# FLOW CONTROL USING SYNTHETIC JET ACTUATORS

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*A synthetic jet can be produced over broad range of time and length-scales. Theirs unique attributes make them attractive fluidic actuators for various flow-control tasks. Generation, evolution and interaction of synthetic jets are reviewed in the presented paper. Application of this actuator type ranging from separation and turbulence control, control to thrust vectoring and mixing augmentation to skin friction control is shown.*

Key words: *synthetic jet, continuous jet, actuator, flow control, boundary layer separation, mixing, jet vectoring, skin friction*

## 1. Introduction

Recently, many researchers (namely in the US) are interested in a synthetic jet research. The reason is potential possibility of using this type of actuators in flow control. Although, these actuators have not been used in practice yet, the MEMS technology development in recent years makes this principle very promising for using in various fluid dynamics control applications namely in aero-engineering.

Some authors refer to this phenomenon as a zero-net-mass-flux jet, unsteady bleeding, suction and blowing, oscillatory blowing, acoustic streaming etc. However, comparing with acoustic streaming there is a considerable difference. Acoustic streaming represents itself the generation of a mean motion by sound. These flows are very similar to synthetic jet flow in that they are zero net mass. However, a synthetic jet is not necessarily an acoustic streaming effect, since it does not rely on any acoustic effect, and it has a mean flow on the same order as the oscillatory orifice flow. Acoustic streaming cannot occur unless the fluid compresses, but a synthetic jet can be generated in a completely incompressible fluid.

An isolated synthetic jet is produced by the interactions of a train of vortices that are typically formed by alternating ejection and suction of fluid across an orifice in a wall such that the net mass flux is zero. Resulting jet is formed entirely from the working fluid of the flow system in which it is deployed and thus can transfer linear momentum to the flow system without net mass injection across the flow boundary.

Synthetic jets can be produced over a broad range of length and time-scales, they are attractive fluidic actuators for a broad range of flow control applications. A synthetic jet could be of circular or planar nominally 2D cross-section depending on the generators orifice shape. Planar synthetic jet using a slot orifice is more convenient for a 2D boundary layer control purposes, however the physics of both 2D and rotary symmetrical synthetic jets is analogous. Most of results presented in this review are related to a 2D synthetic jet.

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