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Mechanism of formation of coherent structures in under-expanded supersonic impinging jets[1] SHAHRAM KARAMI, DANIEL EDGINGTON-MITCHELL, Monash University, VASSILIS THEOFILIS, University of Liverpool, JULIO SORIA, Monash University — Large-eddy simulations of under-expanded impinging jets are performed to study the mechanism by which the initial high-frequency instabilities change to low-frequency coherent structures within a short distance. The spectral characteristics of the Mach energy norm is utilised to obtain the spatial growth of instabilities. Linear spatial instability analysis with streamwise varying mean flow profiles is also performed. Cross-correlation of velocity and pressure show that hydrodynamic wavepackets form approximately one jet diameter downstream of the nozzle lip. No evidence has been found to support the 'collective interactive' mechanism of Ho & Nosseir (JFM, Vol. 105, p. 119-142, 1981). The 'vortex pairing' of Winant & Browand (JFM, Vol. 63, p. 237-255, 1974) is observed near the nozzle; however, it has an insignificant role in the sharp reduction of the most unstable frequency of disturbances. Nonetheless, both Mach energy norm and linear spatial instability analyses show that the most unstable frequency of disturbances decreases rapidly in a very short distance from the nozzle lip in the near-nozzle region through the spatial growth of instabilities where linear instability analysis over-predicts the frequency of the most unstable instabilities.

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