Resilient ExtraTerrestrial Habitats research institute (RETHi)

Vision: Develop and demonstrate transformative smart autonomous technologies that will adapt, absorb and rapidly recover from expected and unexpected disruptions to deep space habitat systems without fundamental changes in function or sacrifices in safety.

Research Objectives:

- Establish a *comprehensive systems resilience framework* to support design, operation, and management of efficient and effective long-term deep space habitats
- Develop smart habitats that *autonomously sense, anticipate, respond to*, and *learn from* disruptions
- Develop *decision-making techniques* for complex interconnected, interdependent habitat systems
- *Educate* the next generation of engineers and scientists

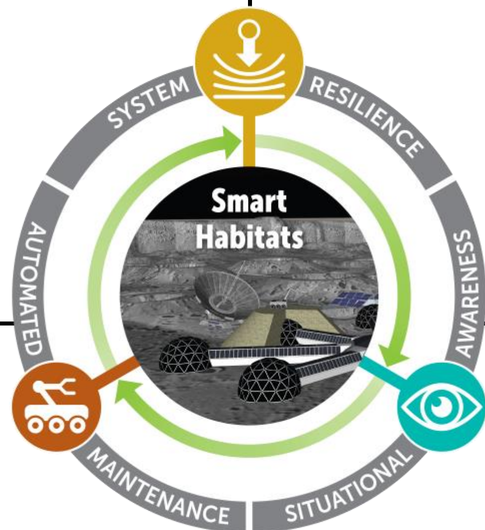
Leadership Team: Shirley Dyke (PU, PI)
Karen Marais (PU) (Lead, Thrust 1)
James Braun (PU) (Lead, Thrust 2)
Justin Werfel (HU) (Lead, Thrust 3)
Ramesh Malla (UC) (Lead, Industrial Collaboration)

Lead Organization: Purdue University (PU)

Participant Organizations: University of Connecticut (UC), Harvard University (HU), University of Texas San Antonio (UTSA)

Additional Key Personnel: Ilias Bilionis (PU), Antonio Bobet (PU), David Cappelleri (PU), George Chiu (PU), Ashwin Dani (UC), Elena Glassman (HU), Song Han (UC), Chuck Hoberman (HU), Mohammad Jahanshahi (PU), Arturo Montoya (UTSA), Krishna Pattipati (UC), Julio Ramirez (PU), Jiong Tang (UC), Dawn Whitaker (PU), Robert Wood (HU)

Industry partners: UTC Collins Aerospace & ILC Dover.



Approach:
Our activities will comprise three interconnected research thrusts:

- Thrust 1 will examine key systems contained in the habitat, considering their interactions and spatial distribution to establish a framework for resilient architectures.
- Thrust 2 will use these principles to establish techniques and algorithms needed to extract the greatest amount of actionable information through intelligent monitoring.
- Thrust 3 will develop autonomous robotic repair and maintenance capabilities for deep space habitats.
- These parallel but connected efforts will converge in the establishment of a Cyber-physical Testbed.

Benefits:

- Methods to achieve intelligent and resilient design of complex systems' accelerated recovery.
- Autonomous robotic capabilities for wide-ranging use in space or to work alongside humans on the Earth.
- Advances in active learning to characterize the temporal evolution of complex systems of systems.
- Techniques to model and simulate human decision-making, especially in extreme situations
- Training the next generation of graduates to lead the U.S. into the future.
- Strengthened partnerships between academic institutions and the US space industry.