

Leading Advanced Turbine Research for Hybrid Electric Propulsion Systems

Technical Advisory Board

Jack Beuth (CMU), Reuben Delrosario (Crowne), Robert Hancock (AFRL), Charles Lentz, Arthur Orton (FAA)

PI: Karen Thole (PSU)

Project Manager: Scott Fishbone



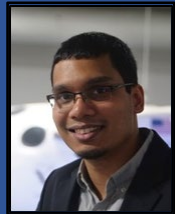
Technical Challenge 1

Thrust 1: Jon Gladin (GA Tech)

Thrust 2: Zubair Baig (PW)

Thrust 3: Gbadebo Owolabi (Howard)

Thrust 5: Jon Gladin (GaTech)



Technical Challenge 2

Sean Bradshaw (PW)

Thrust 1: K. Thole/R. Berdanier (PSU)

Amrita Basak (PSU)

Thrust 2: T. Lieuwen/B. Emerson (GA Tech)

Thrust 3: Karen Thole (PSU)



PennState



HOWARD
UNIVERSITY



Collins
Aerospace

Our ULI Objective and Accomplishments:

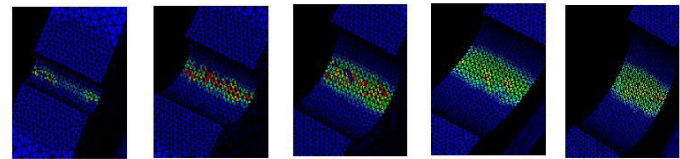
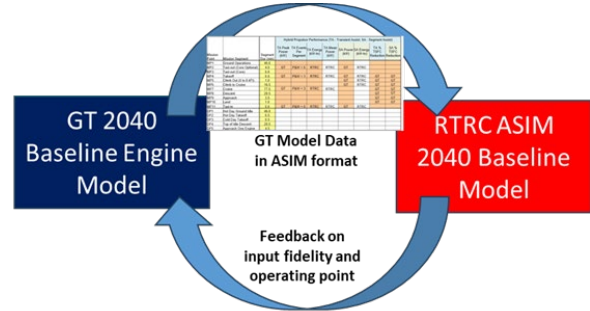
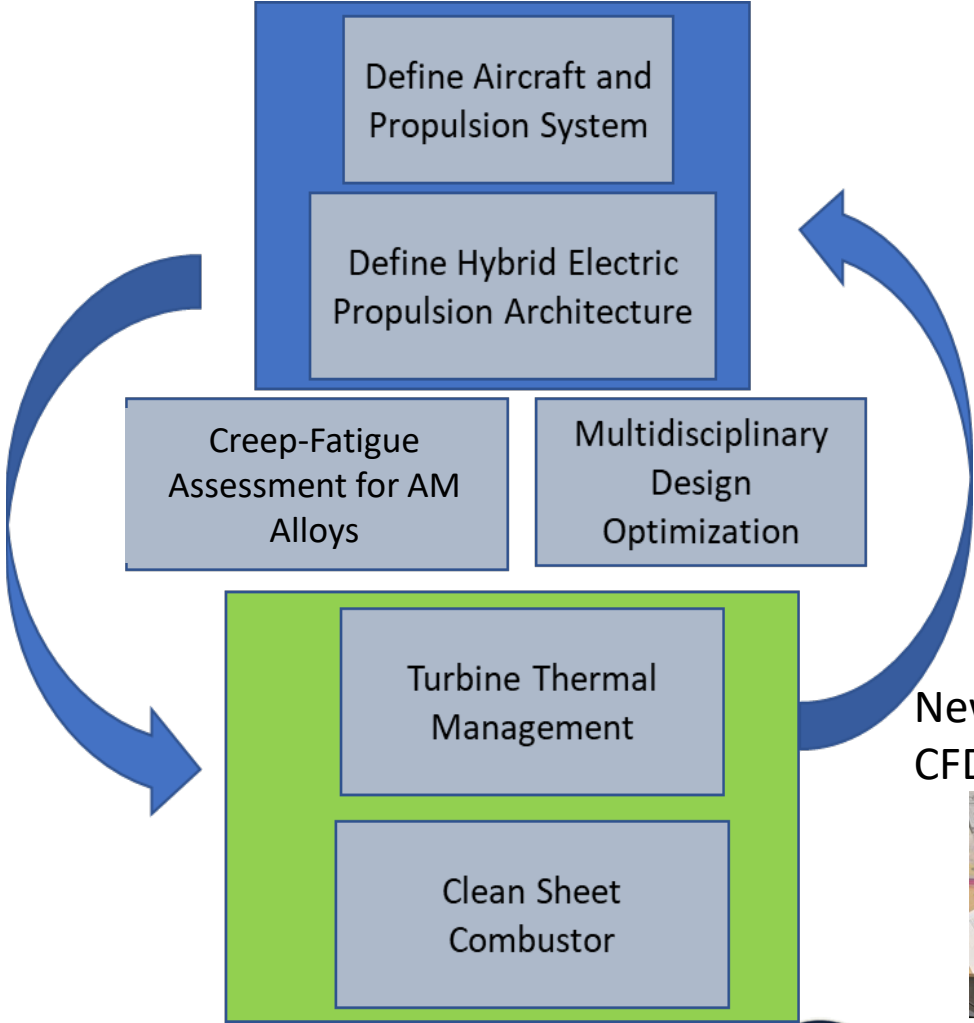
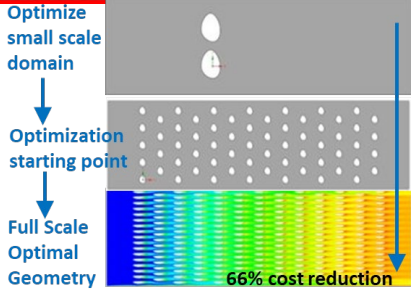
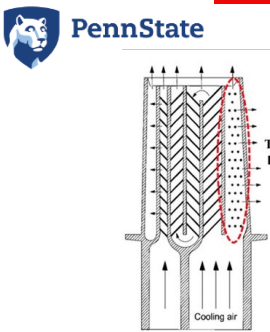
Optimize HEP turbine design to meet efficiencies equating to large cores and **reduce the energy consumption by 8-12%** over the entire flight envelope.



