CUSTOMER SNAPSHOT

Minimally Invasive Robotic Surgery (MIRS) with the DLR MiroSurge

Robotics to Operate on a Beating Heart

MiroLab is making significant advances to conventional Minimally Invasive Surgery (MIS), commonly referred to as keyhole surgery. MIS is performed through small incisions to maximize the preservation of healthy tissue. However, it is still essentially done by hand as the surgeon manipulates the surgical instruments through extended instruments. MiroLab goals include giving surgeons a remote digital telepresence and telemanipulation capability to execute the most demanding surgery. This approach is referred to as Minimally Invasive Robotic Surgery (MIRS), see Fig.1.

MiroLab, an advanced robotic assistance research laboratory, is part of Robotics and Mechatronics Center (RMC) at the German Aerospace Center (DLR).

RMC is a world leading robotics research cluster and the competence center for DLR research and development in the areas of robotics, mechatronics, and optical systems. RMC specializes in the interdisciplinary design, computer-aided optimization, simulation and implementation of complex mechatronic systems and human-machine interfaces.

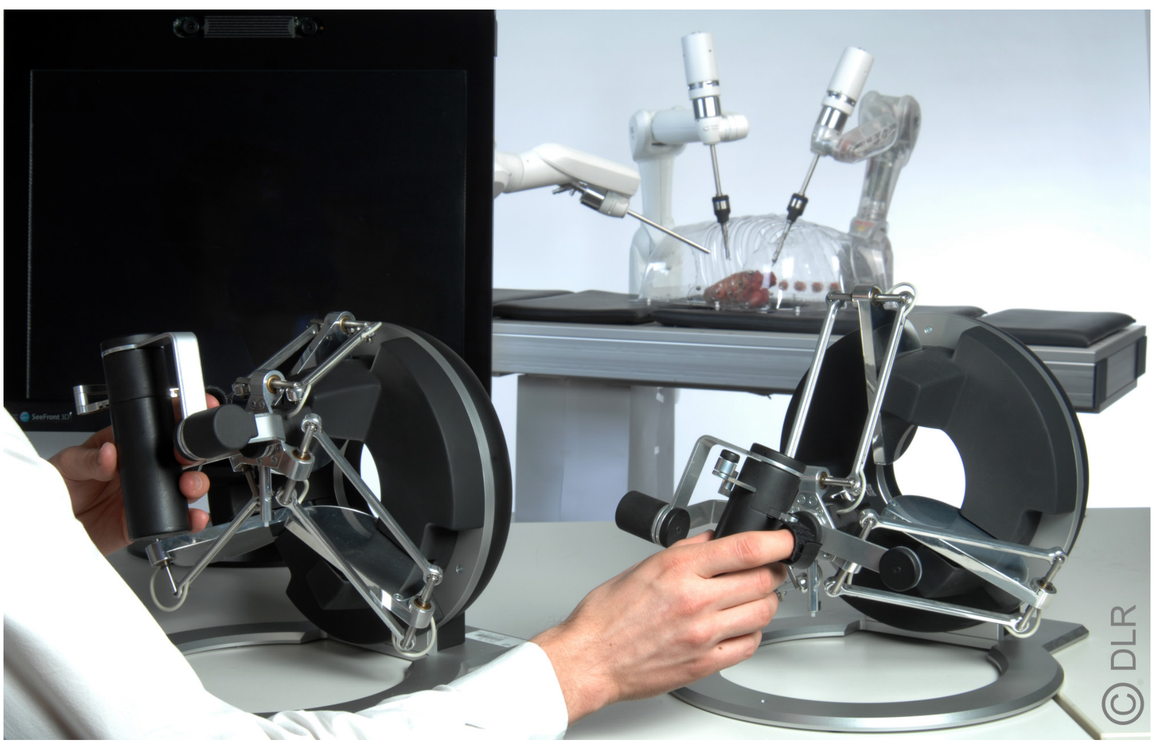

Figure 1: The MiroLab MIRS system

The Challenge in Life Critical Robotic Control

The MIRS system challenges the surgeon's skills because of the lost hand-eye-coordination and absent direct manual contact to the operation area, yet by inserting robotic controllers in the loop we introduce the capability to deal with complex surgical operations far beyond what current MIS technology allows. For instance, operating on a beating heart requires the surgeon to perceive an almost static view of the heart to allow for greater control of highly precise directed cuts and stitches needed to perform the operation. This requires the camera and instruments to be automatically coordinated with the movement of the heart, and yet not disassociate the surgeon from the procedure at hand. The challenge is to give back the surgeons hand-eye capabilities and 'feel' while they are teleoperating.

