# HELICITY IN SUPERCRITICAL TEMPORAL MIXING LAYERS

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Recent results from Direct Numerical Simulations (DNS) of supercritical binary-species temporal mixing layers (e.g. Okong'o et al. 2002, and Okong'o and Bellan 2002) have shown that the vorticity magnitude at achieved transitional states depends substantially on the species system. For example, heptane/nitrogen mixing layers reach transitional states that exhibit considerably higher vorticity magnitude than that found at transitional states of oxygen/hydrogen mixing layers. This difference in vorticity magnitude was attributed to the much larger initial density stratification of oxygen/hydrogen layers, making them more difficult to entrain.

Vorticity is closely associated with turbulence (Chorin 1994), and it is turbulence that distorts the heavy fluid and disintegrates it when it is injected into a combustion chamber (e.g. diesel, gas turbine and liquid propellant engines); this is clearly shown in the experiments of Chehroudi et al. 1999. This association motivated the examination of the helicity in supercritical temporal mixing layers, as the helicity-density (the velocity-vorticity dot product) measures the knottedness of the flow, and thus its distortion; this distortion provokes the formation of parcels of fluid for a jet, as observed in experiments (e.g. Chehroudi et al. 1999). The helicity-density equation was considered and its budget was examined for several databases encompassing transitional states obtained for different binary-species systems and various perturbation wavelengths utilized to excite the layer and induce entrainment and pairing. These results are reported with particular emphasis on the two terms in the helicity-density equation that involve both the pressure and mass-density. Because under supercritical conditions the pressure and mass-density are strongly coupled through real-gas equations of state, the examination of the contribution from these two terms relative to the dynamic and stress-related terms is particularly important.

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**Acknowledgment**

This work was conducted at the Jet Propulsion Laboratory (JPL), California Institute of Technology and sponsored by the Air Force Office of Scientific Research under the direction of Dr. Julian Tishkoff and by the Army Research Office under the direction of Dr. David Mann, through interagency agreements with NASA, and by the National Aeronautics and Space Administration (NASA), Marshall Space Flight Center under the direction of Dr. John Hutt. The computational resources were provided by the JPL Supercomputing Center.