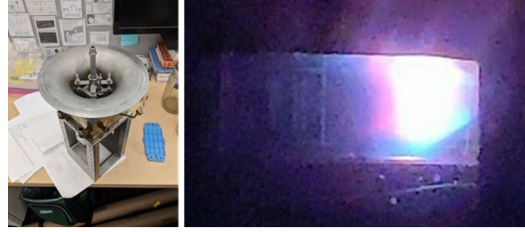
START



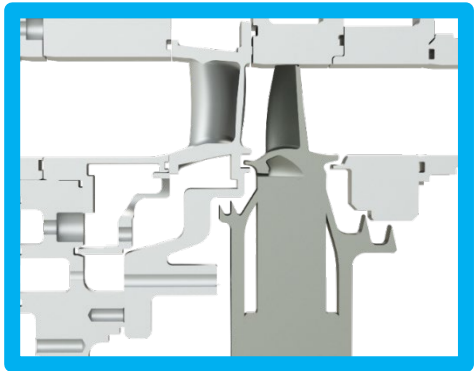
Additive Manufacturing



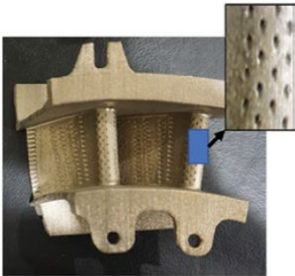
New combustor rig with CFD companion study



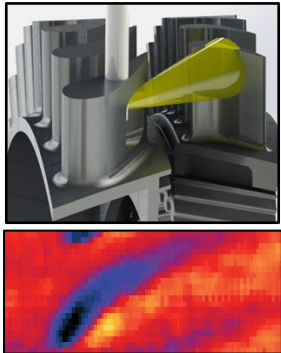
The National Experimental Turbine (NExT) represents a common research platform for government agencies, OEMs, and universities to investigate new technologies



