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CONTROL OF SOUND GENERATION IN FLOW PAST TWO SIDE-BY-SIDE SQUARE CYLINDERS BY SHORT SPLITTER PLATES

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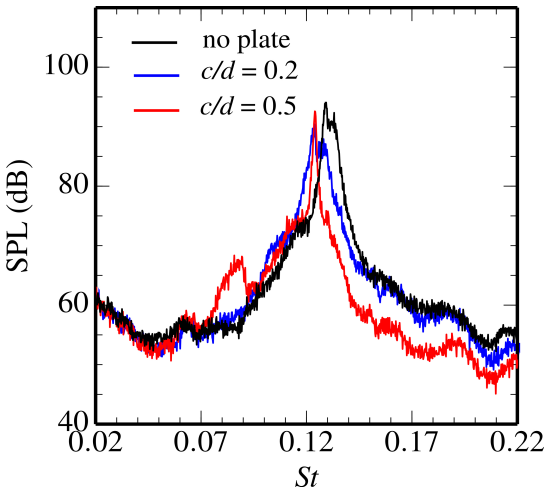
In order to control aerodynamic sound radiated from two side-by-side square cylinders in low subsonic flows, effects of short splitter-plate attached to the rear surface of each cylinder on the vortex shedding and sound generation were examined experimentally at Reynolds numbers of $O(10^4)$ in a low-noise and low-turbulence wind tunnel with the exit cross-section of 500 × 500 mm² . Two square cylinders with the side-length of d = 10 mm were set perpendicularly to the oncoming freestream. The center-to-center distance L/d between the two cylinders was 3.6-6.0, in the non-biased flow regime. Vortex shedding from the two square cylinders without splitter-plate was completely synchronized when the two cylinders were closer to each other, e.g., for L/d = 3.6, generating a quadrupole-like sound source which radiated in-phase sound in the far field; see Octavianty and Asai (2015). Our particular interest was then paid to differences in the effect of short splitter-plate (whose length was less than 0.5d) between the cases of a single cylinder and two side-by-side cylinders.

Figure 1 compares spectra of sound pressure from two side-by-side square cylinders with and without splitter plate for L/d = 3.6 at Reynolds number of Re = 3.3 × 10^4 (U_∞ = 50 m/s). The prominent Aeolian tone corresponding to the synchronized vortex-shedding was largely reduced even for the attachment of very short plates of c/d = 0.2, and was further reduced for slightly longer plates of c/d = 0.5. For the single cylinder case, on the other hand, the sound pressure level (SPL) was reduced only by 3 dB due to attachment of splitter-plate of c/d = 0.5 under the same flow condition, as shown in Fig. 2. We also found that when L/d was increased, the noise-suppression-effect of short splitter plate(s) was weakened, just like the single cylinder case. Spanwise coherency of shed vortices and near wake structures were examined in detail to understand the effect of splitter-plates on the synchronized vortex shedding from a pair of cylinders in side-by-side arrangement.



The spectra of sound pressure for single square cylinder at Re = 3.3 × 10^4