Hybrid Laminar Flow for Subsonic Cruise Efficiency: Has the Time for Subsonic Drag Reduction Arrived?

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Abstract

The holy grail of viscous drag reduction is laminar control: the ability to maintain laminar flow in the adverse conditions of transonic cruise at high Reynolds number. Depending on the assumptions made for fossil fuel costs, drag reduction may of may not be a reasonable alternative for subsonic aircraft. While classical T-S theory provides some insights into the behavior of laminar boundary layers, the realities of swept wing flow make the problem substantially more complex. We discuss experiments in advanced laminar flow control that happened 20 years ago, and the prognosis for application to real aircraft. We also discuss more exotic solutions, like the injection of plasma into localized regions of the flow. Finally we discuss recent insights derived into flow over steps and gaps, which are a real issue for any practical implementation. In these cases not only does classical theory fail, but also it may seriously underestimate the Reynolds number at which transition to turbulence occurs.

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