Budapest University of Technology and Economics

MSc Thesis

Final Project /BMEGEATMWD2/

Aerodynamic Force Modification via Base Roughness

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A Thesis submitted in partial fulfilment of
the requirements for the award of
the degree of Master of Science

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Academic year of submission:	2013 / 2014 Autumn

I, the undersigned, hereby declare that the Thesis submitted for assessment and defence, exclusively contains the results of my own work assisted by my supervisor during the Erasmus Scholarship at Cranfield University and BUTE. Further to it, it is also stated that all other results taken from the technical literature or other sources are clearly identified and referred to according to copyright (footnotes/references are chapter and verse, and placed appropriately).
I accept that the scientific results presented in my Thesis can be utilised by the Department of the supervisor for further research or teaching purposes.

Budapest, 12th of Dec, 2013

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Abstract

This thesis report focuses on a numerical simulation done on a simplified quarter scale car model called Windsor body. Thesis report has been written during the Erasmus Scholarship Program at Cranfield University in the academic year 2012/2013. The study is based on an experimental investigation of drag reduction with passive flow control by Rob Littlewood. Measurement consist a baseline configuration and additional roughness element test cases. The results showed drag and lift reduction via the roughness. This has been numerically investigated by former Cranfield University students and my task was to further improve the model. Drag reduction is the main interest of the automotive flow and this roughness study approach present promising results.

The report includes two study investigating the drag mechanism. The Roughness Study is a project on investigating the FLUENT solver roughness options capabilities. The k-ε Realizable and k-ω SST turbulence models have been tested with the result that the k-ε is not suitable for such an investigation, while the k- ω SST performs reasonably well. The other study is based on the different vertically mounted roughness element cases flow analysis. The conclusion of the investigation is that the numerical simulation with the applied assumptions and conditions is able to estimate the drag mechanism and reproduce a realistic wake structure behind the body but only with the k-ω SST turbulence model .

Keywords

Windsor, drag, roughness, wake

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Daniel Bence Ivady

Table of Contents

List of Figures

List of Tables

List of Symbols

Abbreviations

CFD	Computational Fluid Dynamics
RANS	Reynolds Averaged Navier Stokes
URANS	Unsteady Reynolds Averaged Navier Stokes
LES	Large Eddy Simulation
3D	3 Dimension
CAD	Computer Aided Design
PIV	Particle Image Velocimetry
LDA	Laser Doppler Anemometry
TKE	Turbulent Kinetic Energy

Notations

C0	Configuration 0 - Baseline Geometry
C1	Configuration 1 - 3 full added slat Geometry
C2	Configuration 2 - 3 short added slat Geometry
C3	Configuration 3 - 5 full added slat Geometry
C4	Configuration 4 - 5 short added slat Geometry
ROOF	Refers to roof surface in the Roughness Study Case
BACK	Refers to back and roof surface in the Roughness Study Case
R H	Refers to type of Surface Roughness Study Cases
SST	Refers to k-ω Shear Stress Transport Model
KEPS	Refers to k-ϵ Realizable Model