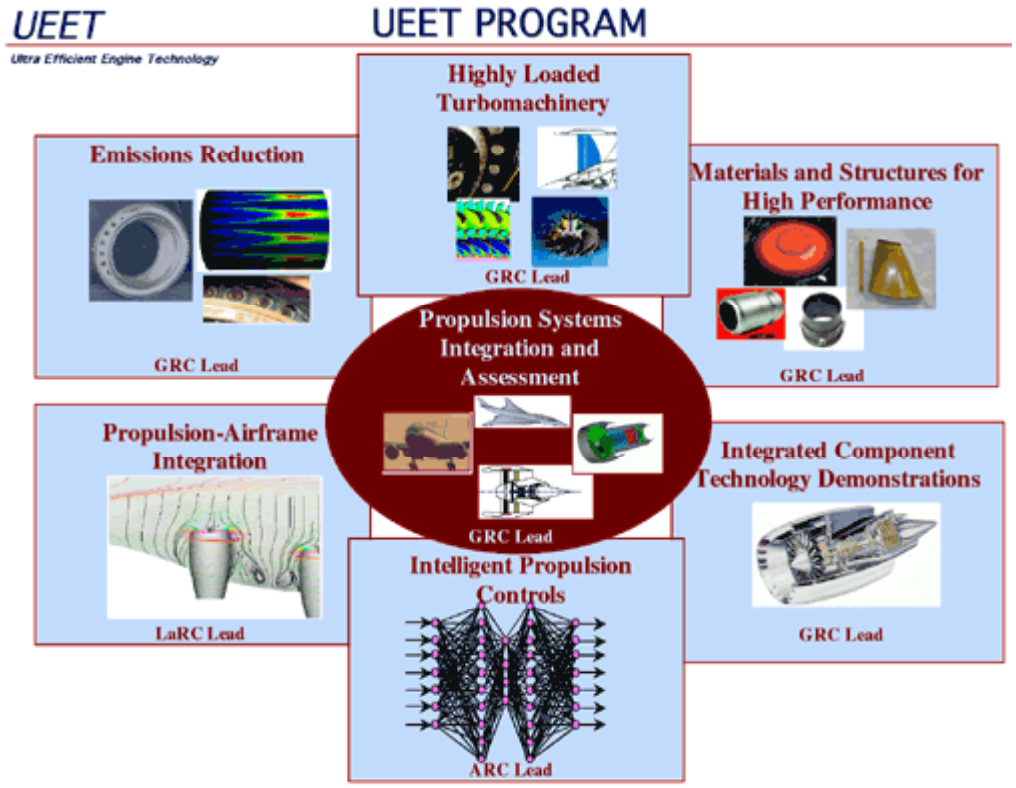
Ultra-Efficient Engine Technology (UEET) Program



The Ultra-Efficient Engine Technology (UEET) Program includes seven key projects that work with industry to develop and hand off revolutionary propulsion technologies that will enable future-generation vehicles over a wide range of flight speeds.

A new program office, the Ultra-Efficient Engine Technology (UEET) Program Office, was formed at the NASA Glenn Research Center to manage an important National propulsion program for NASA. The Glenn-managed UEET Program, which began on October 1, 1999, includes participation from three other NASA centers (Ames, Goddard, and Langley), as well as five engine companies (GE Aircraft Engines, Pratt & Whitney, Honeywell, Allison/Rolls Royce, and Williams International) and two airplane manufacturers (the Boeing Company and Lockheed Martin Corporation). This 6-year, nearly $300 million program will address local air-quality concerns by developing technologies to significantly reduce nitrogen oxide (NO_x) emissions. In addition, it will provide critical propulsion technologies to dramatically increase performance as measured in fuel burn reduction that will enable reductions of carbon dioxide (CO_2) emissions. This is necessary to address the potential climate impact of long-term aviation growth.

The seven projects that make up the UEET Program are the Propulsion Systems Integration and Assessment Project, the Emissions Reduction Project, the Highly Loaded

Turbomachinery Project, the Materials and Structures for High Performance Project, the Propulsion-Airframe Integration Project, the Intelligent Propulsion Controls Project, and the Integrated Component Technology Demonstrations Project. These projects are described briefly in the following paragraphs.

