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Investigation of External Pressure Coefficients on Large Antenna Parabolic Reflector Using Computational Fluid Dynamics

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Abstract : Estimation of wind forces plays a significant role in the in the design of large antenna parabolic reflectors. Reflector surface accuracies are very sensitive to the gain of the antenna system at higher frequencies. Hence accurate estimation of wind forces becomes important, which is primary input for design and analysis of the reflector system. In the present work, numerical simulation of wind flow using Computational Fluid Dynamics (CFD) software is used to investigate the external pressure coefficients. An extensive comparative study has been made between the CFD results and the published wind tunnel data for different wind angle of attacks (α) acting over concave to convex surfaces respectively. Flow simulations using CFD are carried out to estimate the coefficients of Drag, Lift and Moment for the parabolic reflector. Coefficients of pressures (Cp) over the front and the rear face of the reflector are extracted over surface of the reflector to study the net pressure variations. These resultant pressure variations are compared with the published wind tunnel data for different angle of attacks. It was observed from the CFD simulations, both convex and concave face of reflector system experience a band of pressure variations for the positive and negative angle of attacks respectively. In the published wind tunnel data, Pressure variations over convex surfaces are assumed to be uniform and vice versa. Chordwise and spanwise pressure variations were calculated and compared with the published experimental data. In the present work, it was observed that the maximum pressure coefficients for α ranging from +30° to -90° and α=+90° was lower. For α ranging from +45° to +75°, maximum pressure coefficients were higher as compared to wind tunnel data. This variation is due to non-uniform pressure distribution observed over front and back faces of reflector. Variations in Cd, Cl and Cm over α=+90° to α=-90° was in close resemblance with the experimental data.

Keywords : angle of attack, drag coefficient, lift coefficient, pressure coefficient
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