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Modelling, Simulation, and Experimental Validation of the Influence of Golf-Ball-Inspired Dimpled Design in Drag Reduction and Improved Fuel Efficiency of Super-Mileage Vehicle

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Abstract : Due to the dwindling supply of fuel reserves, engineers and designers now focus on fuel efficient designs for the solution of any problem; the transportation industry is not new to this kind of approach. Though the aerodynamic benefits of the dimples on a Golf-ball are known, it has never been scientifically tested on how such a design philosophy can improve the fuel efficiency of a real-life vehicle by imparting better aerodynamic performance. The main purpose of the paper is to establish the aerodynamic benefits of the Golf-ball-Inspired Dimpled Design in improving the fuel efficiency of a Super-mileage vehicle, constructed by Team Go Viridis for 'Shell Eco Marathon Asia 2015', and to predict the extent to which the results can be held valid for a road car. The body design was modeled in Autodesk Inventor and the Computational Fluid Dynamics (CFD) simulations were carried out using Ansys Fluent software. The aerodynamic parameters of designs (with and without the Golf-ball-Inspired Dimples) have been studied and the results are experimentally validated against those obtained from wind tunnel tests carried out on a 1:10 scaled-down 3D printed model. Test drives of the Super-mileage vehicle were carried out, under various conditions, to compare the variation in fuel efficiency with and without the Golf-ball-Inspired design. Primary investigations reveal an aerodynamic advantage of 25% for the vehicle with the Golf Ball Inspired Dimpled Design as opposed to the normal design. Initial tests conducted by 'Mythbusters' on Discovery Network using a modified road car has shown positive results which has motivated us to conduct such a research work using a custom-built experimental Super-Mileage vehicle. The content of the paper becomes relevant to the present Automotive and Energy industry where improving the fuel efficiency is of the top most priority.

Keywords : aerodynamics, CFD, fuel efficiency, golf ball
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