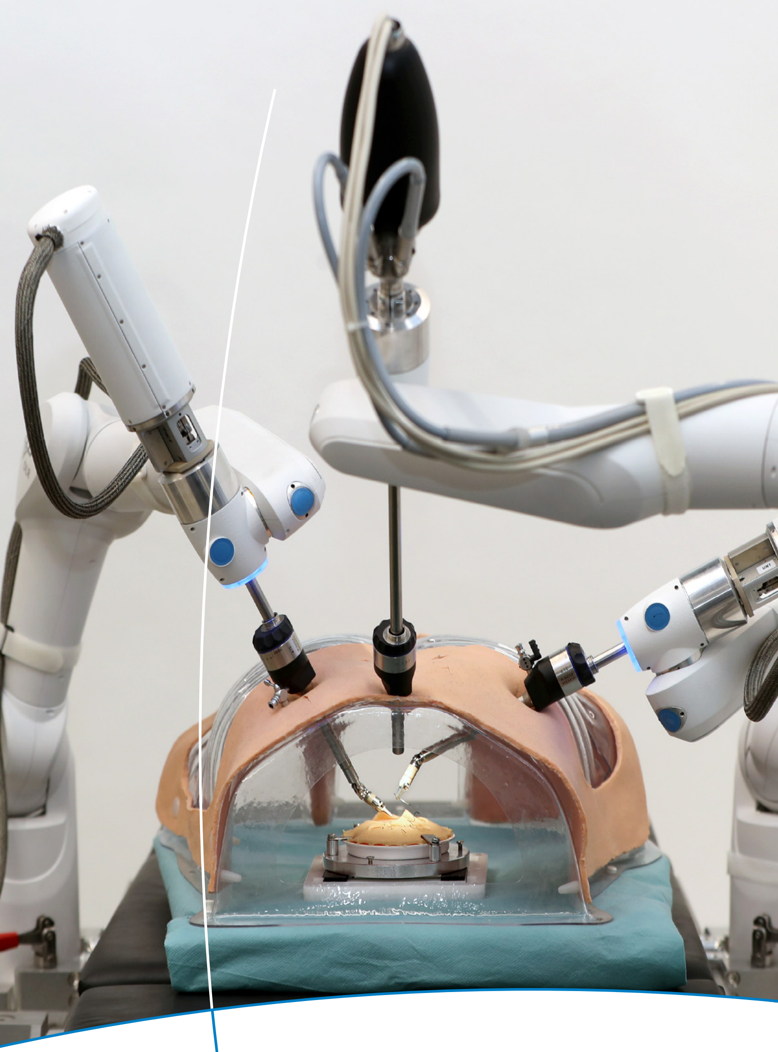


DLR MiroSurge

A versatile research platform for medical robotics

MIRO robot

MIRO is a compact (dead weight of 10 kg, payload of 3 kg), lightweight, kinematically optimised and torque-controlled robot for a wide range of applications in the field of medical research.

Thanks to its kinematic redundancy, which is achieved by the integration of seven torque-controlled joints, it can be used as a research platform for a wide range of medical applications. MIRO can easily be used in a restricted environment, where it has to avoid collisions with other robots, devices or medical stuff.

The implemented control strategies enable direct interaction between human and robot on the one hand and precise, tele-manipulated or autonomous functions on the other. Impedance control allows for definable and sensitive interaction dynamics between the MIRO and the user ("hands-on robotics") or the patient. The augmentation of any required geometrical constraints is also possible to protect sensitive organ structures.

For highly precise manipulation tasks, the robot can be operated with position control. The specialisation of the versatile MIRO lightweight robot arm is provided by its instrumentation and application-specific software.

MICA instrument

MICA is the second generation of the versatile instrument for minimally invasive robot-assisted surgery. For research in this field, the instruments are connected to the tool interface of the MIRO robot.

MICA is a robot with three degrees of freedom and is comprised of a task-independent drive unit and a task-specific tool with a tool interface, shaft and end effector.

