery. A collaborative team from Beijing-based Tsinghua University, and a biotech company, Sinovation Medical, has set a goal to develop a next-generation intelligent minimally invasive neurosurgery system. The team has conducted exhaustive investigations into multimodal image computing, robot motion planning, and intelligent navigation in unstructured environments.

"We hope our robot can enhance surgeons' work, assisting with their vision, movement, and planning, to improve precision and safety," said Guangzhi Wang, chair of Tsinghua's Department of Biomedical Engineering. He and Wenbo Liu, Chief Technology Officer of Sinovation Medical, led the team to develop the Sinovation neurosurgical robot and associated software.

Ensuring accuracy and safety

In neurosurgery, traditional optical probe-based positioning is prone to errors, requires a separate system, and demands complex preparation procedures, including CT scanning. To improve positional accuracy, the Sinovation neurosurgical robot uses a robotic arm and a device based on three-dimensional (3D) structured light technique to automate these steps and achieve positioning without markers, reducing errors.

The robot is capable of environment modelling for obstacle recognition, based on scanning of the skull. An algorithm then allows it to automatically find the best surgical route, and move to the planned location efficiently and safely. Equipped with a high-precision pressure sensor and guided by a special algorithm, the robotic arm monitors its force feedback in real time, enabling a closed loop control system to regulate the force applied, ensuring safety.

The 3D visualization technology, based on multi-modal image integration, reveals the detailed intracranial structure. It allows surgeons to avoid vital blood vessels when planning for the puncture procedure, leading to a safe, personalized, and optimized surgical plan.

Innovations based on patients' needs

The Sinovation neurosurgical robot is now used in clinical studies at more than 100 tertiary hospitals across China for procedures dealing with epilepsy, Parkinson's disease, haemorrhage, and other brain diseases. In epilepsy, stereotactic electroencephalogram (SEEG) is increasingly used to help trace the origin of seizures, and identify a target for surgery. The Sinovation robot can help with inserting electrodes into the brain precisely for SEEG, reducing implantation time by more than 60%. Similarly, in Parkinson's and other movement disorders, robot-assisted electrode implantation allows for making surgical decisions in advance, guiding more precise targeting.

The neurosurgical robot also enables biopsy for intracranial lesions from various directions and angles, without the pain caused by installing a stereotactic head frame. It also negates the use of head frame in stereotactic aspiration for treating brain haemorrhage, potentially providing a safe and effective approach for locating and draining the hematoma.

Sinovation Medical has also teamed up with Jianmin Zhang's group, from the Second Affiliated Hospital at Zhejiang University School of Medicine, to advance brain-computer interface (BCI) technologies. Together, they proposed a robot-assisted implantation technique, allowing for precision at 0.1mm for each movement to accurately place an Utah Electrode Array at a target location, a critical step in clinical application of BCI for helping those with severe physical disabilities to communicate. ■

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