MECHANICAL & AEROSPACE ENGINEERING GRAD STUDENT SEMINAR

Turbulent Boundary Layer Separation over Textured Surfaces

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11:00 AM
AME Room 106

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ABSTRACT: The turbulent boundary layer behavior over aircraft bodies and lifting surfaces dictates the total skin-friction drag and, in cases with flow separation, the vehicle scale aerodynamic performance. For this seminar, we discuss possible strategies to engineer surface micro-textures to improve the boundary layer separation resilience in unsteady environments. Using herringbone-type micro-texturing and by inducing spanwise skin-friction heterogeneity, we localize known boundary layer coherent structures that are responsible for significant amount of turbulent transport. We show that when this boundary layer is subjected to separation over a smooth backward facing step, the weakly-three dimensional boundary layer develops a strong spanwise differential in separation tendency. Specifically, the regions of relatively low mean streamwise momentum (known as 'low momentum pathways' or LMPs) are prone to strong separation (larger separation bubble), while the 'high momentum pathways' (HMPs) are more resilient to separation (smaller separation bubble). We explore the basic turbulent mechanisms that result in this behavior, including that of 'slingshot effect' – a phenomean resulting in disproportionately large production of Reynolds Shear Stress relative to the Turbulent Kinetic Energy.

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