OVERVIEW OF NASA’S PROPULSION 21 EFFORT
Mary Jo Long-Davis
National Aeronautics and Space Administration
Glenn Research Center
Cleveland, Ohio

Overview of NASA’s Propulsion 21 Effort
Mary Jo Long-Davis
NASA
(216) 433-8708
Mary.J.Long-Davis@nasa.gov

https://ntrs.nasa.gov/search.jsp?R=20070002982 2019-12-27T15:33:12+00:00Z
State-wide coalition focused on research and development aimed at three aircraft engine-related goals:

- More energy efficient
- Quieter
- More reliable
Management Structure

Executive Board
NASA/GE/OSU

NASA

General Electric Aircraft Engines

Contract

NASA/CP—2006-214383/VOL1

Co-operative Agreement

Ohio State University

Data Control Plans

GMI

Argo-Tech

Timken

Webcore

University of Akron

University of Cincinnati

University of Dayton

Case Western Reserve University

Transmet

Parker-Hannifin
Modeling, Analysis, and System Studies
- High Pressure Turbine Clearance Control
- Smart Containment System
- Turbine Cooling Control
- Active Structural Control
- Active Noise Reduction
- Intelligent Combustor

Active Controls for Emissions and Noise Reduction
- Sub-System Health Management
- Disk Life Meter
- Turbine Engine Prognostics
**Disk Life Meter**

**Objective:**
Develop materials models and sensors to measure remaining life in turbine disk materials at sustained high operating temperatures.

**Pit Formation and Growth Now Need to Be Understood**
Objective:
Develop bearing diagnostics and health monitoring system for inter-shaft bearings to provide early detection of impending bearing failure. Demonstrate a conceptual monitoring system for a differential roller bearing.
Intelligent Combustor

**Objective:**
Develop a combustor incorporating advanced diagnostics and active combustor control to reduce NOx emissions by 85% relative to 1996 ICAO standards, while retaining the performance of existing combustors.

New swirler concepts

Lean blow-out precursor identification

LBO Precursor

Dynamic Pressure from Kistler Sensor
Active Noise Control

Objective:
Use fluidic injection, shape memory alloys, and/or plasma actuators to enhance exhaust nozzle jet mixing to actively reduce jet engine noise. Incorporate active/smart concepts into acoustic liner design to increase liner acoustic performance.
**Objective:**
Develop and demonstrate innovative turbine system and component cooling technologies with active flow and temperature control, including prognostic / diagnostic sensors, for improved engine fuel burn and emissions.

**Turbine Cooling Control**

**Advanced Cooling Concepts**
- Cooled Cooling Air, Active Flow Control, Next-Gen Airfoil Cooling

**Thermal Management & 3D System Simulation**

**Sensors for Active Control & Prognostics**
**Smart Containment System**

**Objective:**
Develop an innovative “smart” softwall containment system that capitalizes on the anisotropic nature of composites.

[Diagram of smart containment system]

Conceptual design of smart containment system

Nanofiber circuit diagnostic grid
High Pressure Turbine (HPT) Clearance Control

**Objective:**
Develop an HPT clearance control system that can adapt to changing environment/requirements.

![Diagram of HPT clearance control system](image)
**Objective:**
Perform technology assessment and identify needed modeling improvements to handle adaptive technologies.

**CO₂ Reduction (Fuel Burn)**
(Baseline Engine is 2015 QAT/UEET)

**Noise Reduction**
(Baseline Engine is 2015 QAT/UEET)

**NOx Reduction**
(Baseline Engine is 2015 QAT/UEET)
Summary

• Propulsion 21 technologies contribute to reducing CO₂ and NOₓ emissions and noise

• Integrated Government/Industry/University research efforts have produced promising initial technical results

• Graduate students from 5 partnering universities will benefit from this collaborative research--> educating the future engineering workforce

• Phase 2 Efforts scheduled to be completed 3QFY06