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Fluidic oscillators for active flow control applications

Active flow control (AFC) applications are increasing every day, the use of (AFC) technologies allows, among other applications, reducing drag forces in bluff bodies, increasing lift in airfoils reducing cavity noise and enhancing mixing in combustion chambers. There exist several (AFC) methodologies to modify the boundary layer thickness and its separation point in a given bluff body, all of them being based on the use of slots, grooves, or holes, through which fluid is injected or sucked. The use of constant blowing, constant sucking or periodic forcing, are the three common methods to interact with the boundary layer. Periodic forcing appears to be the most efficient one regarding the energy requirements, yet for each application it is necessary to employ a particular pulsation frequency and amplitude. Among the different devices used to generate pulsating flow, the most common ones are the zero net mass flow actuators (ZNMFA), also called synthetic jets and the fluidic oscillators (FO). The main advantage of (FO) versus (ZNMFA), resides in the lack of moving parts, which a priory gives confidence regarding its reliability. In the present paper one of the most common configurations of (FO) will be carefully analyzed via using 3D computational fluid dynamics (CFD). The origin of the fluctuations, based on the Coanda effect, will be studied, the relation incoming flow-outgoing frequency and amplitude as a function of the Reynolds number shall be clarified, a parametric analysis is also to be performed in order to understand the effect of the different internal dimensions on the (FO) overall performance. The advantage of the present paper versus previous publications, see for example resides in the evaluation of the momentum acting on the jet entering the mixing chamber.

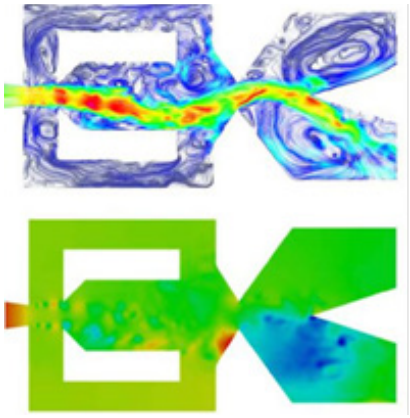

Figure 1: Instantaneous streamlines and pressure distribution inside the fluidic actuator under study.

Recent Publications

1. Seifert A et al. (2009) Large Trucks Drag Reduction Using Active Flow Control. In The Aerodynamics of Heavy Vehicles II: Trucks, Buses, and Trains. Springer. Pages:115-133.
2. Seele R et al. (2009) Discrete sweeping jets as tools for improving the performance of the V-22. Journal of Aircraft. 46(6):2098-2106.

3. Raman G and Raghu S (2004) Cavity resonance suppression using miniature fluidic oscillators. AIAA Journal. 42(12):2608-2612.

4. Raman G et al. (2005) Jet thrust vectoring using a miniature fluidic oscillator. The Aeronautical Journal. 109(1093):129-138.

Biography

Josep M Bergada pursued his PhD in Mechanical Engineering (1996) from University Polytechnic of Catalonia (UPC), Barcelona, Spain. He is currently an Associate Professor in Fluid Mechanics Department at UPC. He has published more than 18 key-papers in reputed journals and over 55 papers in international conferences. He is also serving as an Editorial Board Member of a reputed SCI journal and has reviewed over 250 papers from more than 15 SCI journals. His books on fluid mechanics is gaining international relevance. His research interest include: active flow control, piston pumps, tribology, compressible flow, CFD etc.

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