The Influence of Slipstreaming on the Aerodynamic Performance of Passenger Cars

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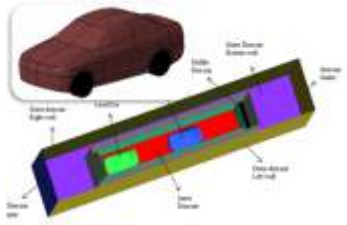
Abstract:

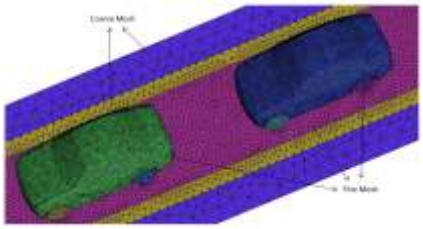
In motor-sports, drivers use different strategies to drive cars ahead of other competitors. Slip streaming is a frequent habit on racing tracks where the cars are far closer to each other than on public roads. Many racing drivers practicing Slipstream and overtaking maneuvers to win races. Slipstreaming is a technique where two vehicles move in an aligned pattern in a close group, reducing overall effect of drag for leading and trailing vehicles. This helps in reducing the fuel consumption, improve down force and cornering abilities. Many race drivers during racing maintain a constant gap behind the leading car to exploit the benefit of slipstream. In this project, a detailed study on slipstreaming effects between two passenger cars in convoying driving conditions was carried out for varying gap between them.

Initially, literature survey was carried-out on the effect of slip-stream on the aerodynamic performance of automobile. Geometric model of two passenger cars in cascaded driving conditions with a gap between them was generated using CATIA V5 R19 software tool. Computational grid was generated using ANSYS ICEM CFD tool. Steady state external aerodynamics CFD simulation was carried out on a single car, and lift and drag forces were evaluated using ANSYS FLUENT software tool. Parametric CFD simulations were carried out by varying the gap (0.5, 1.0 and 1.5 the length of car) between leading car and trailing car in a cascaded driving conditions. The same parametric study was carried out for different velocities.

From CFD simulations, the aerodynamic performance of leading trailing cars were studied and compared. The wake region behind leading and trailing cars was compared for different gaps. It is found that the lift and drag forces were considerably reduced for both leading and trailing cars compared to single car. From the parametric studies, it is found that the gap 1.0 the length of car was found to be most productive for both leading and trailing cars with reduced drag and lift forces.

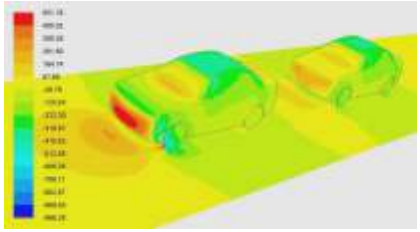


Geometric model of cars in slipstream with boundary conditions

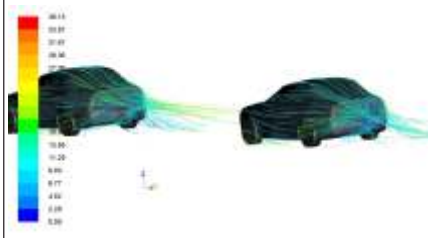


Multi-block grid computational domain

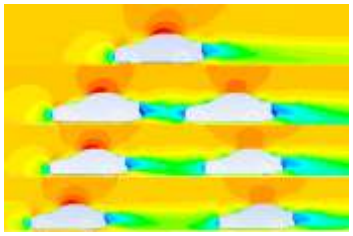
Pathlines coloured by velocity magnitude shown in the wake region for a single car



Pressure distribution across leading and trailing cars



Pathlines coloured by velocity magnitude showing the wake regions of leading and trailing cars



Velocity distribution showing the length of wake regions for varying gap between leading and trailing cars