PARAMETRIC SHARP EDGE MORPHING FOR AERODYNAMIC SHAPE OPTIMIZATION

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ABSTRACT – The upward spiral of fuel prices has led to an increased demand for more fuel efficient vehicles. Vehicle fuel economy at highway speeds is significantly influenced by the aerodynamic drag of the vehicle. Overall body shape requirements/constraints needed to create an aerodynamically efficient vehicle are well known. The real challenge to the aerodynamicist is to incorporate these aerodynamic queues into a shape that is also aesthetically pleasing and acceptable to the design studio.

Vehicle styling that incorporates highly curved rearward facing surfaces can be particularly problematic in developing an aerodynamically efficient vehicle. Attached flow accelerating around rearward facing surfaces creates areas of relatively low pressure. These low pressure areas, in turn, lead to significant increases in overall vehicle drag. These low pressure areas can be reduced or eliminated by forcing earlier separation through curvature changes to the underlying surface. These surface changes, however, are typically not acceptable from a styling perspective. Earlier flow separation can also be initiated by adding sharp edges or strakes to the original curved surface. This approach can at times be more acceptable to styling.

Defining the optimum profile, location, size, and orientation for these sharp edges is extremely challenging experimentally from both a cost and timing perspective. An analytically based approach combining feature (sharp edge) creation, morphing technologies and computational fluid dynamic simulation is a viable alternative.

In this paper, we show how sharp edge features can be introduced and how their shapes and sizes can be parametrically controlled to find the optimum shapes using ANSA morphing capabilities. The paper also describes a process where the template of parameterization for shape optimization can be applied repetitively to different vehicles. The template containing the morphing boxes, optimization task, and related scripts is created in the base ANSA model and the whole setup is carried to different vehicles.