A two-dimensional computational study had been performed regarding aerodynamic forces and pressures affecting a cambered inverted airfoil, CLARK-Y smoothed with ground effects by solving the Reynolds-averaged Navier-Stokes equations, using the commercial software COMSOL Multiphysics 5.0 solver. Turbulence effects are modeled using the Menter shear-stress transport (SST) two-equation model. The negative lift (down-force), drag forces and pressures surface were predicted through the simulation of wings over inverted wings in different parameters namely; varying incidences i.e. angles of attack of the airfoils, varying the ride hide from the ground covering various force regions, two-dimensional cross-section of the inverted front wings to be fixed on nose of a race car- and varying speeds of initial airflow (Reynolds number). The results show that the down-force increases as the angle of attack increases; however, if an inverted wing is fixed on a car at high angles of attack the wing starts to stall which is not a desired condition that affects the vehicle stability and performance. As the ride height was reduced, the down-force was increased; at clearances between the suction surface and the ground of less than 0.2 of the chord length c, the down-force is significantly
higher. Very close to the ground, at a ride height of less than 0.1c, down-force decreases as the wing stalls. Also, down-force increases as the free-stream velocity (Reynolds number) increases. The pressures for lower and upper surface of the wing increased with increasing both of angle of attack and ride height, but remains relatively ineffective with varying the speeds.

References


Index Terms

Computer Science  Applied Mathematics

Keywords