Airframe Design for “Silent Aircraft”

The noise goal of the Silent Aircraft Initiative, a collaborative effort between industry, academia and government agencies led by Cambridge University and MIT, demands an airframe design with noise as a prime design variable.

The authors begin by linking their work to a larger initiative. This paper was submitted to a special section on silent aircraft, so it is likely that many audience members will have heard of this initiative. Even so, they address a more general audience by briefly describing the initiative’s goal.

This poses a number of design challenges and the necessary design philosophy inherently cuts across multiple disciplines involving aerodynamics, structures, acoustics, mission analysis and operations, and dynamics and control.

The authors broadly summarize the knowledge gap by listing the disciplines that are relevant to the problem of designing a silent aircraft.

This paper discusses a novel design methodology synthesizing first principles analysis and high-fidelity simulations, and presents the conceptual design of an aircraft

The authors then explain the methodology discussed in this paper.

with a calculated noise level of 62 dBA at the airport perimeter. This is near the background noise in a well populated area, making the aircraft imperceptible to the human ear on takeoff and landing. The all-lifting airframe of the conceptual aircraft design also has the potential for a reduced fuel burn of 124 passenger-miles per gallon, a 25% improvement compared to existing commercial aircraft.

The authors then present the high-level results, including noise levels and emission reductions, and how they accomplish the goals of the initiative introduced in the first sentence.

A key enabling technology in this conceptual design is the aerodynamic shaping of the airframe centerbody which is the main focus of this paper.

In a slight departure from the standard hourglass model, they address their methodology, move on to results, then return to the focus of the technical aspect of the paper, i.e., “the aerodynamic shaping of the airframe centerbody”.

Design requirements and challenges are identified and the resulting aerodynamic design is discussed in depth. The paper concludes with suggestions for continued research on enabling technologies for quiet commercial aircraft.

Finally, the authors conclude their abstract by broadly summarizing their work and possible future directions of research.