Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Turbulence generation with piston-driven synthetic jets KOHEI YAMAMOTO, TOMOAKI WATANABE, KOJI NAGATA, Nagoya University — An apparatus for generating compressible turbulence in a closed chamber is developed with high-speed synthetic jet actuators driven by pistons, which are connected to electronic motors. Each actuator repeatedly suctions and injects fluid via four orifice holes on the top of the cylinder. Totally eight actuators are placed on two opposing surfaces of a rectangular parallelepiped chamber. By driving the actuators at 150 Hz, jets with the maximum Mach number of about 1.2 are repeatedly ejected from each actuator into the chamber. The interaction of the opposed synthetic jets generates turbulence with density variations in the chamber. The characteristics of the generated turbulent flow field are investigated with particle image velocimetry (PIV) and shadowgraph method. Large density fluctuations are observed in the turbulent flow by the shadowgraph visualization. Tracer particles for PIV are seeded into the chamber by oil evaporation and condensation inside the cylinder due to significant pressure variations. Root-mean-squared velocity fluctuations are similar for the direction of the jet ejection and its normal direction at the center of the chamber, where the mean velocity is also small compared with the velocity fluctuations. The turbulence at the center is shown to be nearly isotropic and homogeneous compared with the regions strongly influenced by the jets. The probability density function of velocity fluctuations is well approximated by the Gaussian distribution at the center of the chamber.

Kohei Yamamoto
Nagoya University

Date submitted: 02 Aug 2020 Electronic form version 1.4