Abstract Submitted
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Numerical simulation of tandem-cylinder noise-reduction using plasma-based flow control[1] MENG WANG, AHMED ELTAWEEL, FLINT THOMAS, ALEXEY KOZLOV, University of Notre Dame, DONGJOO KIM, Kumoh National Institute of Technology, Korea — The noise of low-Mach-number flow over tandem cylinders at $Re_D = 22,000$ and its reduction using plasma actuators are simulated numerically to confirm and extend earlier experimental results. The numerical approach is based on large-eddy simulation for the turbulent flow field, a semi-empirical plasma actuation model, and Lighthill's theory for acoustic calculation. Excellent agreement between LES and experimental results is obtained for both the baseline flow and flow with plasma control in terms of wake velocity profiles, turbulence intensity, and frequency spectra of pressure fluctuations on the downstream cylinder. The validated flow-field results allow an accurate acoustic analysis based on Lighthill's equation, which is solved using a boundary-element method. The effectiveness of plasma actuators for reducing noise is demonstrated. In the baseline flow, the acoustic field is dominated by the interaction of the downstream cylinder with the upstream wake. With flow control the interaction noise is reduced drastically through suppression of vortex shedding from the upstream cylinder, and the vortex-shedding noise from the downstream cylinder becomes dominant. The peak sound pressure level is reduced by approximately 15 dB.

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