The robotic controllers and video view is remote from the robotic actuators and sensors, plus the sensitivity needed to give back the surgeon's touch requires a highly reliable, distributed haptic feedback loop, executing at a deterministic high rate. Added to this is that the architectural approach should enable a very high degree of decoupling in the software so that researchers can work and experiment with the system firsthand. Such flexibility is usually anathema to a future safety critical implementation. Therefore, to ease future transfer of MiroLab technology into medical products requires a clear path to safety critical implementation of the laboratory proof of concept.

To develop the 'feel' for the surgeon requires a highly adaptable research facility, able to rapidly prototype solutions to issues surgeons raise as they are put into the control loop. The more rapidly adaptable a system is, the more value can be derived from a surgeon's very costly time. To facilitate this requirement, the MiroLab MIRS system has to be architected modularly.

Solution

RTI Connext™ DDS provides the communications infrastructure between the three MIRO robots, the endoscope, the surgeon's robot controllers and the surgeon's and technician's user interfaces, facilitating synchronization and coordination between them, see Fig. 2.

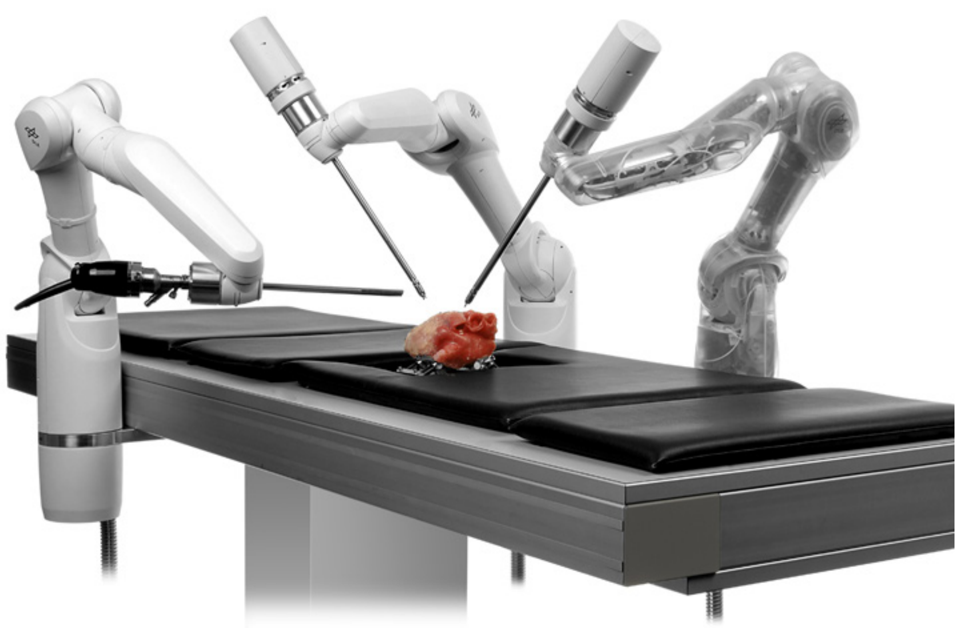

Figure 2: Three MiroLab robots coordinated through RTI Connext DDS software

DLR's MiroLab adopted RTI Connext DDS because it delivered high performance distributed communications with decoupled systems architecture. With Connext DDS, they could implement a deterministic solution functioning at rates between 1KHz and 3KHz, thus enabling the development of the distributed haptic closed control loops.

The availability of RTI Connext Micro also means that systems can be developed today with an understanding of the medical certification route in the future.

Benefits

Using the ability of RTI Connext DDS to deliver a high degree of decoupling between sources and sinks of data and application modules, MiroLab is developing an extremely flexible surgical robotics research facility that allows for rapid prototyping of ideas and concepts. This flexibility is critical, allowing for surgeon and technician input and review in this emerging field of research. Today's system uses three robots, but the system can readily be expanded to insert four, five or more robots with minimal additional software communication development.

For future deployment, RTI offers Connext DDS Cert as a safety-certifiable DDS implementation. This ensures that researchers have a clear path from the laboratory to future field deployments without complete re-engineering.

"RTI Connext DDS is the perfect tool because it enables us to create our vision of a versatile robotic surgery system for research," said Stefan Jörg, Research Engineer of Robotics and Mechatronics Center at DLR. "Its simple data-centric architecture delivers a wonderful high-performance research platform with an extreme degree of flexibility and adaptability."

About RTI

Real-Time Innovations (RTI) is the Industrial Internet of Things (IIoT) connectivity company. The RTI Connext® databus is a software framework that shares information in real time, making applications work together as one, integrated system. It connects across field, fog and cloud. Its reliability, security, performance and scalability are proven in the most demanding industrial systems. Deployed systems include medical devices and imaging; wind, hydro and solar power; autonomous planes, trains and cars; traffic control; Oil and Gas; robotics, ships and defense.

RTI is the largest vendor of products based on the Object Management Group (OMG) Data Distribution Service™ (DDS) standard. RTI is privately held and headquartered in Sunnyvale, California.

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