Large-Eddy Simulations for Flow Control

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Abstract : There are several technologically-important flow situations in which there is a need to control the outcome of the fluid flow. This could include flow separation, drag, noise, as well as particulate separations, to list only a few. One possible approach is the passive control, in which the design geometry is changed. An alternative approach is the Active Flow Control (AFC) technology in which an actuator is imbedded in the flow field to change the outcome. Examples of AFC are pulsed jets, synthetic jets, plasma actuators, heating and cooling, Etc. In this work will present an overview of the development of this field. Some examples will include: Airfoil Noise Suppression: LES is used to simulate the effect of the synthetic jet actuator on controlling the far field sound of a transitional airfoil. The results show considerable suppression of the noise if the synthetic jet is operated at frequencies. Mixing Enhancement and suppression: Results will be presented to show that imposing acoustic excitations at the nozzle exit can lead to enhancement or reduction of the jet plume mixing. In a vertical takeoff of Aircraft or in Space Launch, we will present results on the effects of water injection on reducing noise, and on protect the structure and pay load from fatigue damage. Other applications will include airfoil-gust interaction and propulsion systems optimizations.
Keywords : aerodynamics, simulations, aeroacoustics, active flow control (AFC), Large-Eddy Simulations (LES)

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