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Meet TRON: A TeleRobotic Operator Network

The Telerobotic Surgery Operative Network (TRON) project has just completed an exciting major milestone – the delivery of the Taurus-M telesurgical robot prototype to TATRC's Medical Robotic and Autonomous Systems (MedRAS) Lab.

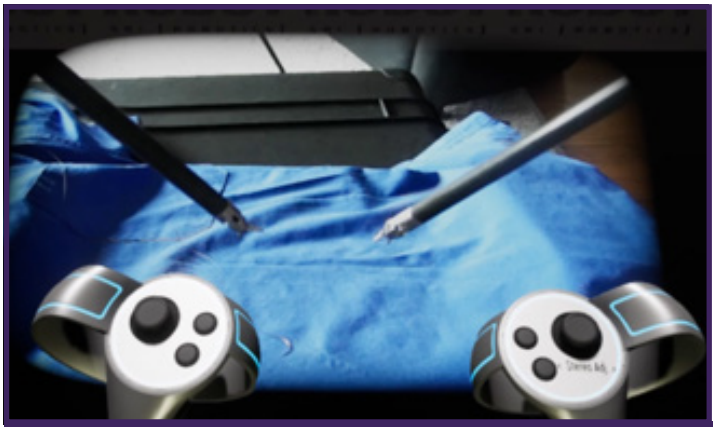
TRON is a collaborative research effort between TATRC, the Military Medical Centers, SRI international, and several universities. The TRON team includes Mr. Nathan Fisher from TATRC and MAJ Steven Hong, MD from Walter Reed National Military Medical Center as Co-Principal Investigators, Mr. Ethan Quist from TATRC who serves as a Robotics Engineer, and the SRI International team led by their senior engineers, Thomas Low and Bruce Knoth.

The TRON project began in FY19, funded by the Medical Simulation and Information Sciences Research Program (MSISRP), Medical Assist Support Technologies (MAST) portfolio, to research telesurgical robotics as a means to provide a force multiplier for forward surgical care by extending the reach of remote surgeons closer to the point of injury.

The goal of the Telerobotic Surgery Operative Network (TRON) project is to establish a semi-autonomous robotic framework that will enable safe and effective telesurgery in forward care environments by accommodating for the deleterious effects of signal latency and disruption. To achieve these goals, SRI adapted a novel robot called the Taurus, by integrating state of the art da Vinci Xi surgical instruments as end effectors, resulting in the "Taurus-M". The design of the surgical robot is compact enough to be deployable in forward care environments and allow intervention closer to the point of injury when evacuation to a Role 3 or 4 hospital is not feasible. Teleoperation is controlled through a Virtual Reality headset, which allows an expert surgeon to control the robot while remaining at their primary duty location.

In the past few weeks, SRI has completed the build of the Taurus-M robot and shipped the system directly to TATRC. Here at Fort Detrick, TATRC will be continuing the research and hosting resident surgeons from Walter Reed to perform surgical testing and evaluations of this system. The initial focus will be on evaluating the performance of this novel robotic system in comparison with large standard-of-care surgical robotic platforms in fixed facilities, such as Intuitive's da Vinci platform. However, the TRON team's research plans extend well beyond proving out the Taurus-M platform. Designing a compact robotic surgery system is an important first step but it is not enough to overcome the implementation barriers of forward-deployed telerobotic surgery. Current telerobotic surgical capabilities are hindered by time-delays (latency) and signal disruption during traditional teleoperation, which relies on immediate robot response and visual feedback. To overcome this hurdle, the TRON project seeks to develop a new paradigm for teleoperation that is less sensitive to signal latency. A major focus of the research is investigating methods of applying machine perception and intelligence techniques to automate the sub-tasks required during typical procedures such that the remote surgeon demonstrates the required subtask, which the robot then interprets and carries out without requiring high-frequency position commands from the operator. If successful, this approach will mitigate some of the challenges associated with signal latency, disruption, and bandwidth restrictions when operating in forward environments.

Taurus-M Robot, aptly named "GARY" in honor of recently retired Dr. Gary Gilbert. Dr. Gilbert was the former TATRC Robotics program manager.



View from inside the Virtual Reality Headset

During the planned testing in the TATRC lab in FY21, data will be collected that will be used by TATRC's academic partners who are developing the control algorithms for semi-

autonomous subroutines that allow the TRON platform to perform even with the introduction of noise, aberrant motions, and signal delay. For example, the University of California, Berkley has recently published some early results from their TRON-funded research indicating initial success in automating the Fundamentals of Laparoscopic Surgery (FLS) peg-transfer tasks. The data collected in the TATRC lab, from experienced clinicians operating the Taurus-M robot, will be used to improve the automation techniques being investigated at UC Berkley and other partner institutions.

"This is a huge step forward and ensures that we are keeping our promise to our Nation; to look forward, innovate, and leverage the latest technologies so that our wounded Warriors will always receive unparalleled medical care," stated MAJ Steven Hong MD, Co-PI and Chief of Head and Neck Surgical Oncology and Reconstructive Surgery at WRNMMC. "The delivery of the robot 'Gary,' aptly named after the beloved and recently retired TATRC Robotics Program Manager Dr. Gary Gilbert, whose life's work and vision made this project possible, is really a culmination of the incredible hard work by the TATRC Team and our partners at SRI, UC Berkeley, UC San Diego, University of Chicago and Stanford." The TRON collaborators will continue to lead the development of the telerobotic surgery platform with a targeted live demonstration of the system at Project Convergence in September 2022.

For more information on this exciting initiative, please contact Mr. Nathan Fisher, nathan.t.fisher3.civ@mail.mil.