# Exploration of a Slotted Airfoil Laminar-Flow-Control Concept

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## Purpose

This research aims at exploring the practicality of the slotted, natural-laminar-flow (SNLF) airfoil concept. In prior tests made in the Penn State Low-Speed, Low-Turbulence Wind Tunnel (LSLTT), this concept demonstrated its design performance goals in the cruise configuration [1]. In the current effort, the performance with different deflection angles and pivot locations of the aft element will be measured to determine the effectiveness of the aft element as a flap and/or aileron.

In addition, a comparison of the SNLF concept with a laminar flow control (LFC) airfoil using distributed suction will be undertaken.

## Background

Although the drag reduction concepts of active laminar flow control (LFC) and passive natural laminar flow (NLF) have been around for decades, it is only recently that rising fuel costs have rekindled interest in the potential benefits of these technologies. While a great deal of research over the years, and most recent efforts, have focused on the achievement of LFC through distributed suction and NLF through shaping, a recently conceived approach, that of a slotted, natural-laminar-flow (SNLF) airfoil, has received only limited attention. While the SNLF airfoil achieves drag reductions that are not much different than those obtained with active methods, it does so passively using an airfoil having two elements with a slot between them. The presence of the slot allows favorable pressure gradients over the entire fore element, resulting in full laminar flow over that element. The aft element achieves laminar flow over roughly 70-percent of the upper surface and 100-percent of the lower. The overall result is an airfoil that achieves laminar flow over all but some 15-percent of the surface. While this concept is likely limited in the amount of sweep that can be accommodated, benefits should be realizable to relatively high Reynolds numbers. Preliminary testing of such an airfoil has been promising [1, 2], but many practical issues have yet to be addressed, such as maximum lift capability and whether or not the aft element can be employed as a flap and/or a full-span aileron while still maintaining laminar flow. In addition, the drag penalty introduced by the aft-element brackets that connect the two elements has yet to be assessed.

Given the preliminary results obtained thus far, the SNLF concept appears very promising and, given the possibility of it having higher performance while being less complicated

than the active LFC approach, it certainly merits additional consideration.