Apr 17, 2026

Resilient Composite Manufacturing for Next-Generation Space Structures

Beyer Distinguished Lecture

Dr. Jeffery Baur

Scott White Professor
Aerospace Engineering
University of Illinois
Urbana-Champaign
(UIUC)

Seminar Details

2:30-4:00pm

UH Campus
Classroom & Business Building
Room CBB 110

Online via Teams
https://teams.microsoft.com/meet/28672503493418?p=0CX16bX3BZZ6J5ss6O

ABSTRACT

The rapidly expanding space industry—projected to deploy tens of thousands of satellites and space structures in the coming years—demands new manufacturing strategies that are agile, energy-efficient, and resilient to the unique constraints of in-space environments. In-Space Assembly and Manufacturing (ISAM) must overcome challenges not faced on Earth, including material transport limitations, complex supply chains, and exposure to harsh conditions such as large thermal gradients, Atomic Oxygen (AO), high-energy radiation, and hypervelocity Micro-Meteoroid and Orbital Debris (MMOD) impacts. To address these needs, we investigate synergistic technologies for rapid manufacturing of high-performance composite structures in space: (i) frontal polymerization using ring-opening metathesis chemistry for low-energy curing of compactly stowed raw materials, (ii) continuous-fiber additive manufacturing for enhanced impact toughness and tailored structural performance, and (iii) thermography-enabled structural health monitoring with pathways toward controlled healing. These methods support multifunctional, topology-optimized, and morphogenic architectures capable of autonomous deployment and improved damage tolerance. Recent advances at the University of Illinois demonstrate scalable fabrication of strong, lightweight composites cylindrical longerons slated for in-space demonstration in 2026 and additively manufactured sinusoidal fiber architectures with ~30% better impact resistance with only modest reductions in tensile (14%) and flexural (7%) modulus. Inclusion of a mid-plane printed thermoplastic also demonstrated a 6–12X increases in mode-I fracture toughness (G_{IC}) and the potential for on-orbit healing. Together, these innovations highlight an emerging framework for resilient, on-demand composite manufacturing for next-generation space systems.

BIOGRAPHY

Dr. Jeffery Baur is the Scott White Professor of Aerospace Engineering at the University of Illinois Urbana-Champaign (UIUC) and director of the Composites and Additive Materials Laboratory. His research focuses on multifunctional and adaptive composites for in-space manufacturing, high-temperature structures, and sustainable materials. Before joining UIUC in 2022, he spent six years in the propulsion and chemistry industry and 26 years at the Air Force Research Laboratory, where he served as Division Technical Director, Branch Technical Advisor, and Program Manager. At AFRL, he was a key architect of programs in additive manufacturing of air vehicles, morphing missiles, and composite structures for experimental aircraft.