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# Evolution of wall pressure fluctuations in flow over the DARPA SUBOFF model

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## ABSTRACT

In this study, wall-resolved large-eddy simulation is conducted to investigate the evolution of wall pressure fluctuations in flow over the DARPA SUBOFF bare model at $Re_L = 1.1\times10^6$. Due to the coexistence of convex and concave streamwise curvatures, the flow in the stern region features alternating zones of favorable and adverse pressure gradients (APG). The simulation validates the experimental findings by Balantrapu *et al*. (*J. Fluid Mech*., vol. 960, 2023, A28), confirming that in APG-dominant axisymmetric boundary layers without streamwise curvatures, the root-mean-square wall pressure fluctuations ($p_{w,rms}$) decreases downstream alongside the wall shear stress ($\tau_w$), maintaining a constant ratio of $p_{w,rms}/\tau_w$. This study further finds that when streamwise curvatures and strong streamwise pressure-gradient variations present, this relationship breaks down. Instead, the local maximum Reynolds shear stress $-\rho\langle u_s u_n\rangle_{\max}$ emerges as a more robust pressure scaling parameter and more significant contributor in in APG-dominant axisymmetric boundary layers.

**Keywords:** wall-resolved large-eddy simulation; wall pressure fluctuation; adverse pressure gradient; DARPA SUBOFF; axisymmetric boundary layer; curved flow.

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