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ADRASTEA: A DEMONSTRATION OF MOMENTUM EXCHANGE TETHER TECHNOLOGY FOR SMALL SATELLITES

Abstract

ADRASTEA (Augmented Deployment and Release of Artificial Satellites by Tether Extension and Acceleration) is a technology demonstration mission being developed by students at the University of Alabama in Huntsville (UAH), which will be demonstrating momentum exchange tether (MET) technology in space, scheduled to be launched in August 2024. This mission, supported by UAH, Alabama Space Grant Consortium, and NASA's RockSat-X program will fly a 1.5U unit that will deploy out four PicoSats on steel tape tethers each one meter long, begin to rotate, and then release PicoSats into new trajectories away from the deployer, fashioning a small constellation.

This mission will grow the space flight heritage of MET technology, which has yet to see much usage in spacecraft due to its limited applicability compared to traditional propulsion methods such as chemical or electric thrusters. METs are a space propulsion concept that rely on the exchange of momentum between two tether-connected objects, typically a payload and a deployer or counterweight. This concept involves the rotation and separation of a spinning system, converting angular momentum into linear momentum upon release, altering the objects' velocities nearly instantaneously without requiring propellant. This technology is being investigated as a propulsion alternative for small satellites with constraints that make utilizing traditional propulsion methods difficult. METs are also scalable and can be applied to both small and large spacecraft.

In most MET missions, flown and conceptual, kilometers-long tethers have been used to deploy individual payloads. The ADRASTEA mission will demonstrate MET usage with two new key differences not yet performed in space: deploying multiple tethered payloads from a single deployer craft, and utilizing significantly shorter tethers each only a meter long. To maintain feasibility and low risk, this mission will operate on a suborbital flight to prevent orbital debris risks in case of anomalies. The spacecraft will undergo symmetric and asymmetric tether release operations, attempting to controllably send payloads into dedicated directions at specific speeds and monitor the new trajectories and motion of all bodies in the system. This work aims to increase the technology readiness level of small-scale METs and provide a basis for more advanced small satellite missions and constellations.