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Boundary Layer Trip Effects On Incipient Dynamic Stall Flutter[1] THOMAS CORKE, PATRICK BOWLES, DUSTIN COLEMAN, FLINT THOMAS, University of Notre Dame, MARK WASIKOWSKI, Bell Helicopter — Experimental results of compressible light dynamic stall on a modern helicopter rotor-blade airfoil are presented at free-stream Mach numbers ranging from 0.2 to 0.6, Reynolds numbers up to 3.5×10^6, and reduced frequencies corresponding to relevant helicopter rotor speeds ($k \leq 0.05$ for $M_\infty \geq 0.4$). Diagnostic tools include high frequency pressure transducers to study the temporal behavior of the pressure field and integrated loads, as well as macro focused Schlieren images of the leading edge flow field ($0 \leq x/c \leq 0.10$). The study concentrates on the air load's net aerodynamic work on the airfoil to identify combinations of collective and cyclic input that cause negative or reduced torsional damping. Free (un-tripped) and forced (tripped) laminar to turbulent transition were explored in order to constrain the mechanism for dynamic stall onset. Leading edge roughness resulted in a suppression of the suction peak and strong dynamic vortex compared to the baseline that resulted in reduced torsional damping at high subsonic free-stream Mach numbers ($M_\infty \geq 0.5$). Comparisons to predictions from a Leishman-Beddoes model for dynamic stall are also presented.

[1]Supported by Bell Helicopter

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