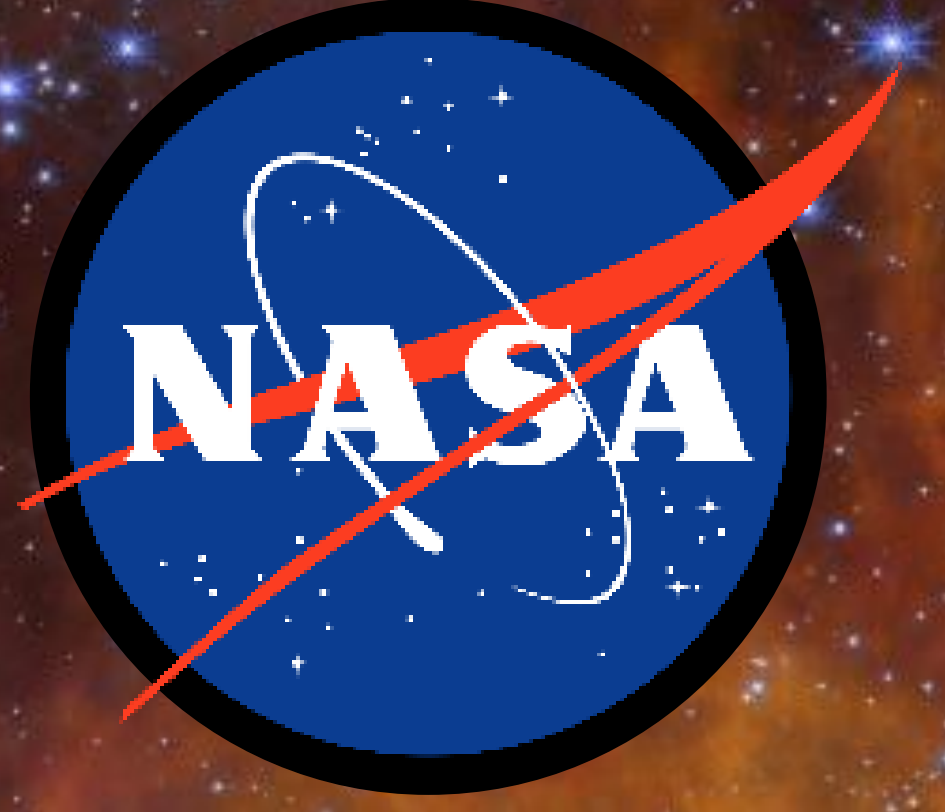


Ground Demonstration of Autonomous Robotic Laser Beam Welding for In-Space Servicing, Assembly, and Manufacturing



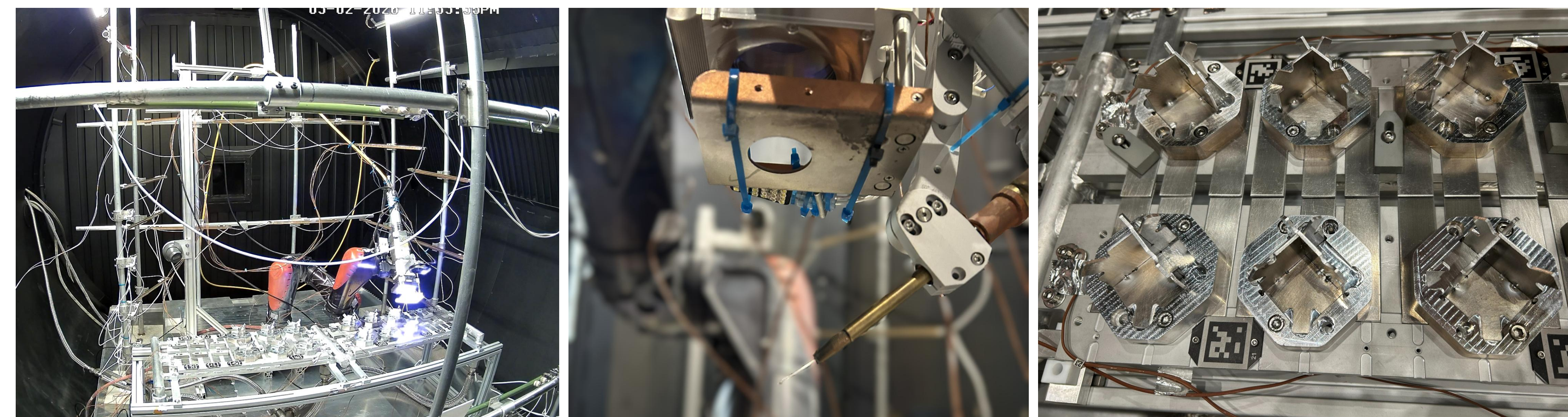
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Lunar Assembly And Servicing By Autonomous Robotics (LASAR)

