Experimental investigation of the surface pressure field for prediction of trailing edge noise of wind turbine aerofoils - DTU Orbit (08/11/2017)

Experimental investigation of the surface pressure field for prediction of trailing edge noise of wind turbine aerofoils
This paper concerns the characterisation of turbulent boundary layer trailing edge noise by measuring the surface pressure field. Two aerofoils typically used at the outer blade section of modern MW wind turbines were tested in an anechoic wind tunnel for Reynolds numbers ranging from 1 million to 1.9 million and angles of attack ranging from −10° to 14°. The emitted trailing noise from the aerofoils was measured with a microphone array at a distance of 1.6 m away from the aerofoil. The two-dimensional surface pressure field, which is considered the source of the emitted trailing edge noise, was measured with pinhole microphones distributed in streamwise and spanwise direction on the surface of the aerofoil. Two acoustic formulations relating the fluctuating surface pressure field to far field trailing edge noise were investigated. The measurements of the fluctuating surface pressure field were used as input to the model. There was a factor of 2 as difference between the two models. The prediction of the far field trailing edge noise with one model was in excellent agreement with the microphone array measurements in a frequency range of 500-2000 Hz. This opens up the possibility of quantifying trailing edge noise with surface pressure measurements. In the high frequency range the models overpredicted the measured far field sound. For frequencies lower than 500 Hz more validation is necessary. The measurements of the surface pressure field revealed that the spanwise correlation length scale is only a function of the Reynolds number when properly normalised. This result can be used to reduce the number of surface pressure microphones necessary to characterise far field trailing edge noise.

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