SIMPLIFIED VEHICLE OPERATIONS

The future of flight: enhancing the safety and accessibility of general aviation

Flight holds a natural allure for many people, yet the personal aviation markets remain relatively small and stagnant. Beyond financial constraints, people often relinquish their dream of flight due to safety concerns and the substantial time investment required to be a proficient pilot. **Simplified Vehicle Operations (SVO) aims to make flying safer, simpler, and more accessible by automating the most error-prone, perishable, and distracting low-level pilot tasks.**

This paper is the first in a series of whitepapers presenting the SVO concept, significance, and practice in general aviation.

WHAT IS SVO?

SVO in general aviation and advanced air mobility involves using automation to simplify aircraft operation for pilots while maintaining safety. The core concept behind practical SVO involves breaking down the tasks that pilots are trained to perform—including the three fundamental pilot functions of Aviate, Navigate, and Communicate—and identifying certain tasks that could be more effectively and reliably executed by automated or autonomous systems.[1]

SIGNIFICANCE

Recent studies have shown that 80 percent of student pilots voluntarily withdraw from training before obtaining their pilot's certificate, and the majority who do earn their license cease flying within a few years due to the recurring demands of maintaining proficiency.[2] By automating the tasks that are most error prone, need constant practice, and can distract the pilot, SVO offers potential safety and economic benefits related to cost, pilot credits, and barriers of training.[3] Safety benefits include but are not limited to proposed SVO technologies that are initially developed to prevent loss of flight control where 47 percent of General Aviation Accidents occur.[4] Economic benefits are tied to the reduced time investment required for training, which lowers barriers to entry and increases access to ultimately help drive adoption and market growth.

SVO relies on methods to ensure effective collaboration between pilots and automated systems, whether they are working together or independently. The goal is to create a seamless partnership between pilots and automation for safer and more efficient operations.

Everyday Transportation Example

In automobiles, complex gear mechanisms linked to clutches and manual gear shifts have been replaced by simplified and automated transmission systems. This has eliminated manual transmission training and seamlessly reduced the driver workload.

THE OPPORTUNITY

During the initial phase of SVO implementation, training programs are expected to be specifically tailored to individual vehicles. However, in terms of licensing, the architecture of functional skill categories will permit operators to progressively attain skill ratings until they encompass the full spectrum of contemporary pilot abilities.

THE FUTURE

By significantly reducing training durations without compromising safety, SVO stands as a pivotal advancement in aviation and is a potential catalyst for system-wide modernization. The restructuring of pilot skill categories, reliance on accident data analysis, and strategic integration of autonomous systems (with system-wide safety assurance for increasing levels of autonomy) collectively contribute to a safer, more efficient, and more accessible aviation landscape.

U.S. Department of Transportation

HASS
Highly Automated Systems Safety Center of Excellence

SVO PILOT SKILL CATEGORIES

SVO encompasses the three fundamental pilot functions of Aviate, Navigate, and Communicate. The challenges associated with conventional flight controls are widely recognized, and over the years, there have been numerous efforts to make them simpler and safer. Traditional aircraft automation relies on pilot intervention in the event of system failure, thereby increasing training requirements to cover system monitoring and off-nominal procedures. SVO automation is designed to be fail-functional, eliminating the need for the pilot to be trained as a backup for these automated functions.

Simplified Flight Control (SFC) addresses the Aviate function, which involves maintaining control of the aircraft while flying a desired flight path. Aviate is the first and most safety critical priority for a pilot. Consequently, SFC has the greatest potential for improving safety through SVO. Most electric vertical take-off and landing (eVTOL) concepts have some form of "full envelope protection" that protects the aircraft from entering an unsafe altitude regardless of pilot inputs.

Through more reliable execution of pilot tasks, SVO technologies allow pilots to focus on the higher-level functions that are inherently challenging to automate and better suited to human control. SVO enables low/part-time pilots to fly simply and safely, even when failures occur.

EVALUATION AND CERTIFICATION

In July 2023, the Federal Aviation Administration (FAA) released a Notice of Proposed Rulemaking (NPRM) for the Modernization of Special Airworthiness Certification (MOSAIC) package of aircraft certification. The proposed rule would put performance safety standards around larger aircraft that innovators are building by expanding the definition of Light Sport Aircraft.

Several eVTOLs currently being developed use SVO to provide stability and control during the transition phase of flight or within a specific range of flight conditions. The FAA is collaborating with industry to explore and understand the full capability of these safety enhancing technologies that may inform policy decisions.

The establishment of certification standards for SVO systems on vehicles and designing personalized flight training curricula for SVO operators is postulated to lower the barriers to the more widespread use of general aviation while maintaining or increasing the level of safety. The GAMA SVO Working Group is working with industry, U.S. DOT, and FAA to progress SVO concepts and discussions, aiming to establish the necessary standards and regulatory framework for these innovative technologies.

SVO IN PRACTICE

There is a continuum of SVO applications. A Full Authority Digital Engine Control (FADEC) system is an example of SVO where the pilot's job of managing the engine is taken over by a certified and engineered system. In aircraft with a FADEC, there is no "reversionary mode" where the pilot must directly control the mixture – it is 100 percent handled by the certified system at all times. The certified SVO function in a FADEC reduces the pilot's tasks and training they need. This makes it less likely for mistakes to happen in engine management, making flying safer.

REFERENCES

1. https://gama.aero/documents/svo-whitepaper-a-rationale-construct-for-simplified-vehicle-operations-svo-version-1-0-may2019/
2. https://www.aopa.org/
3. https://ntrs.nasa.gov/api/citations/20205000771/downloads/AVIATION%202020%20AAM%20SVO%20final.docx.pdf Achieving Resilient In-Flight Performance for Advanced Air Mobility through Simplified Vehicle Operations, Wing, David et al, NASA Langley Research Center, 2020
4. https://pilotinstitute.com/aviation-accident-causes/ Why Do Aircraft Crash? – Aviation Accident Statistics Revealed

CONTACT

Sarasina Tuchen
Senior Scientist, HASS COE
sarasina.tuchen@dot.gov

transportation.gov/hasscoe

U.S. Department of Transportation

HASS
Highly Automated Systems Safety Center of Excellence

linkedin.com/company/hasscoe