The research is to explore the evolution of a synthetic (zero net mass flux) jet. A synthetic jet is produced by the interactions of a train of vortices that are typically formed by alternating momentary ejection and suction of fluid across an orifice such that the net mass flux is zero. A unique feature of these jets is that they are formed entirely from the working fluid of the flow system in which they are 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-scale and their unique attributes make them attractive fluidic actuators for a broad range of flow control applications.

Over the last few years, the streamwise and spanwise evolutions of finite span synthetic (zero net mass flux) jets were investigated experimentally using PIV. The synthetic jet was produced over a broad range of length- and time-scales at various Reynolds numbers, stroke lengths, slit widths, and formation frequencies. The velocity and vorticity fields
were measured in two planes, across the slit (i.e., along the short axis of the orifice) and along the slit (i.e., along the long axis). The effect of the slit aspect ratio on the development of the synthetic jet, and the spatial evolution of secondary three-dimensional vortical structures in the flow field were investigated. The measurements in the plane along the slit revealed a unique flow pattern, where near the orifice the flow is two-dimensional, while farther downstream the vortex pair lines develop secondary counter-rotating structures. The streamwise and spanwise spacing between these structures vary with stroke length and formation frequency. As the orifice aspect ratio increases the effect of the slit edges decreases, thus the secondary structures are less pronounced.