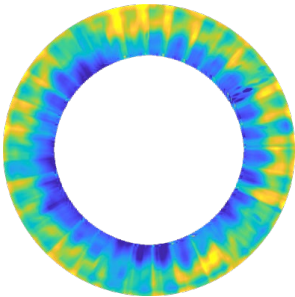
Blade Cooling



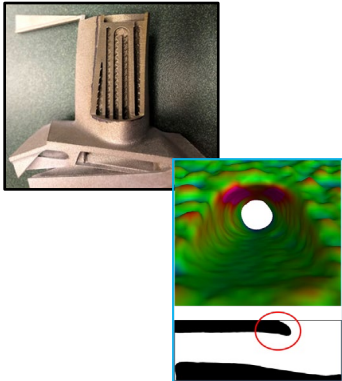
Blade Heat Transfer



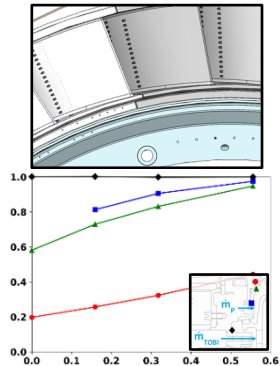
Stage Efficiency



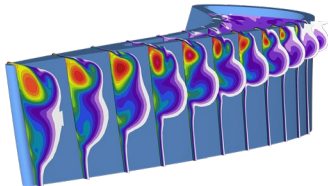
Advanced Manufacturing



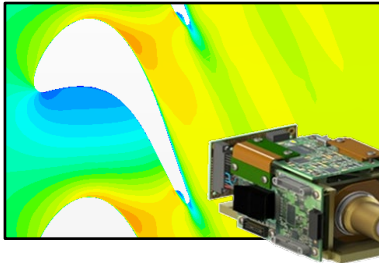
Rim Sealing



Tip Gap Designs

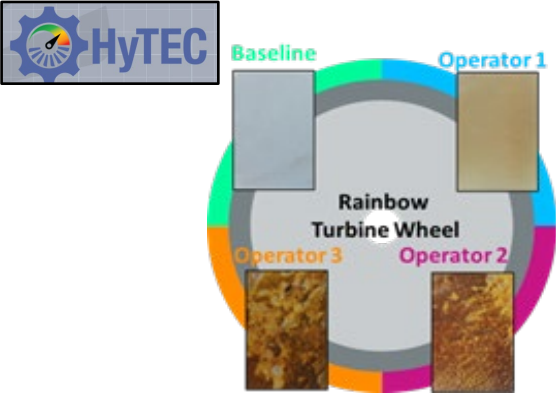



CFD / Measurement Methods



The NASA ULI is a multiplier and connector for research and recruiting




Synergistic with other NASA programs



**PennState**
College of Engineering

Center for Gas Turbine Research,
Education, and Outreach

**Research Experience for Undergraduates:
Lowering the Carbon Footprint through
Research in Propulsion and Power
Generation**



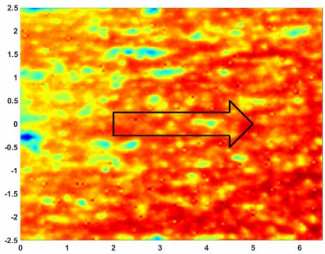
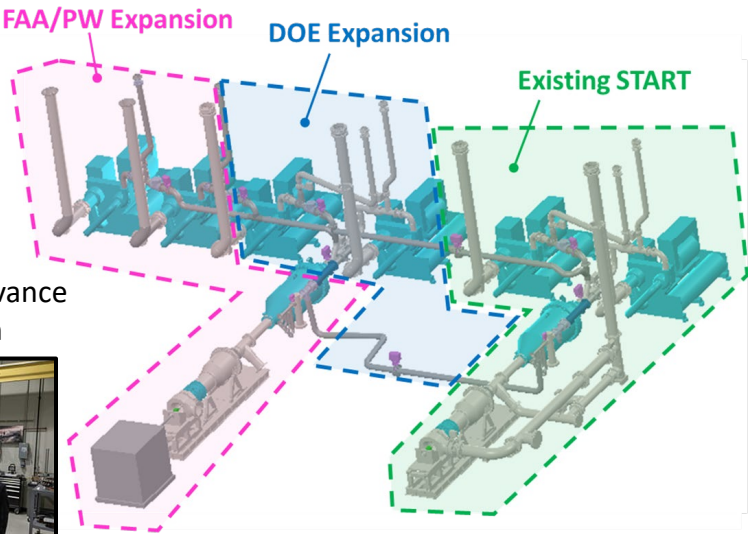
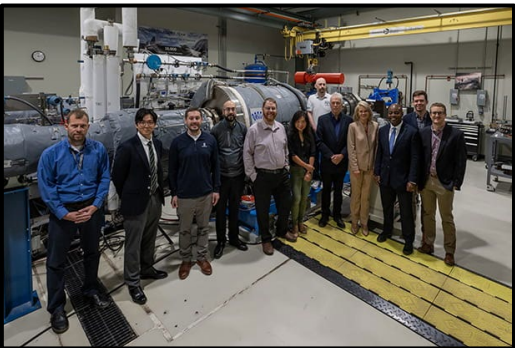
The Pennsylvania State University
May 30 – August 4, 2023
<https://sites.psu.edu/powerpropulsionreu/>

