Project Outlines 2016 for Final Year Undergraduate

Dr. Mohamed Sukri Mat Ali
researchsuktri@gmail.com
Wind Engineering Laboratory
Department of Mechanical Precision Engineering
Malaysia-Japan International Institute of Technology (MJIIT),
UTM KL, 54100 Kuala Lumpur.

May 25, 2016

Contents

1 Numerical Study of Flow Around A Motorbike With The Effect of Crosswind

Crosswinds have the potential to influence the stability and therefore the safety of a motorbike rider. Numerical computations using Unsteady Reynolds-Averaged Navier-Stokes (URANS) will be employed to investigate the flow around a motorbike subjected to crosswinds with yaw angles of 15, 30, 60 and 90 degrees. The Reynolds number was 2.2 million, based on the crosswind velocity and the height of the rider from the ground. The aerodynamic force coefficients and flow structures around the motorbike and rider will be obtained and analysed. It is expected that by increasing yaw angles will result in stronger vortex shedding around the windshield and helmet.

2 Wind Noise Caused by The A-pillar and The Side Mirror of a Generic Vehicle Model

Noise generation is now a significant issue for driving comfort. With rapid technology development in the engine performance and quiet tyre design, aerodynamically generated noise has emitted the same if not higher than the noise emitted from the two noise sources with the increasing of the car's speed. This study intends to investigate the generation of aerodynamic noise on a generic passenger car. The model is a simple car shape with a slanted shape on the front and blunt shape on the rear. The two lateral sides having an angle of θ. Particular attention is given to the effect of varying A-pillar geometry, i.e., θ, on the flow physics that is responsible for the generation of the noise. The details information on the flow behavior are numerically obtained using URANS and will be validated with LES and experimental work. The simulation is performed using OpenFOAM CFD source code framework and the job is run with parallel processors. For acoustics analysis, Lighthill's acoustic analogy is used. The exact representation of the noise radiation is simplified by properly evaluate the validity of the Curle and Ffowc-Williams Hawkings approaches in solving the Lighthill equations. In the end of this study, a systematic design parameter guideline is provided that gives the estimation of the aerodynamically generated noise according to the A-pillar shape of the passenger car.

3 Energy Harvesting System Based on Wind Induced Vibration

A new electromagnetic/piezoelectric energy harvester for harnessing energy from flow induced vibration is to be developed. It converts flow energy into electrical energy by fluid flow and tranducer. Numerical simulations for estimation of the generated voltage of the energy harvester is to be developed and validated. A prototype of the energy harvester will be fabricated and tested. It is expected that experimental results show an output voltage of approximately 10.2 mVpp when the excitation pressure oscillates with an amplitude of 254 Pa and a frequency of about 30 Hz.

4 Leading Edge Serrations Which Reduce The Aerodynamic Noise Of A Wind Turbine

Numerical investigation into the use of leading edge (LE) serrations as a means of reducing the broadband noise generated due to the interaction between the aerofoils LE and impinging turbulence is proposed. Investigations are performed on a flat plate using Open source CFD package with LES turbulence model. The leading edge serrations are in the form of sinusoidal profiles of wavelengths, , and amplitudes, 2h. The frequency and amplitude characteristics are studied in detail in order to understand the effect of LE serrations on noise reduction characteristics and are compared with straight edge baseline flat plates. Noise reductions are expected to be insignificant at low frequencies but significant in the mid frequency range (500 Hz to8 kHz) for all the cases studied. The flat plate results are also will be compared to the noise reductions on a serrated NACA-65 aerofoil with the same serration profile. Noise reductions are expected to be significantly higher for the flat plates with a maximum noise reduction of around 9 dB compared with about 7 dB for the aerofoil. In general, it is anticipated that the sound power reduction level (PWL) is sensitive to the amplitude, 2h of the LE serrations but less sensitive to the serration wavelength, .

5 Air-core Vortex Suppression Mechanism For Liquid Draining of A Cylindricial Tank

An air core is generated during draining after rotating cylindrical tanks filled with liquid. Air cores have a complex flow structure including rotational motion and a change in the free surface shape. In addition, the generation and extinction of air cores are dependent on the initial rotating speed, the dimensions of the tank, and the liquid materials. This phenomenon is usually detected in various applications for different fields such as the flow in the tundish discharging process of the smelting process, the liquid fuel system of rockets, from the suction of pumps, and so on. In this study, the flow structures including the drain time, the change in the free surface shape, velocity field, and vorticity distributions are numerically investigated.