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Response on the Near Wall Turbulence to Localized Unsteady Blowing Periodical and Dissymetric in Time

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The effect of a localized unsteady blowing on the near wall turbulence structure and the drag is investigated experimentally and through direct numerical simulations. Localized time dependent blowing is either sinusoidal or dissymmetric in time with a rapid acceleration phase followed by a slow deceleration phase. The flow is partly relaminarized during the oscillation cycle because of an induced positive spanwise vorticity layer that dilutes the negative vorticity existing near the wall whose diffusion is constrained into the low buffer layer with limited effect of turbulent mixing, when the frequency of the oscillating blowing is large. Thus, in case of sinusoidal blowing the vorticity concentrates, becomes compact and rolls-up into a coherent spanwise vortex at approximately the beginning of the low buffer layer. The unsteady periodical blowing dissymmetric in time prevents the destabilization and the set-up of the spanwise vortex that causes the drag increase. These results point at possible alternate ways of drag management.

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