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Weak Compressibility Method for Prediction of Fluid Noise Generation by Cavity Flow at Low Mach Number

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This paper presents the implementation and validation of a numerical simulation method that takes into account the air-borne acoustic wave propagation within the turbulent flow solution at low Mach number, which is so-called weak compressibility, in order to cope with fully coupled aero-acoustics problems in a nonlinear system. An academic single 3D cavity case is used to validate the method in comparison with the experiment. The simulated results showed excellent agreement with the experimental data in regard to the acoustic pressure and frequency for the dominant peak of the sound pressure level (SPL) spectra over a wide speed range up to 55 meter per second. An industrial case of so-called singer riser in the system of ocean natural gas rig is studied using this method. There is fluid sound generation due to the interaction of the gas flow field with the pipe grooves. This sound causes strong resonance and vibration over the equipments on the gas rig platform therefore forces the gas producer to control the gas production rate. By using numerical simulation, the aero-acoustic behaviour of a gas flowing in a lab-scale corrugated pipe has been captured which provides deep insights of fluid sound generation mechanism of this singer riser. Experimental results are used to validate the numerical models.