Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

An experimental investigation of the efficacy of perforated holes on unsteady aerodynamic force reduction for a 2D cylinder in uniform incoming flow[1] VIGNESH SUDALAIMUTHU, XIAOFENG LIU, San Diego State University — A series of wind tunnel aerodynamic force measurements have been conducted on a 2D hollow cylinder with perforated holes uniformly-distributed on its surface to evaluate the efficacy of perforation as a means of passive flow control in reducing unsteady aerodynamic forces. Both smooth and perforated cylinders were tested for comparison at Reynolds numbers ranging from 50,000 to 200,000 corresponding to free stream velocities varying from 5 to 20 m/s (at an increment of 5 m/s) and a cylinder diameter of 0.152 m. The aerodynamic forces acting on the testing model were measured using a 6-component load cell. For each tunnel speed, the test has been repeated for 10 runs at a sampling rate of 10 kHz for 60 seconds each, with a total of 6,000,000 samples acquired for each test. Both mean and r.m.s. values of the lift and drag coefficients were calculated. Power spectral density distributions of the unsteady aerodynamic force loading was analyzed to investigate the effect of the perforation on the frequency composition. Comparisons indicate that the perforated cylinder with a 8% porosity and a hole diameter of about 2% of that of the cylinder gives both substantially less unsteady drag and lift than those of the smooth cylinder for the entire Reynolds number range tested, with the r.m.s. force reduction from 8% to 82% for the drag and 64% to 85% for the lift, confirming a corresponding beneficial reduction in flow-induced cylinder vibration as observed during the experiments.

[1]Sponsor: San Diego State University

Xiaofeng Liu
San Diego State University

Date submitted: 01 Aug 2017 Electronic form version 1.4