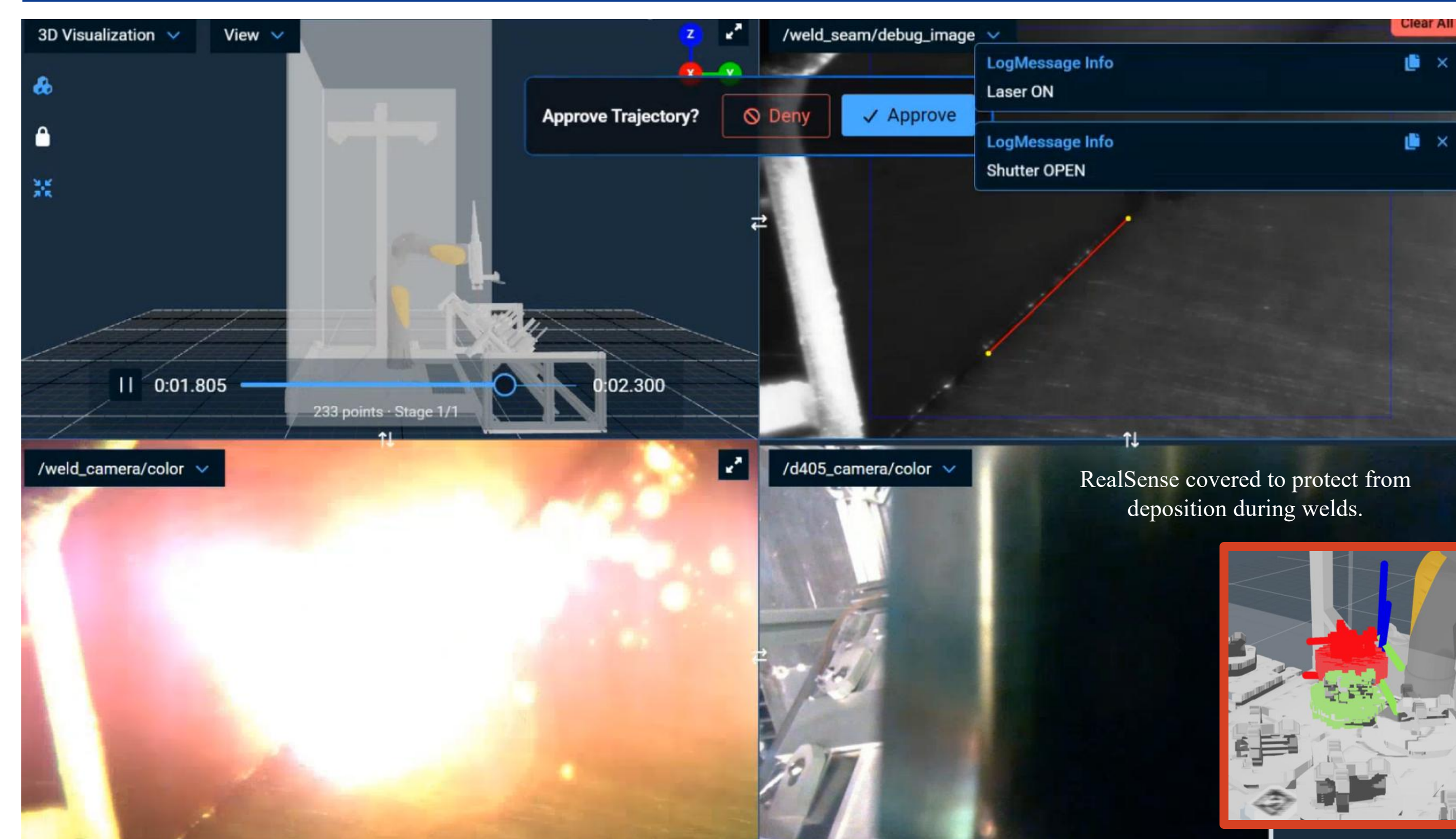
In-space servicing, assembly, and manufacturing (ISAM) missions require robotic systems that can perform precise joining and repair tasks despite communication latency, thermal variation, diverse lighting conditions, uncertain workpiece geometry, and limited crew intervention. We present the **Lunar Assembly and Servicing by Autonomous Robotics (LASAR)** system, a ground demonstration of autonomous robotic laser beam welding and additive manufacturing capabilities relevant to future ISAM missions. LASAR uses technologies already utilized by NASA's Fly Foundational Robotics mission, establishing a direct connection between terrestrial ISAM testing and future orbital robotic operations. Thermal-vacuum chamber (TVAC) tests evaluated robotic welding at extreme temperatures from approximately -40°C to 55°C, while additional tests incorporated a wire-feed mechanism for additive deposition and weld repair. The LASAR demonstrations advance perception-guided manipulation, remote operations, and in-space welding capabilities needed for scalable ISAM infrastructure.

