

# Getting to grips with enhanced dexterity

Close collaboration with surgeons has led to a versatile robotic technology allowing for both **SINGLE- AND MULTI-PORT** minimally invasive procedures.

## Robotic systems with

**improved dexterity**, accuracy, and ergonomics have been a great tool for minimally invasive surgeries. However, most of the existing surgical robotic systems, like the da Vinci Surgical System, are designed for a single configuration, allowing for either multi-port or single-port procedures. A versatile design accommodating both has yet to reach the market.

Beijing Surgerii Technology set out to fill that gap. Since its establishment in 2014, its researchers have been dedicated to developing next-generation surgical robotic platforms for multi-port and single-port

procedures, both essential for meeting diverse clinical needs. Single-port access, with one incision, is considered less invasive, while multi-port allows surgeons to work on more widespread tissues of interest. Adaptable tools capable of handling both are needed to enable complex surgeries in a confined operating theatre.

Continuum robots, featuring a continuously curving manipulator, inspired by elephant trunks or snakes, are highly manoeuvrable in restricted spaces. However, their flexibility comes at the expense of rigidity, raising questions about their clinical application.

The Surgerii team presents a solution in the dual continuum mechanism (DCM), in which the proximal and distal segments can bend in opposite directions, and the distal segments, or the tip, are driven by pushing and pulling dozens of super elastic thin nitinol rods. This has led to a 8mm-diameter manipulator strong enough to lift 500 grams, while dexterous enough to peel the shell from a quail egg without damaging the membrane inside.

With the arrangement of the nitinol rods, the DCM also features actuation modularity with enhanced reliability. Such a design allows the surgical manipulator to be inserted through single or separate ports flexibly, allowing for both multi-port and single-port procedures.

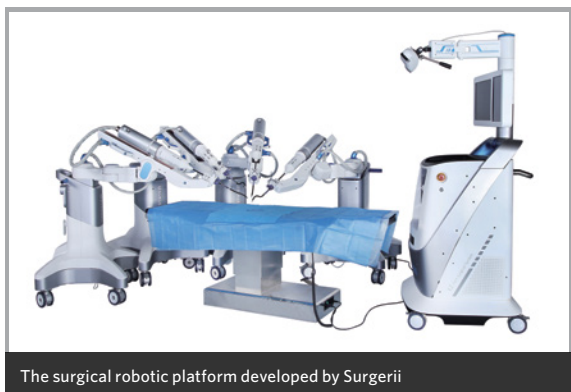
Surgerii's resulting platform consists of a surgeon console, an equipment cart, and four modular patient-side carts, each driving a surgical manipulator or a stereo high-dimension endoscope. Each surgical manipulator has six degrees of freedom, and the patient-side carts remain totally stationary during surgery, eliminating risk of collision between manipulators.

Critical to this success is Surgerii's partnership with the General Hospital of the People's Liberation Army (PLAGH), a large health-care hub integrating medical care, education and research. Housing 125 clinical, medical and technological departments, 4,200 beds, numerous top-level professionals, and state-of-the-art equipment, this top-tier hospital has more than 4.9 million outpatient visits and conducts 90,000 operations annually. Intent on being a surgical innovator, PLAGH has performed thousands of robot-assisted surgeries, led by its clinical professors, Rong Liu and Jiangping Gao.

Working with PLAGH, animal studies on Surgerii's surgical platform have been carried out using different trocars and accessories. Urologic, cardiothoracic, gynaecologic and general surgeries were successfully performed on porcine model under teleoperation, guided by the stereo visual feedback from the endoscope. "The future of this versatile technology is promising," said Liu. ■

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The surgical robotic platform developed by Surgerii



Single-port configuration



Multi-port configuration