World Academy of Science, Engineering and Technology
International Journal of Mechanical and Materials Engineering
Vol:12, No:07, 2018

Aeroacoustics Investigations of Unsteady 3D Airfoil for Different Angle Using Computational Fluid Dynamics Software

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Abstract : Noise disturbance is one of the major factors considered in the fast development of aircraft technology. This paper reviews the flow field, which is examined on the 2D NACA0015 and 3D NACA0012 blade profile using SST k-ω turbulence model to compute the unsteady flow field. We inserted the time-dependent flow area variables in Ffowcs-Williams and Hawkings (FW-H) equations as an input and Sound Pressure Level (SPL) values will be computed for different angles of attack (AoA) from the microphone which is positioned in the computational domain to investigate effect of augmentation of unsteady 2D and 3D airfoil region noise level. The computed results will be compared with experimental data which are available in the open literature. As results; one of the calculated Cp is slightly lower than the experimental value. This difference could be due to the higher Reynolds number of the experimental data. The ANSYS Fluent software was used in this study. Fluent includes well-validated physical modeling capabilities to deliver fast, accurate results across the widest range of CFD and multiphysics applications. This paper includes a study which is on external flow over an airfoil. The case of 2D NACA0015 has approximately 7 million elements and solves compressible fluid flow with heat transfer using the SST turbulence model. The other case of 3D NACA0012 has approximately 3 million elements.

Keywords : 3D blade profile, noise disturbance, aeroacoustics, Ffowcs-Williams and Hawkings (FW-H) equations, k-ω-SST turbulence model
Conference Title : ICTETA 2018 : International Conference on Thermal Engineering Theory and Applications
Conference Location : Dublin, Ireland
Conference Dates : July 23-24, 2018