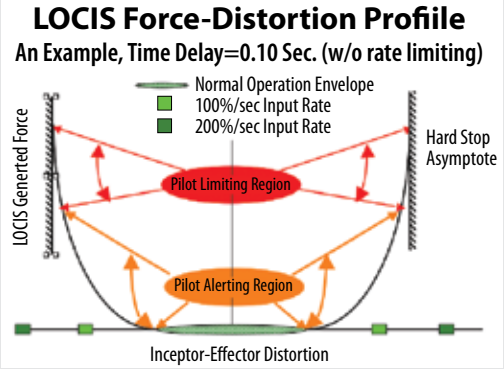
NASA Langley's
Tactile Feedback of Flight Controls
Loss of Control Inhibitor System

A **NASA Headquarters** researcher has developed active and adaptive systems and methods to prevent loss-of-control incidents by providing tactile feedback to a vehicle operator. The Loss of Control Inhibitor System (LOCIS) will reduce the accidents and incidents resulting from loss of control, which is the #1 fatal accident category for the worldwide commercial jet fleet. LOCIS will alert the pilot to degradation in the response of the primary flight control surfaces at the pilot's commands. Further, LOCIS can warn the pilots to reduce or abandon their aggressive flight control inputs because the flight control system is incapable of responding to their inputs, and to continue may result in loss of control resulting from the phenomenon of aircraft-pilot coupling or pilot-induced oscillation. The technology can be readily incorporated into existing technologies and transitioned to the marketplace. NASA is seeking market insights on commercialization of LOCIS and welcomes interest from potential producers, users, and licensees.

Benefits

- Reduces the accidents and incidents resulting from loss of control, the #1 fatal accident category for the worldwide commercial jet fleet
- Alerts pilot to degradation in the response of primary flight control surfaces, which can result from:
  - Runaway trim
  - Misrigging
  - Surface rate or deflection limiting
  - Mechanical compliance
  - Flexing of the surface actuator spool valve
- Reduces the risk of aircraft-pilot coupling (or pilot-induced oscillation)

partnership opportunity



LOCIS Force-Distortion Profile

Applications

The technology offers wide-ranging market applications, including:

- All commercial aircraft utilizing fully powered irreversible and fly-by-wire flight controls with passive control feel
- All human-controlled equipment using fully powered irreversible and control-by-wire maneuvering controls, which need to be safely maneuvered under varying, and unpredictable, conditions

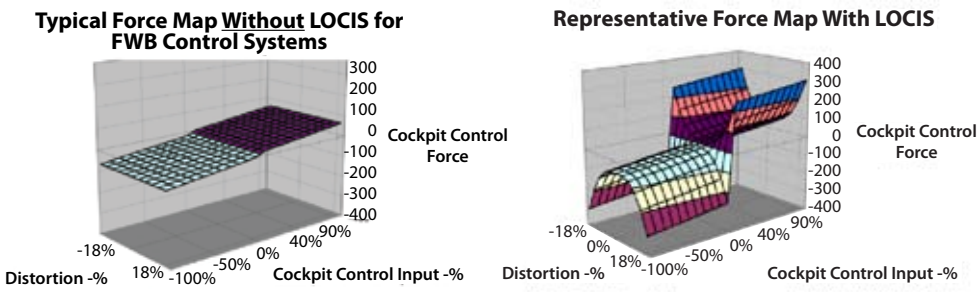
The Technology

In the early days of aviation, the pilot's muscle was the driving force that moved the cockpit controls. The pilot applied the operating pressure necessary to overcome aerodynamic loads deflecting across the controlled surface, which resulted in stretched cables or bent push rods. Because the pilot's input to the controls served as the primary driver of the control surfaces, there was a relatively fixed relationship between the pilot's input and the resulting control surface output. The relationship was important in helping the pilot understand how his control system was functioning or helping him feel a malfunction in the controls.

Today's commercial aircraft have fully powered irreversible, hydro-mechanical, and fly-by-wire flight control systems, which have provided significant advantages in advancing the design of aircraft. However, with today's commercial aircraft, the pilot is not privy to the "feel" of the flight control system through his cockpit controls. The driving force is no longer the pilot's muscle, but powered actuators that drive the flight control surfaces. There is no feedback to the pilot's cockpit controls proportional to the aerodynamic loading of the surfaces, which existed with the prior flight control technology.

With LOCIS, the operator gives a control input to an inceptor. An inceptor sensor measures an inceptor input value of the control input. The inceptor input is used as an input to a Steady-State Inceptor Input/Effector Output Model that emulates the vehicle control system design. A desired effector output from the inceptor input is generated from the model. The desired effector output is compared to the actual effector output to get a distortion metric. A feedback force is generated as a function of the distortion metric and is used as an input to a feedback force generator, which generates LOCIS force back to the inceptor. The LOCIS force is felt by the operator through the inceptor, alerting the operator of deterioration in the functioning of the flight controls.

U.S. Patent 7,285,932



Force map comparison with and without LOCIS

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

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