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Second-mode control in hypersonic boundary layers over assigned complex wall impedance VICTOR SOUSA, DANISH PATEL, JEAN-BAPTISTE CHAPELIER, CARLO SCALO, Purdue University — The durability and aerodynamic performance of hypersonic vehicles greatly relies on the ability to delay transition to turbulence. Passive aerodynamic flow control devices such as porous acoustic absorbers are a very attractive means to damp ultrasonic second-mode waves, which govern transition in hypersonic boundary layers under idealized flow conditions (smooth walls, slender geometries, small angles of attack). The talk will discuss numerical simulations modeling such absorbers via the time-domain impedance boundary condition (TD-IBC) approach by Scalo et al. *Phys. Fluids* (2015) in a hypersonic boundary layer flow over a 7-degree wedge at freestream Mach numbers $M_\infty = 7.3$ and Reynolds numbers $\mathrm{Re_m} = 1.46 \cdot 10^6$. A three-parameter impedance model tuned to the second-mode waves is tested first with varying resistance, R, and damping ratio, ζ, revealing complete mode attenuation for $\mathrm{R} < 20$. A realistic IBC is then employed, derived via an inverse Helmholtz solver analysis (Patel et al. AIAA 2017-0460) of an ultrasonically absorbing carbon-fiber-reinforced carbon ceramic sample used in recent hypersonic transition experiments by Dr. Wagner and co-workers at DLR-Göttingen.

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