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Geometric Influence on Force and Frequency Response of a Bioinspired Undulated Cylinder KATHLEEN M. LYONS, University of Wisconsin - Madison, WI, CHRISTIN T. MURPHY, ANDREW GUARENDI, Naval Undersea Warfare Center - Newport, RI, JENNIFER A. FRANCK, University of Wisconsin - Madison, WI — The unique three-dimensional geometry of seal whiskers has been shown to significantly change the turbulent structures directly downstream, resulting in reduced forces and dampened vibrations when compared with circular cylinders. Biomimicry gives an opportunity to apply the unique whisker geometry to other areas of engineering that require vibration suppression, frequency tuning, or force reduction. This computational investigation isolates the complex geometric parameters of the seal whisker via an undulated cylinder model prescribed by seven non-dimensional parameters including undulation wavelength, thickness, slenderness, amplitudes in the streamwise and transverse flow directions, as well as a peak-shift and a symmetry parameter that induce a non-sinusoidal periodic undulation. Using a two-factor fractional factorial design of experiments, these simulations demonstrate the geometric parameters and two-parameter interactions that are most influential for reducing drag, root-mean-square lift force, and shifting the frequency spectra. It is shown that both transverse and streamwise undulation amplitudes have a notable impact on the downstream turbulent vortex structures, thus impacting the frequency spectra and recirculation region via different mechanisms.

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