Experience next-generation propulsion and power research with leading academic experts at this Research Experience for Undergraduates site funded by the National Science Foundation (NSF), the Air Force Office for Scientific Research (AFOSR), and the National Aeronautics and Space Administration (NASA). Join a team of over 15 undergraduate researchers working in a range of disciplines, including additive manufacturing, turbomachinery, low-carbon energy systems, heat transfer, and combustion. In this program, students will regularly network with professionals from across the propulsion and power-generation industry and develop professional skills for successful careers.

For more information about the program and how to apply, visit our website at:
<https://sites.psu.edu/powerpropulsionreu/>



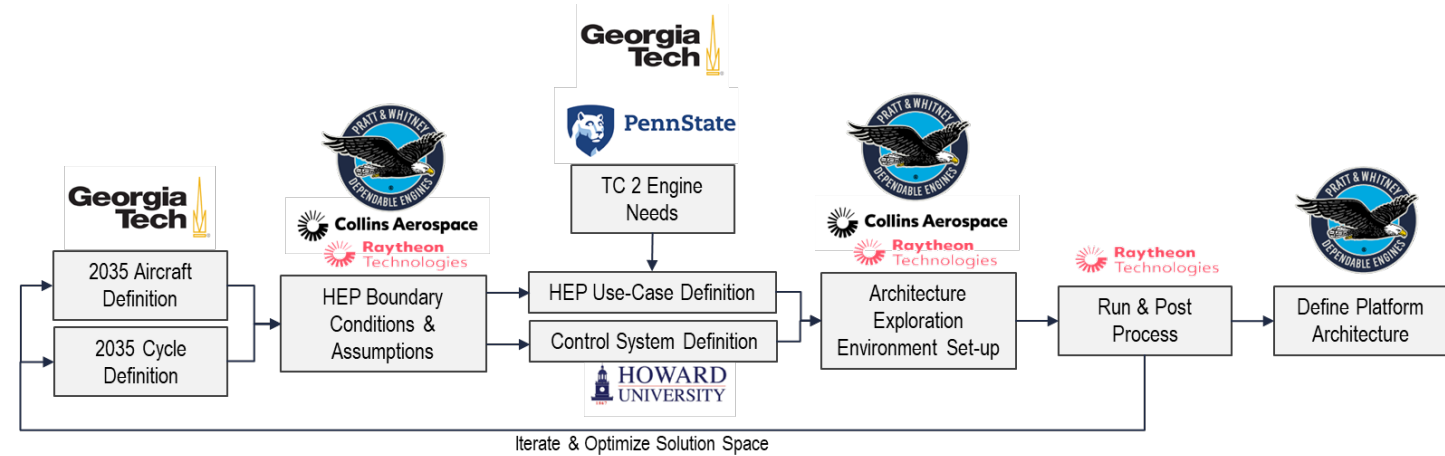
\$26M START Lab expansion to advance sustainable power and propulsion



There have been some ULI challenges

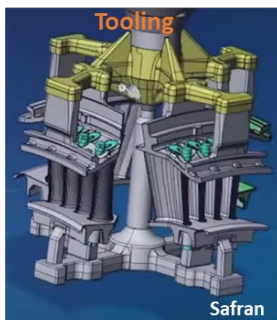
Proposal preparation

- Significant coordination
- Investigators may change
- Industry participation is challenging (but worth it!)
- File sharing for export-controlled materials



Turbine Blade Manufacturing

~ 2-3 years for new designs



Project execution

- Three to five years is a short amount of time!
- Managing a large team requires initial start-up time
- Technical Advisory Board can be competitors
- Not all universities can execute large projects
- Early career faculty have extra challenges



