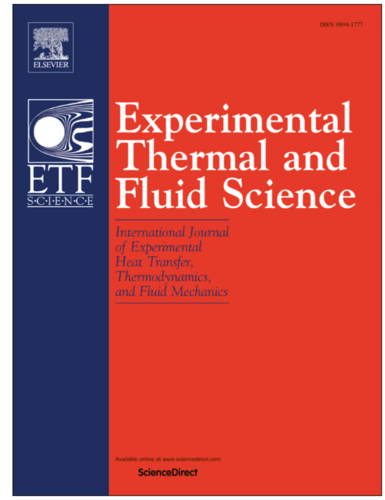


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# The evolution of quadruple synthetic jets

Gerardo Paolillo[a,*], Carlo Salvatore Greco[a], Gennaro Cardone[a]

[a] *Department of Industrial Engineering, University of Naples Federico II, Naples 80125, Italy*

**Abstract**

The formation and evolution of quadruple synthetic jets issuing into quiescent air are experimentally investigated. Four different configurations (monopole-like, dipole-like, quadrupole-like and 90-degrees-circularly-shifted-jets) have been studied by varying the phase lags between the ejection strokes of the four jets, at constant values of the source Reynolds and Strouhal numbers, equal to 4000 and 0.2, respectively. For each configuration instantaneous three-component in-plane velocity fields in the most relevant streamwise planes are measured with stereoscopic particle image velocimetry. The evolution of the turbulent jet flow is analyzed by the velocity field triple decomposition, thus separating the time-averaged component from the forced periodic oscillation and the turbulent fluctuation. It is observed that the near region of the flow domain is dominated by the formation and advection of large-scale coherent vortex structures, which are originated by the interaction of the vortex rings inherent to the single synthetic jets. The vortex dynamics is captured by phase-averaged measurements and its role in determining the flow field structure of each of the investigated configurations is widely discussed. The vortex structures are observed to lose their coherence and break down into turbulence while propagating downstream. The decay of the large-scale coherent motions is accompanied by the establishment of a self-preserving behavior of both the mean flow and turbulent quantities. Nevertheless, it is shown that the far-field topology depends critically on the

*Corresponding author
*Email address:* gerardo.paolillo@unina.it (Gerardo Paolillo)