**University of Maryland Robotics Facilities**

**University of Maryland Unmanned Aircraft Systems Test Site:** The University of Maryland Unmanned Aircraft Systems (UAS) Test Site is a research and operations facility based in California, Maryland that works with university, government, and private partners to advance UAS research and demonstrate operational capabilities. The test site boasts more than 50 vehicles ranging from 2 to 500 lbs and access to restricted airspace where they can operate up to 10,000 feet. The site also has authorizations to fly beyond line of sight, at night, and in operations involving multiple aircraft. Formed in 2014, the UAS Test Site is one of only a handful of institutions across the country that work directly with the Federal Aviation Administration, with the ultimate objective of seamlessly integrating UAS into national airspace.

**Fearless Flight Facility:** The Fearless Flight Facility (F3) is the only university outdoor flight laboratory for testing unmanned aircraft systems (UAS) in the D.C.-Maryland-Virginia region. The 100-foot wide, 300-foot long, and 50-foot high facility serves as a critical nexus between the Clark School of Engineering’s College Park labs and UMD’s UAS Test Site in Maryland’s St. Mary’s County.

**Brin Family Aerial Robotics Lab:** The University of Maryland (UMD) received a generous gift from the Brin Family to support excellence in drone-related activity and inspire UMD students, faculty and staff engaged in research, competitions and activities involving unmanned aerial vehicles. As part of this gift, Paley oversees the Brin Family Drone Lab on the first floor of the Brendan Iribe Center for Computer Science and Engineering. This lab is a large shared space for indoor drone testing, including high-precision motion capture cameras, numerous workbenches and storage space.

**Alfred Gessow Rotorcraft Center:** Since 1982, the Alfred Gessow Rotorcraft Center at the University of Maryland has been one of the three Rotorcraft Centers of Excellence, supported for most of the years by the Army Research Office (1982–95) and later on by the Army/NASA National Rotorcraft Technology Center (1996–2006, 2011–present). The Center carries out multi- disciplinary/ interdisciplinary research on various aeromechanics disciplines of rotorcraft systems including eVTOL manned and unmanned platforms.

**Neutral Buoyancy Research Facility:** NBRF is one of two currently operating neutral buoyancy tanks in the US. It is the only one located on a college campus and the only one dedicated to basic research. The tank is 50 feet across, 25 feet deep, and holds 367,000 gallons of water (about the same as three municipal swimming pools). The NBRF also has complete SCUBA diver support facilities, including two locker rooms, air compressors for filling SCUBA bottles, and an underwater communications system. The NBRF is equipped with sixteen Qualisys underwater motion-capture cameras and supporting digital-image capturing equipment.

**Robotics and Autonomy Laboratory:** The Robotics and Autonomy Laboratory is a multi-functional space on the 3rd floor of the E.A. Fernandez IDEA Factory. RAL functions as a shared research and education facility for all MRC faculty and affiliated students. It supports mobile robotics research, robotics prototyping and manufacturing, and optical inspection equipment. This lab is staffed full time by a lab manager that can also help with hardware integration.

**Robotics Manipulator Lab:** Features several state-of-the-art manipulators (2x KUKA LBR iiwa 7, Sawyer, 2x Baxter, UR5e) as well as various interchangeable robotic grippers. Manipulators can be easily repositioned into different configurations to allow for collaborative projects with multiple manipulators. Additionally, the Ridgeback omnidirectional platform from Clearpath Robotics can be used as a mobile base for the manipulators. The lab works as a shared facility and provides access to all MRC faculty and affiliated students.

**Robotics Realization Lab:** RRL supports faculty and students in the Maryland Robotics Center by providing auxiliary manufacturing equipment and space for the development of robot hardware that is not commercially available. This lab is staffed full time by a lab manager that can also help with hardware integration.

**Research Prototyping Lab and MakerBot Innovation Center (Terrapin Works):** The UMD Clark School of Engineering provides the following shared equipment/resources: 3D Systems ProX 200, Stratasys Object500 Connex, Nanoscribe Photonic Professional GT, 33 Replicator 5th Generation Desktop 3D Printers, 13 MakerBot Replicator 2X Experimental 3D Printers, 2 Maker- Bot Replicator Z18 Desktop 3D Printers, 2 MakerBot Replicator Mini 3D Printers, 2 MakerBot Digitizer Desktop 3D Scanners.

**Maryland Autonomous Technology Research and Innovation Xploration (MATRIX) Lab:** Located in the University System of Maryland at Southern Maryland (USMSM) Southern Maryland Autonomous Research and Technology (SMART) Building, the MATRIX Lab features state-of-the-art facilities for autonomous vehicle research including an 80’ by 60’ open air-land lab with an amphibious pool, a hydrology lab featuring a circulating water channel with a 80 cm by 130 cm cross-section, an AR/VR capable research space, roof-top antenna farm, and outdoor ground and air vehicle testing.

