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Control of Laminar-turbulent transition on a natural laminar flow airfoil JOHN WYLIE, KEITH TAYLOR, MICHAEL AMITAY, Rensselaer Polytechnic Institute — Tollmien-Schlichting (T-S) waves are the principal mechanism for laminar- turbulent transition over external surfaces. The present work aims to identify T-S waves on a natural laminar flow airfoil in the presence of an adverse pressure gradient, and subsequently reduce or eliminate the amplitude of identified T-S waves, delaying the transition to turbulence in the observed flow field. Three Piezoelectric-Driven Oscillating Surface (PDOS) actuators were used at three corresponding streamwise locations. These actuators act as dynamic surface modification, which both introduce artificial T-S waves, and subsequently cancel these waves. In the study, two upstream actuators were used to excite and phase-lock the T-S waves through systematic oscillation. The downstream actuator was used to cancel the T-S waves by applying an anti-phase disturbance at the proper amplitude. Particle Image Velocimetry was used to observe the development of the T-S waves and to characterize the three-dimensional development of the T-S waves along the airfoil model. The results indicate a dampening of the T-S wave magnitude, resulting in a delay of the transition of laminar to turbulent flow in the presence of a known adverse pressure gradient.

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