ESI capabilities in this area include:

- Aircraft ice accretion and ice protection system analysis
- Airplane/helicopter performance analysis and accident reconstruction
- Airplane stability and control analysis
- Animations and mock-ups
- Autopilot design and performance
- Digital Flight Data Recorder (DFDR) and Cockpit Voice Recorder (CVR) analysis
- Flight testing with on-board data acquisition and video recording
- High fidelity airplane simulator model creation and use
- Medical evaluation of pilot behavior
- Pilot expert testimony, including analysis of piloting actions and expectations
- Sound spectrum analysis
- Uninhabited Aircraft System (UAS) design, performance, and piloting
- Wind tunnel testing

ESI has been a leader in aviation engineering and aircraft accident reconstruction for over 25 years. Our Aviation Practice Group’s over 30 members are located in offices around the country and have extensive experience in engineering analysis, research, design, piloting, and much more. To assist our clients on a wide range of aviation projects, our aviation consultants regularly work across technical disciplines such as metallurgy, medical issues, human factors, and biomechanics. ESI has handled aviation issues world-wide. Regardless of the scope or scale of the project, our aviation experts will provide comprehensive, complete, and professional analysis.
ESI has over 25 years of aircraft accident reconstruction experience. We specialize in every aspect of the reconstruction of airplane, helicopter, and even balloon accidents. We routinely reconstruct airplane performance from recorded radar and on-board recorded data. We have significant experience in analyzing flight data recorder and cockpit voice recorder information. Wreckage and accident site inspections form an important part of our accident reconstructions. We also have test pilot, medical, and human factors expertise to fold into our accident reconstructions.

Flow Visualization
ESI constructed and maintains a wind tunnel and smoke generator for use in flow visualization studies. The tunnel has an open circular test section approximately two feet in diameter and has been used to demonstrate flow fields around objects as large as skyscrapers and as small as a human head. Its maximum speed of 40 mph is ideal for most applications, and a high-speed camera is used to capture flow-pattern details as needed.

Complex Dynamic Modeling
ESI’s expertise in time-domain simulation allows us to model complex flexible structures. Our team members have modeled an inner tube attached by an elastic rope to an accelerating speed boat, as well as a very large crane on flexible soil holding a large structural element exposed to gusting winds.

Tutorials
Many of the fundamental concepts of airplane performance and aerodynamics can be complex and intimidating for the layman. ESI has developed a series of tutorials designed to de-mystify many of these concepts for our clients. Some of our tutorials include: "What is an Aerodynamic Stall?", "How Airplanes Turn," and "How ATC Radar Works."

Aircraft Icing
ESI experts have participated in icing research studies using NASA’s LEWICE ice accretion codes. These icing codes have been used to analyze ice accumulation on aircraft wings, tails, engine inlets, and other components, and to evaluate potential ice protection systems. ESI has also performed flight tests using artificial ice shapes attached to an aircraft, in addition to instrumented flights in natural icing conditions.

Airplane Component Certification
ESI performs analysis of airplane components that have been proposed for certification using existing airplane models. Our team members have performed ice accretion analyses on retrofit antenna pods in order to predict the resulting reduction in performance. Our staff has also performed ice accretion analyses on the flap of a proposed remotely piloted vehicle.

Wind Tunnel Testing
ESI has performed studies in research-quality wind tunnels across the country. These studies include:
- Testing the subsonic performance of different hypersonic shapes designed to help re-entry vehicles (such as the Space Shuttle), which can operate at 20 times the speed of sound, to land at very low speeds.
- Determining lift and drag penalties as a result of bird strike damage to an aircraft wing.
- Recording the pressure distribution on a building exposed to high winds from various directions.

Aerodynamic Design
ESI has conducted research at the U.S. Air Force Academy to optimize the aerodynamic design of a hovercraft. Different airfoil types were examined and tested in one of the Academy’s wind tunnels.

Sound Spectral Analysis
ESI has performed digital signal analysis on sound files to determine their frequency spectrum. Our team members have also performed spectral analysis on cockpit voice recorders recovered from accident sites. By determining the spectrum of audible alerts from onboard systems, voices of the flight crew or Air Traffic Control, engine noises, structure failure sounds, and sounds created by the activation of switches in the cockpit, ESI has recreated the sequence of events contributing to the crashes of aircraft.

Flight Testing
ESI has significant experience in conducting flight tests to address key aircraft performance parameters and behavior. With the aid of sophisticated and compact data acquisition system and high-bandwidth instrumentation, ESI professionals have measured the natural frequency of aircraft control surfaces, such as rudders and trim tabs. We have also evaluated aircraft performance in icing conditions quantified by onboard instruments. Other tests have measured yoke and rudder forces and displacements to obtain information on control inputs. ESI also has a former U.S. Air Force test pilot on staff.

ESI's expertise in time-domain simulation allows us to model complex flexible structures.

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