Flight-Relevant Hardware in Thermal-Vacuum Environment



Rocket Lab Robotics xLink arm, Laserline LDM40-4000 laser generator, OTS-5 laser optics, cameras (RealSense D405 and Baumer) for perception-driven welding. Wire feeder integrated for additive weld repairs. Welding workpiece includes multiple types of welds.

Integrated Control for Supervised Remote Operations

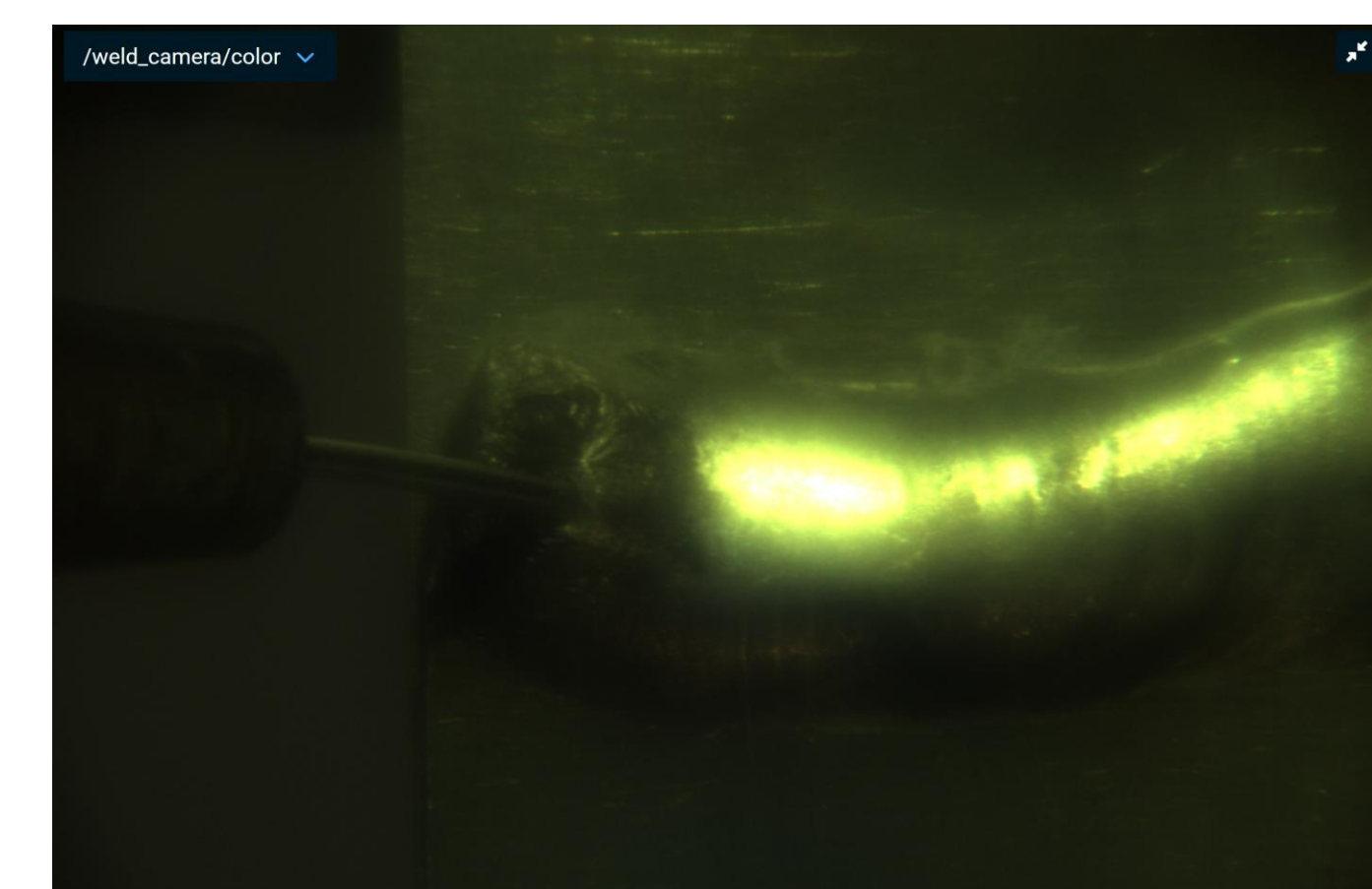


PickNik MoveIt Pro for remote operations and integrated control. 3D visualization of system and collision-aware motion plans (upper left). RealSense camera feed (bottom right) for weld location perception with April tags or registration (inset). Baumer camera for visual servoing of weld-tool alignment (upper right). Welding operation (bottom left).

