NOVA: A Rover Platform for **N**avigation, **O**perations, and **V**alidation of **A**utonomy Algorithms**.** S.S. Kumar[1], V.M. Griffo[1], and Y.K. Nakka[1], [1]Aerospace Robotics Lab, Daniel Guggenheim School of Aerospace Engineering, Georgia Institute of Technology, 270 Ferst Drive, Atlanta, GA 30332. Contact: sadhana.kumar@gatech.edu.

Introduction: NOVA (**N**avigation, **O**perations, and **V**alidation of **A**utonomy Algorithms) is a low-cost, 3D printed rover with unique actuation that provides a platform for testing autonomy algorithms. Designed to be accessible to a broad range of users, the effort also involves a new architecture that separates high-risk autonomy stacks, raising the Technology Readiness Level of new systems by allowing them to be tested in a relevant setup. Drawing on insights such as those presented in the CADRE paper [1], this project emphasizes the significance of small form factor robots for advancing multi-agent autonomy research in space environments.

System Design: This research integrates advanced suspension, a modular and cost-efficient electrical system, and a high-performance autonomy stack to support versatile mobility and varied research applications (Figure 1).

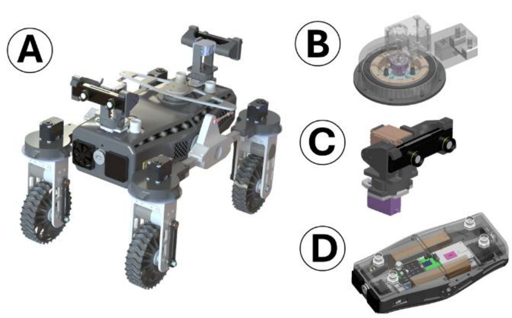

Figure 1: Overview of NOVA: (A) Full Rover, (B) Swerve Drive Module, (C) Camera Gimbal Assembly, (D) Chassis and Electronics.

Mechanical Subsystem. NOVA employs a suspension system inspired by the rocker-bogie mechanism. This mechanism has been adapted to include only two rocker links and one pivot joint per pair of wheels. A swerve drive is used for the wheel's yaw degree of freedom, driven by a DYNAMIXEL XL430-250T servomotor that interfaces with a single-stage planetary gearbox with a ring gear output. This enables diagonal motion that may not be possible with traditional differential drives. A belt drive module is used to transmit mechanical power from a Pololu gearmotor to the wheel, achieving a more compact form factor and reducing the risk of motor interference with the chassis during the motion of the rocker-bogie suspension on uneven terrain.

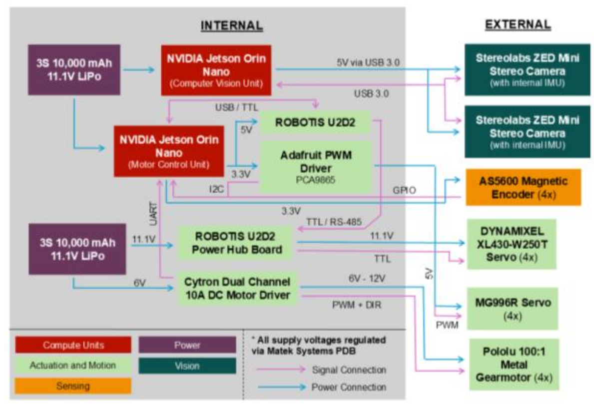

Figure 2: Electrical-mechanical integration.

Electrical Subsystem. The rover's electrical architecture provides a modular foundation for core controls and autonomy, enabling easy adaptation to various research or mission-specific requirements (Figure 2). Although cost-efficient, the design maintains suitability for advanced research applications by incorporating high-performance components, such as the NVIDIA Jetson Orin Nano CPU and Stereolabs ZED mini cameras, to support future work in autonomy and spatial mapping. Power requirements for the system can provide a 1-hour runtime.

Autonomy Stack. NOVA implements a full autonomy stack, including spatial planning, mapping, perception, state estimation, and control algorithms using widely adopted software such as OMPL and FastSLAM.

Conclusion: NOVA demonstrates the capabilities of a low-cost, modular, and high-performance rover as an accessible platform for advancing autonomy research and supporting future multi-agent space exploration.

References: [1] J.-P. de la Croix *et al.*, "Multi-Agent Autonomy for Space Exploration on the CADRE Lunar Technology Demonstration," in *Proc. IEEE Aerospace Conf.*, Big Sky, MT, USA, Mar. 2024, pp. 1-14.