NASAfacts

Fundamental Aeronautics Program

The Fundamental Aeronautics Program (FA), part of NASA's Aeronautics Research Mission Directorate, works to enable a future where a variety of advanced aircraft exist that improve the flexibility, efficiency and environmental impact of air travel.

As the nation transitions to an upgraded air-transportation system, Fundamental Aeronautics helps develop the tools, technologies and scientific knowledge to aid in the design of new types of vehicles that will fly faster, cleaner, quieter, and use less fuel.

FA research areas include:

- Revolutionary fixed-wing aircraft and rotorcraft configurations;
- Lighter and stronger materials and structures;
- Improved propulsion systems;
- Advanced computational tools and models; and
- Advanced concepts for increasing lift and reducing drag.

Among the potential benefits of FA research are:

- Reductions in aircraft noise and emissions;
- More efficient operational performance; and
- Increased mobility through an increasingly busy national airspace.

Fundamental Aeronautics also studies ways to improve technology approaches to 21st century supersonic commercial airplanes and hypersonic vehicles.

Images (Clockwise, left to right) **Designing for Efficiency:** This wind tunnel model is of the "D8"—a proposed future aircraft design with a very wide fuselage to provide extra lift, a low-sweep wing to reduce drag and weight, and embedded engines that sit aft of the wings. **Speeding Toward Space:** This artist's rendering is of a NASA concept for a vehicle that uses an airbreathing engine to travel at hypersonic speed to reach the edge of space. **Reimagining Supersonic:** This computer image shows researchers the calculation grid and the calculated airflow over a conceptual supersonic aircraft and engine design. **Improving Rotorcraft:** NASA uses this Large Rotor Test Apparatus to test new technologies that could improve rotor blade noise levels and maneuverability.

FA RESEARCH PROJECTS

Subsonic Fixed Wing

Fixed-wing aircraft that fly just under the speed of sound comprise the majority of vehicles that move people and goods through the national airspace 24 hours a day, seven days a week. Today's air travel provides an unmatched combination of speed and range, but tomorrow's will require subsonic aircraft that operate far more efficiently while meeting rigorous environmental requirements.

This project focuses on ways to reduce aerodynamic drag, decrease overall aircraft weight, improve structural integrity and increase propulsion efficiency so less fuel will be used. Reducing harmful atmospheric emissions is another research priority, as are approaches to noise reduction, both on the ground and in the air. Successfully meeting these challenges will enable sustained and robust growth of the nation's air-transportation system.

Subsonic Rotary Wing

Advanced rotary-wing vehicles, or rotorcraft, could alleviate anticipated air-transportation capacity issues by making use of non-primary runways, taxiways and aprons. Especially useful, according to studies, would be a large rotorcraft that could cruise at speeds approaching 350 miles per hour.

This project has set aggressive goals to develop technologies that will enable high-speed, efficient rotorcraft in a variety of sizes and configurations to operate routinely in the national airspace. Research is underway to enable improved prediction methods and technologies for increasing cruise speeds, ranges and payloads, while simultaneously decreasing noise, vibration and emissions.

Supersonics

Supersonic air travel has been possible for decades, but has not been commercially viable because of serious environmental and performance challenges, including overland sonic boom annoyance, high fuel consumption, and nitrogen oxide emission at high altitudes. The Supersonics Project is working to eliminate the technology barriers that today prevent practical, commercial supersonic flight.

NASA's supersonics research is organized to overcome these major hurdles:

- Environmental Challenges
  - Reduce sonic boom and airport community noise, and
  - Minimize the impact of high-altitude emissions.

- Efficiency Challenges
  - Improve airframe and propulsion efficiency in all phases of flight, and
  - Achieve low airframe and propulsion weight in a slender vehicle that experiences high temperatures during supersonic cruise.

Hypersonics

NASA conducts hypersonics research because very high speed flight provides unique opportunities and capabilities, including the ability to reach and return from space, and new means of atmospheric flight. The Hypersonics Project utilizes NASA's extensive expertise to advance foundational research in this extremely challenging flight regime.

The project is expanding the state of the art in hypersonic air-breathing propulsion, next-generation high-temperature materials and structural concepts, aeroheating fluid physics, and physics-based design and analysis tools. The research is conducted in close collaboration with other government partners, and directly addresses challenges defined in the National Aeronautics Research and Development Plan.

We're Working on...

"Greener" aircraft: cleaner, quieter and more fuel-efficient

Faster cruise speeds for rotary-wing aircraft like helicopters

Shrinking the sonic-boom "footprint" to make commercial supersonic flights over land practical

Very high-speed flight for potential lower-cost access to space

For more information about the Fundamental Aeronautics Program and NASA aeronautics research, visit **www.aeronautics.nasa.gov/fap/**.

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