NASA’s Vision for Space Exploration (VSE) relies on numerous systems of systems to support a return of robotic and human explorers to the Moon in preparation for human exploration of Mars. Establishing a sustainable and continuous manned presence on the Moon, Mars, and deep space will require a very large total mass of material to be either launched from Earth, or obtained from the moon or asteroids and delivered for use in structural, propulsion, and shielding applications. Moving this material in near-Earth and cislunar space using traditional rocket-based propulsion requires propellant masses that represent a large fraction of the total required launch mass, and thus cost, of the exploration architecture.

The Phase I effort established the feasibility of an innovative multifunctional propulsion-and-structure system concept, called Integrated Structural Electrodynamic Propulsion (ISEP), which uses current-carrying booms deployed from a spacecraft to generate thrust with little propellant expenditure. ISEP utilizes methods conceptually similar to electrodynamic tethers with the added benefit of providing a capability for generating thrust in almost any direction as well as for providing torques for spacecraft attitude control. This modular integrated propulsion architecture will facilitate self-assembly of large space systems, and enable propulsion and attitude control of an assembled system during and after such assembly. During the Phase II effort, we propose to further refine the ISEP technology, and design an ISEP system for a mission of interest to NASA’s VSE. As part of a development and risk mitigation program, TUI will design, build and launch a nanosatellite experiment that will demonstrate both the ISEP concept as well as propellantless current closure using field emissive array cathodes. This simple flight experiment
will demonstrate the feasibility of using the ISEP architecture to reduce costs and enhance capabilities of NASA’s Exploration Systems, Space Operations and Science Mission directorates.