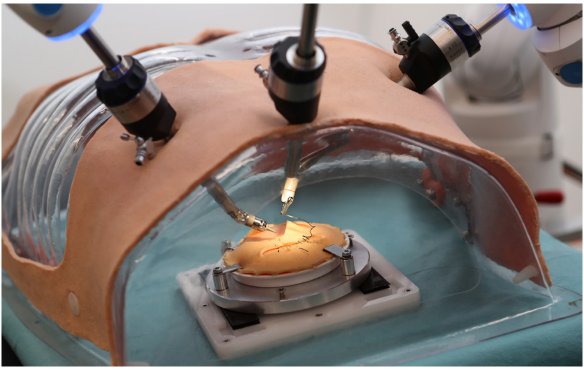
The drive unit can be combined with a variety of tools for different minimally invasive surgical applications. The individual tools vary according to the number of degrees of freedom, movement ranges and the function of the end effector. The tool is actuated by means of three linear movements. These are transferred from the drive unit to the tool joints and end effector via the tool interface and tendons.

MiroSurge system

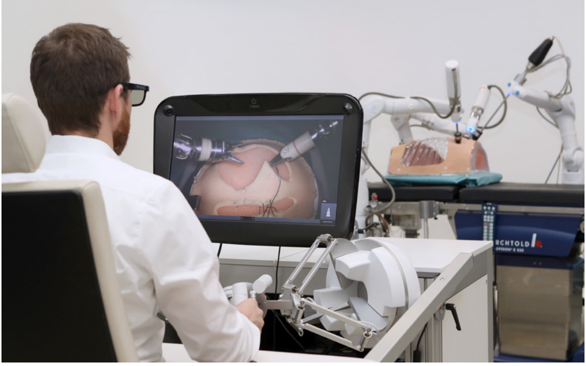
The MiroSurge system is a research platform for the development of new technologies in the field of minimally invasive robot-assisted surgery.

The surgeon controls two MIRO robots which are equipped with MICA instruments via two haptic input devices on the ergonomic surgeon’s console.

A third robot, equipped with a stereo endoscope, can also be controlled. The visual information from the endoscope is displayed on a 3-D display on the surgeon’s console.



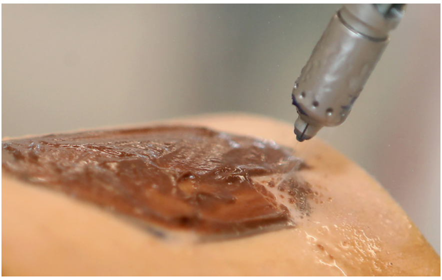
The research at the MIRO Innovation Lab has two main objectives: Firstly, the full dexterity of the surgeon‘s fingers and hands shall be projected into the patient to perform the manipulation tasks. Secondly, the information from inside the patient shall be acquired using sensors, be processed automatically and presented to the surgeon in an intuitive manner.



These technologies provide the basis for the development of guidance or even semi-automated assistance functions which will further augment the surgeon‘s capabilities.

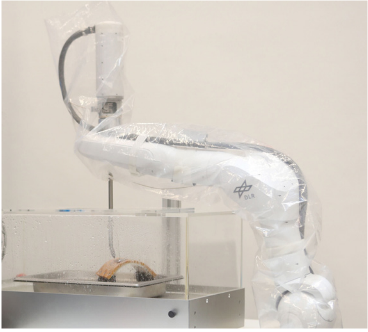
Waterjet surgery

Because of its versatility, MIRO can be used for numerous medical applications in diagnosis and therapy. One example apart from the minimally invasive surgery is waterjet surgery, where a high-pressure waterjet is used to cut or abrase tissue.



We are focusing on two applications for waterjet surgery, which can benefit from robotic assistance:
In minimally invasive waterjet surgery, the robot allows the control of additional degrees of freedom within the patient. This simplifies the instrument handling and enlarges the field of interventions, which can be performed minimally invasive.

In semi-autonomous wound debridement, a waterjet applicator has to be moved with constant speed over the whole wound area to avoid reinfection. By adapting the waterjet pressure, the ablation can be limited to devitalized and necrotic tissue. When a robot instead of the surgeon guides the waterjet applicator, the surgeon is disburdened from moving the applicator, the cleaning of the complete wound area can easily be guaranteed and a cross infection of the surgeon is avoided.



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About DLR

DLR is the Federal Republic of Germany's research centre for aeronautics and space. We conduct research and development activities in the fields of aeronautics, space, energy, transport, security and digitalisation. The DLR Space Administration plans and implements the national space programme on behalf of the federal government. Two DLR project management agencies oversee funding programmes and support knowledge transfer.

Climate, mobility and technology are changing globally. DLR uses the expertise of its 47 research institutes and facilities to develop solutions to these challenges. Our 9000 employees share a mission – to explore Earth and space and develop technologies for a sustainable future. In doing so, DLR contributes to strengthening Germany's position as a prime location for research and industry.

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