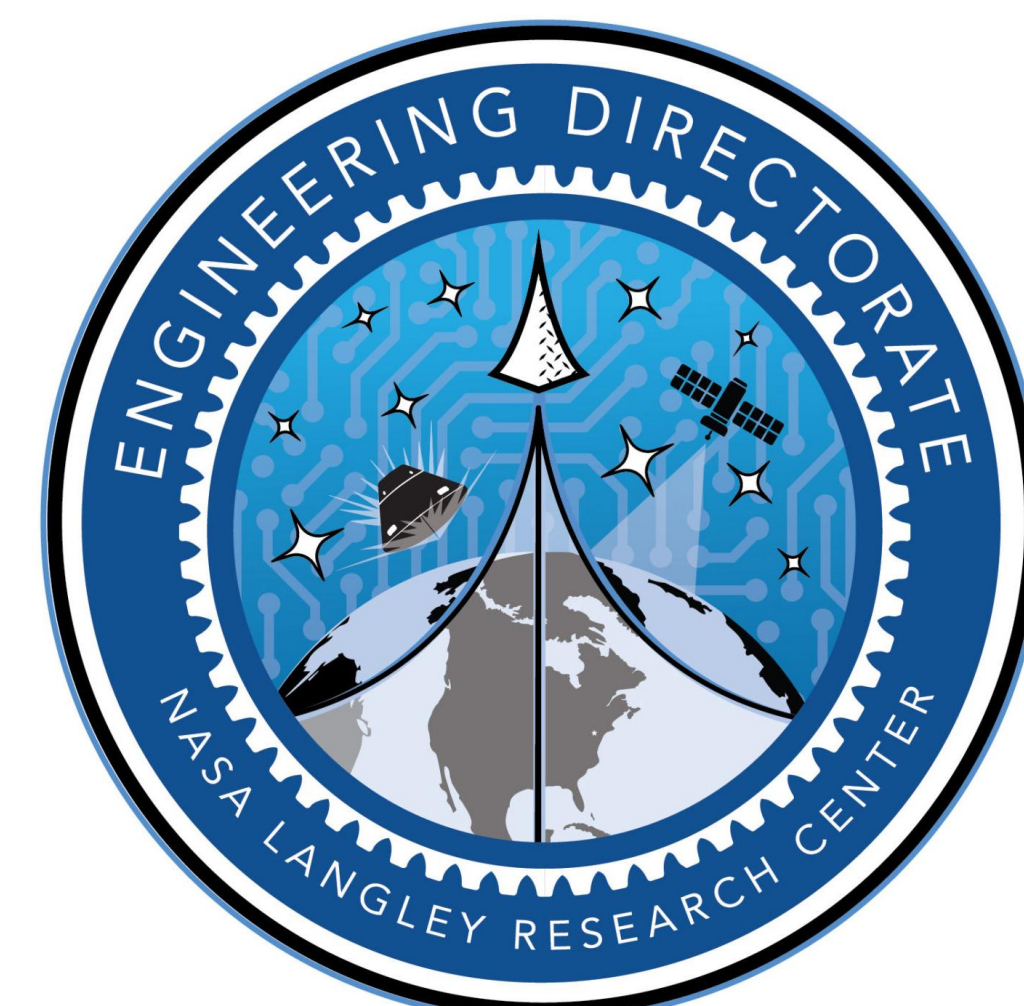
Welds and Repairs



Lap and Snowflake Joint Weld



Additive Weld Repair



References

- Banner from James Webb Space Telescope: <https://science.nasa.gov/mission/webb/>
[1] Fly Foundational Robotics: <https://www.nasa.gov/mission/fly-foundational-robots/>
[2] xLink Arm: <https://motivss.com/products-capabilities/robotics/xlink/>
[3] Laserline laser: <https://www.laserline.com/en-int/products/high-power-diode-lasers/lbm-series/>
[4] Laserline optics: <https://www.laserline.com/en-int/products/processing-optics/modular-ots-optics/welding-optics/>
[5] RealSense D405: <https://www.realsenseai.com/products/stereo-depth-camera-d405/>
[6] Baumer: <https://www.baumer.com/int/en/p/36661>
[7] PickNik MoveIt Pro: <https://picknik.ai/pro/>

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