**Note:** A regular shuttle service runs between the Kim Building in College Park and SMART Building/MATRIX Lab in St. Mary’s County starting January 11, 2023. The shuttle runs every other week on Wednesdays, departing from the road between the Kim Building and Clark Hall at 8 a.m., arriving at the SMART Building around 9:45 a.m. It heads back to College Park from the SMART Building at 4 p.m., arriving at the Kim Building around 5:45 p.m. An easy [online signup](http://go.umd.edu/MATRIXshuttlesignup) is required to guarantee your place on the shuttle.

**List of equipment in MRC labs**

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| **MRC Lab** | **Equipment** |
| Brin Family Aerial Robotics Lab | * 15 ft high 430 sq.ft netted area * Vicon motion capture system with 12 Vantage V8 cameras * components for drones assembly including Nvidia Jetson TX2, Lumenier carbon fiber frames, Intel stereo cameras, KDE Direct motors and ESCs, FrSky radio transmitter, mRobotics GPS, other optical and range sensors * 3 of Crazyflie2.0 * prototyping bench * 2x ceiling Panasonic projectors |
| Robotics Manipulator Lab | * robotic arms (2 of 7-axis Kuka LBR iiwa, 2 of Baxter and 1 of Sawyer from Rethink Robotics, UR5e from Universal Robots) * robotic grippers (ReFlex TakkTile 1 and 2 from RightHand Robotics, 2 of Robotiq 2 finger adaptive gripper, gripper kit for Rethink Robotics arms, Robotiq 3-Finger Gripper) * Soft Robotics Development Kit – UR+ * Clearpath Ridgeback omnidirectional platform * motorized haptic device Geomagic Touch * Axia80‐M8 RS485 F/T Sensor * Rotopod R2000 from Mikrolar * Niveus 4904GT computing workstation |
| Robotics and Autonomy Lab | **Robotic equipment:**   * robotic mobile platforms (2 of TurtleBot2, 7 of TurtleBot3, Segway RMP-440LE, Clearpath Husky, 2 of Clearpath Jackal, 4WD Rover Pro from Rover Robotics, 2 of Spot from Boston Dynamics) * LiDARs (VLP-16 Puck from Velodyne, OS1-32 from Ouster, several Hokuyo 10LX, solid state LiDAR from Leddar) * optical sensors (1 of ZED and 2 of ZED2 stereo cameras, several Intel Realsense depth cameras, DVS128 dynamic vision camera, Microsoft Kinect, and other smaller sensors) * 6 of UR3e robot arms from Universal Robots * 6 of vacuum gripper kits with from Coval * 6 of Hand-E adaptive gripper from Robotiq * Optitrack Prime 17w motion capture system with 8 cameras * various components and accessories for building robots   **Manufacturing equipment:**   * 3d printers (Raise3D Pro2 Plus, Raise3D E2, Fusion3 F410 FDM printers; Objet30 Pro Polyjet printer; Sinterit Lisa Pro SLS printer; ANYCUBIC Photon UV LCD 3d Printer, 3d bioprinter from Hyrel) * Roland MDX-540SA 4-axis mill * Universal VLS3.50 Laser Cutter * Westbond 7476E wirebonder * soldering equipment (Weller rework system, reflow oven from LPKF) * convection oven, Thinky mixer, small spin coater, Elma ultrasonic cleaner, hot plates, Sartorius analytical balance, Whynter freezer   **Various testing experiments:**   * various electronics prototyping equipment (Tektronix and Rigol mixed signal scopes, Rigol oscilloscopes, function generators, Rigol and Keithley power supplies, etc) * Thorlabs optical table * 3x Thorlabs motorized translation stage PT1-Z8 * ATI force sensor Nano17 * high speed camera UX100 * FLIR A65sc thermal imager * Signatone probe station * Olympus DSX1000 digital microscope * several microscopes for optical inspection (from Amscope and Vision Engineering) * Artec Eva and Space Spider handheld 3D scanning system |
| Robotics Realization Lab | **Robotic equipment:**   * various components and accessories for building robots   **Manufacturing equipment:**   * 3d printers (uPrint SE Plus and PRUSA i3 MK3S FDM printers) * WEN drill press * soldering equipment (Zephyrtronics solder/desolder station and Metcal soldering iron) * Branson sonicator, California Air Tools compressors   **Various testing equipment:**   * electronics prototyping equipment (oscilloscope, function generator, power supplies, PC with GPIB interface, etc) |