Propulsion Systems Integration and Assessment

The Propulsion Systems Integration and Assessment Project takes the component technologies being developed in the other projects, integrates them into total conceptual systems, and assesses the potential of those systems for meeting the UEET Program goals. These assessments will also provide overall program guidance and identify technology shortfalls. The Propulsion Systems Integration and Assessment Project has three key subprojects: Propulsion System Evaluation, Environmental Impact Assessment, and High Fidelity System Simulation.

Emissions Reduction

The Emissions Reduction Project will work with the U.S. aeropropulsion industry to develop combustion technologies to significantly reduce NO_x emissions with no increase in other emission constituents (carbon monoxide, smoke, and unburned hydrocarbons) and with comparable NO_x reduction during cruise operations. As in the past, new combustor concepts and technologies will be required to produce cleaner burning combustors to offset the increased NO_x produced by the future more fuel efficient engines with higher pressure ratios and temperatures. These new combustion concepts and technologies will include lean burning combustors with advanced controls and new high-temperature ceramic matrix composite materials that will reduce cooling air. Low-emission combustor concepts will be developed and evaluated to achieve major reductions in NO_x emissions for both large and regional engines.

Highly Loaded Turbomachinery

The Highly Loaded Turbomachinery Project of the UEET Program will provide revolutionary turbomachinery technologies for increased performance and efficiency. The technologies developed will be applicable to a wide range of applications, both in terms of flight speed and size class. This project will develop turbomachinery technologies for lighter weight, reduced-stage cores, low-pressure spools, and propulsors for high-performing, highly efficient, and environmentally compatible propulsion systems. Specifically, concepts for significantly increased aero loading, trailing-edge wake control, and higher cooling effectiveness will be developed and demonstrated through proof-of-concept tests. Fan technology development will reduce weight and increase efficiency while satisfying noise constraints.

Materials and Structures for High Performance

The Materials and Structures for High Performance project will develop and demonstrate advanced high-temperature materials to enable environmentally compatible propulsion

systems with high performance and efficiency. Technologies to be developed in this project include ceramic matrix composite combustor liners and turbine vanes, advanced disk alloys, turbine airfoil material systems, high-temperature polymer matrix composites, and innovative lightweight materials and structures for static engine structures.

Propulsion-Airframe Integration

The Propulsion-Airframe Integration Project of the UEET Program will develop advanced technologies to yield lower drag propulsion system integration with the airframe for a wide range of vehicle classes. Decreasing drag improves air vehicle performance and efficiency, which reduces fuel burn to accomplish a particular mission, thereby reducing the CO_2 emissions. This project can be defined as the determination of optimum nacelle placement and optimum shaping to both the nacelle and the airframe to minimize drag. This objective is accomplished through both computational and experimental methods.

Intelligent Propulsion Controls

The rapid explosion of information technologies makes it possible to envision future autonomous pro-pulsion system designs that allow the control system to, independent of pilot interaction, maximize performance across the particular mission profile while at the same time minimizing environmental impact. Such a control system could also adjust system characteristics to maximize the lives of individual components and, therefore, improve propulsion system life and safety. Currently, the overall Intelligent Propulsion Controls Project is being planned with the challenge to find the proper integration of information, propulsion, and integrated flight propulsion control technologies. The initial efforts will focus on (1) assessing systems for the projected payoffs of various technologies and (2) experimentally and analytically evaluating active combustion control approaches to support the program goal of landing and takeoff NO_x reduction.

Integrated Component Technology Demonstrations

Technology demonstration tests are a critical step in the technology development process. The Integrated Component Technology Demonstrations Project tests will reduce risk significantly by demonstrating that the technologies are still viable when integrated into an overall system. The results of these tests provide the necessary confidence to the aeropropulsion industry to incorporate the technologies in follow-on product insertion programs. The initial efforts in this project will focus on determining the most attractive, cost-effective approaches to conducting the needed tests. Many potential opportunities exist for NASA and DOD to collaborate on these tests through partnership efforts between the UEET and Integrated High Performance Turbine Engine Technology (IHPTET) programs. In addition, potential partnership efforts with the U.S. aeropropulsion industry are being evaluated. In all cases, it is desirable to make maximum use of existing engine hardware to allow for the most cost-effective tests.

Find out more about the UEET Program http://www.ueet.nasa.gov/.

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