

Yiyan Ruan

Robotics & AI Engineer | 3D Perception | Autonomous Systems

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SUMMARY

Robotics and AI engineer with a Ph.D. in Mechanical Engineering and six years of experience building autonomous systems from hardware and controls through RGB-D perception and 3D machine learning. Designed manipulators, mobile robots, and six-axis additive-manufacturing systems for NASA and industry programs; developed GPU-accelerated methods for reconstruction, point-cloud correspondence, and vibration-based sensing.

SKILLS

- **Programming & Platforms:** Python, C, C++, MATLAB, Java; Linux/Ubuntu, Git/GitHub
- **AI/ML & 3D Vision:** PyTorch, CUDA, Open3D, YOLO; RGB-D perception, instance segmentation, 3D reconstruction, point-cloud processing, CNNs, transformers
- **Robotics & Controls:** ROS, motion planning, trajectory optimization, kinematics, manipulator and mobile-robot control, sensor integration and filtering; OptiTrack, stereo/depth cameras, LiDAR, IMUs, GPS, encoders, force/torque sensors
- **Simulation & Modeling:** Unreal Engine 5, RoboDK, CoppeliaSim, digital-twin and structural-dynamics modeling
- **CAD & FEA:** SolidWorks, Creo, Fusion 360, ANSYS, Abaqus
- **Manufacturing & Automation:** CNC machining, milling and turning, laser and waterjet cutting, additive manufacturing, Beckhoff servo systems, EtherCAT, RS-485

EXPERIENCE

Graduate Research Assistant

Aug 2020 – Present

Field and Space Experimental Robotics (FASER) Laboratory, Virginia Tech

Blacksburg, VA

- Designed and built a high-payload mobile robot with a 6-DOF arm on a mecanum-wheeled base.
- Built a foldable robotic crane with a 7 m reach, adapted from NASA Langley's Lunar Surface Manipulation System (LSMS), for large-scale In-Space Assembly testing in the lab.
- **3D perception (IEEE SENSORS 2025):** built an RGB-D pipeline combining neural-network instance segmentation and shape completion to reconstruct full 3D rock meshes, enabling accurate volume and center-of-gravity estimation for autonomous lunar site preparation.
- **Cross-view 3D correspondence:** developed ShadowCorr, a PyTorch/CUDA sparse 3D network for cross-view point-cloud correspondence; achieved 99.32% ARI at 307 ms/scene, outperforming state of art competitive architectures like Point transformer v3 and Open3dIS in accuracy and runtime.
- **Vibration-based sensing:** created the first method to estimate the burial depth of partially embedded rocks without prior knowledge of mass by pairing scanning laser Doppler vibrometry with a neural network, yielding a 25.3% mean absolute percentage error (MAPE).

Robotics Engineer — Robotic Additive Manufacturing of Volumetrically-Oriented Multi-Functional Composites via Digital Twin-Informed Optimization

Aug 2025 – Present

Virginia Tech — FASER Lab · NSF Award No. 2428288

Blacksburg, VA

- Characterized the vibration and stability of a 6-axis industrial robot arm during robotic 3D printing (additive manufacturing) to pinpoint dynamics that degrade print quality.
- Built a digital-twin model of the arm as a coupled spring-mass system to predict pose-dependent stiffness and vibration response across its workspace.
- Developing a pose optimizer that selects robot configurations along a deposition path to maximize stiffness and suppress vibration.

Robotics Engineer — MELD Project No. 30457

Dec 2022 – May 2024

*MELD Manufacturing (via FASER Lab), Virginia Tech**Christiansburg, VA*

- Designed and integrated a 6-DOF Additive Friction Stir Deposition (AFSD) system for in-field rail repair, combining a MELD print head with an SCT Stewart platform rated for 12,000-lb vertical and 3,000-lb lateral loads.
- Engineered an 8-ft Beckhoff-servo rail feeder and support structure; performed reachability and stability analyses and developed software coordinating feeder, hexapod, and print-head operation.
- Collaborated with MELD, SCT, and sponsor stakeholders to align hardware, controls, and manufacturing requirements.

Graduate Teaching Assistant

Jan 2024 – May 2025

*Virginia Tech, Department of Mechanical Engineering**Blacksburg, VA*

- Taught control-systems laboratories and supported vibration and dynamics courses across three semesters, guiding undergraduates through core mechanical-engineering theory.

Robotics / Computer Vision Engineer — Intelligent Sensing for Hybrid Wire Arc Additive Manufacturing

Aug 2023 – Dec 2023

*Virginia Tech — DREAMS Lab · ONR-sponsored**Blacksburg, VA*

- Captured metrology-grade point clouds of wire arc additive manufacturing (WAAM) parts using a custom stereo-camera array to quantify geometric defects.
- Trained an instance-segmentation model to localize defect regions and generated corrective G-code repair toolpaths sized to the deposited bead width.

Robotics Engineer — Assembler Project

Aug 2020 – May 2023

*NASA Langley Research Center (via FASER Lab), Virginia Tech**Hampton, VA*

- Contributed to the mechanical design of the Assembler robot — a reconfigurable manipulator composed of serial Stewart-platform modules.
- Designed, analyzed, and built lightweight, modular, robust end-effectors for the Assembler robot to actuate 6 m tri-trusses in a lunar habitat concept.

Mechanical Engineer Intern

Jun 2018 – Aug 2018

*Tinavi Medical Technology Co., Ltd.**Beijing, China*

- Designed Polaris optical tools for marking 3D locations in a robot-assisted surgery system.
- Designed a precision robotic end-effector for controlled tissue removal during hip-replacement surgery.

SELECTED PUBLICATIONS & MANUSCRIPTS

- **Y. Ruan and E. Komendera**, “Lunar Rock Reconstruction with RGB-D Images,” *2025 IEEE SENSORS*, pp. 1–4. [\[IEEE Xplore\]](#)
- **Y. Ruan and E. Komendera**, “ShadowCorr: Cross-View Correspondence of 3D Segments via Volumetric Consensus,” *submitted to IEEE Transactions on Pattern Analysis and Machine Intelligence*, 2026. [\[Code\]](#) [\[Dataset\]](#)
- **Y. Ruan and E. Komendera**, “Burial Depth Estimation for Partially Embedded Rocks Using Scanning Laser Doppler Vibrometry and Neural Networks,” Accepted for publication in *IEEE Sensors Journal*, 2026 [\[Code\]](#)

EDUCATION

Virginia Polytechnic Institute and State University*Ph.D., Mechanical Engineering**Aug 2020 – Aug 2026**B.S., Mechanical Engineering · Minor, Computer Science**Aug 2015 – May 2020*