Single-Lever Power Control for General Aviation Aircraft Promises Improved Efficiency and Simplified Pilot Controls

General aviation research is leading to major advances in internal combustion engine control systems for single-engine, single-pilot aircraft. These advances promise to increase engine performance and fuel efficiency while substantially reducing pilot workload and increasing flight safety. One such advance is a single-lever power control (SLPC) system, a welcome departure from older, less user-friendly, multilever engine control systems. The benefits of using single-lever power controls for general aviation aircraft are improved flight safety through advanced engine diagnostics, simplified powerplant operations, increased time between overhauls, and cost-effective technology (extends fuel burn and reduces overhaul costs). The single-lever concept has proven to be so effective in preliminary studies that general aviation manufacturers are making plans to retrofit current aircraft with the technology and are incorporating it in designs for future aircraft.

To aid in this effort, nine industry members of the Advanced General Aviation Transport Experiment (AGATE) consortium have teamed together to further develop SLPC technology. This consortium consists of Government, industry, and academia members who are joining forces to revitalize the nation's general aviation sector by designing integrated advanced flight systems that will improve safety and reduce the cost and time for learning to fly. SLPC technology is a vital element of this effort. SLPC team members range from aircraft manufacturers to suppliers, with the propulsion control system specialists at the NASA Lewis Research Center managing the effort.

How Does a Single Lever Work to Control an Internal Combustion Engine?

A single lever is used in tandem with a digital engine control system known as full-authority digital engine control. The combined system controls engine power on an airplane much like an automobile accelerator provides speed. Movement of the power lever automatically sets the amount of fuel flow, air flow, ignition timing, and propeller pitch to achieve requested thrust levels from the engine and propeller during the takeoff, cruise, and landing phases of flight. The single-lever power control increases fuel efficiency, decreases the time between overhauls, and ensures the best engine/propeller performance for all flight phases. SLPC greatly simplifies engine control in comparison to older systems-which use a 50-year-old technology and require the use of as many as five levers for power control.

Courtesy of JetStream Catalog.

The Advantages of a Single Lever

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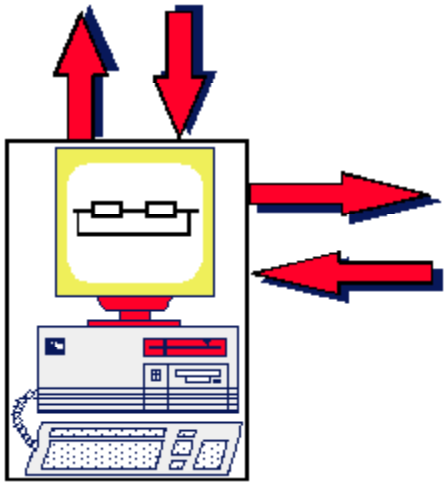
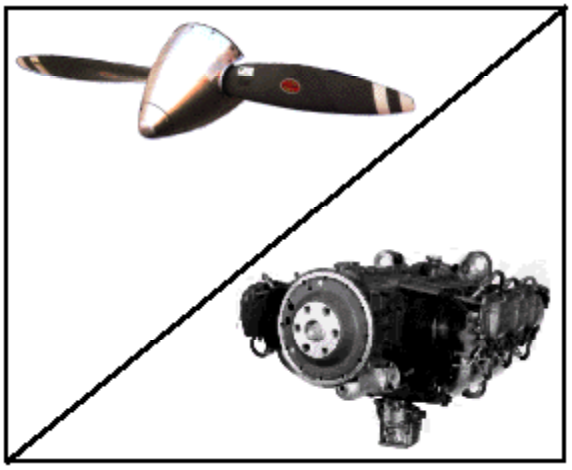
- **Improved flight safety through advanced engine diagnostics**
- **Simplified powerplant operations**
- **Increased time between overhauls**
- **Cost-effective technology (increases fuel efficiency and reduces overhaul costs)**



Pilot inputs are processed by the engine control system, which regulates engine rpm, mixture ratio, ignition timing, and fuel flow.



General aviation engine and propeller.

Movement of the single lever automatically controls engine thrust levels.

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Mechanical versions of single-lever power control were developed 15 years ago for light aircraft engines. However, their implementation was limited because of their complexity and inability to compensate for variations in air density. Later, researchers found that digital computer technology greatly enhances the accuracy and usefulness of the system as standalone equipment or integrated with an advanced cockpit display system. Single-lever power systems are commonly found today on turbine engines that use NASA-developed fly-by-wire digital control technology. This technology is used in present-day, high-performance military jet fighters and commercial transports.

A New Outlook and the Future

Thanks to the establishment of the AGATE consortium in the spring of 1995, companies are now heavily engaged in single-lever development for light aircraft, working together to eliminate any remaining glitches and to further refine the technology. Work is underway to include engine monitoring and diagnostic capability in the full-authority digital engine control to enhance pilot awareness of engine status during flight and to provide a

postflight diagnostic capability.

The team effort has led to reduced development risks and costs, which are shared equally between NASA and industry partners. Pooling of team members' resources and sharing of development costs have also dramatically speeded the development of this technology and are helping to bring new engine controls to market rapidly. SLPC developers plan on developing guidelines, standards, and certification methods for future technology applications. They foresee the day when all general aviation engines will be completely operated by electronic systems, helping to fulfill the broader AGATE vision of creating "highways in the sky."

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