Development of Low Noise Savonius Wind Turbines

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Abstract : Savonius wind turbines are a drag-type of vertical-axis wind turbine that has been used most commonly as a small-scale wind generator. However, noise is a main hindrance to wide spreading of Savonius wind turbines, just like other wind turbines. Although noise levels radiating from Savonius wind turbines may be relatively low because of their small size, they induce relatively high annoyance due to their prolonged noise exposure to the near community. Therefore, aerodynamic noise of small vertical-axis wind turbines is one of most important design parameters. In this paper, aerodynamic noise characteristics of Savonius wind turbines are investigated using the hybrid CAA techniques, and their low noise designs are proposed based on understanding of noise generation mechanism. First, flow field around the turbine are analyzed by solving 3-D unsteady incompressible RANS equations. Then, noise radiation is predicted using the Ffowcs Williams and Hawkings equation. Two distinct harmonic noise components, the well-know BPF components and the harmonics whose fundamental frequency is much higher than the BPF are identified. On a basis of this finding, S-shaped blades are proposed as low noise designs and it can reduce the noise levels of Savonius wind turbines by up to 2.7 dB.

Keywords : aerodynamic noise, Savonius wind turbine, vertical-axis wind turbine
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