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Experimental investigation of low Mach number flow past a rectangular cavity using dual-camera Cinematographic PIV system SHIYAO BIAN, STEVEN CECCIO, University of Michigan, Dept. of Mechanical Engineering, JAMES DRISCOLL, University of Michigan, Dept. of Aerospace Engineering — Flow past cavity has been of interest due to its geometrical simplicity and complex flow characteristics. A dual-camera Cinematographic Particle Image Velocimetry (CPIV) system has been developed to study low Mach number flow over a rectangular cavity. This system consists of two high-repetition rate Nd:YAG lasers and two high-speed CMOS cameras registered to have sub-pixel alignment errors. A rectangular cavity with a length-to-depth ratio of 2 was mounted in the test section of a recirculating water tunnel providing free-stream flow speeds between 5$\sim$26 m/s. Consecutive CPIV images with a spatial resolution of 1632 x 800 pixels and 20 μs time delay were obtained at frame rate of 1.5 KHz. Time traces of surface pressures at the bottom of the cavity are acquired simultaneously by using flush-mounted dynamic pressure transducers. The temporal evolution of velocity and vortical fields reveals the time-dependence of the mixing and mass transport between the shear layer and the cavity. The simultaneous velocity and pressure measurements also show the unsteady interaction between vortical structures and the trailing edge of the cavity under resonating and non-resonating conditions. [Sponsored by National Science Foundation Grant: CTM 0203140]

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