Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

On the optimal flexibility condition of an impulsive starting jet nozzle for thrust generation[1] DAEHYUN CHOI, HYUNGMIN PARK, Seoul National University — Looking at the nature, the propelling organs of underwater mollusks and the respiratory organs of fish and shellfish are commonly in the shape of a flexible nozzle, with an exceptional performance. In this study, the effect of the highly deformable nozzle on the jet thrust is studied. For the experiment, in-house cylindrical silicone nozzles (D = 15mm) were manufactured while varying their elasticity (0.1-0.4 MPa), length (1.5-3D), and thickness (50-250 μm). A starting water jet was pushed using a piston with its exit velocity of 0.2-0.8 m/s, and acceleration time of 0.1-0.3 sec. Particle image velocimetry has been used to measure the velocity field of the jet, and image processing to quantify the nozzle deformation. We found that a larger thrust is generated than the rigid nozzle due to the nozzle deformation when the elasticity of the nozzle increases. In order to predict the interaction between the nozzle and the starting jet, a theoretical model has been constructed by combining the shell theory and tube law. From this model the governing dimensionless number, including the factors from nozzle geometry (aspect ratio and elasticity) and fluid flow (jet velocity and acceleration) are derived, which is proven to determine the optimal nozzle design for maximizing the thrust.

[1]Supported by NRF grant (2017M2A8A4018482, 2020R1A2C22014510) of Korea government.

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Date submitted: 10 Aug 2020 Electronic form version 1.4