GRADUATE THESIS

THE IMPACT OF ACTIVE AERODYNAMICS
ON MOTORCYCLES USING
COMPUTATIONAL FLUID DYNAMICS

AUTHOR: VENKATA ADITYA, SRIPATHI
CO-AUTHOR: SHAMKUMAR J. MAHURKAR
COMMITTEE MEMBERS: DR. CRAIG T. EVERS,
DR. KULDEEP AGARWAL & DR. WINSTON SEALY
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INTRODUCTION

• Aerodynamics play a significant role in Automobiles.
• The same principle applies to motorcycles as well.
• The result is better fairings and body structures.
• The current generation of motorcycles are more efficient due to better aerodynamics.

MOTO GP:
• In MotoGP, the engineering teams have found new methods to improve performance.
• The latest one is to include winglets on the fairing.
• Advantages of this are better traction and cornering improvement.
BASIC CONCEPT:

- Aerofoils produce force on one side due to difference in pressures between both sides.
- In aerospace applications, the force generated is called lift.
- The inverse of lift, called “downforce” is significant to automobiles as it helps in cornering and movement.

CURRENT RESEARCH:

- Two significant researches were performed on the use of winglets on motorcycles.
- One of them deals with usage of anhedral wings for cornering improvement.
- The other deals with utilization of flat plates to assist in braking.
THEESIS CONCEPT

PROJECT CONCEPT:

- The project concept utilizes aerofoils with end plates as winglets on the fairing.
- These winglets are adjustable and hence produce the effect of active aerodynamics.
- The key is to maximize downforce under acceleration and speed conditions.
- The adjustment of aerofoil attack angle helps in producing drag force to assist in braking.
- The usage of the NACA 6412-IL aerofoil for designing the proposed winglet structures.
THESIS RESEARCH ASPECTS

The research aspects are:

- Analyzing the impact of the use of a NACA 6412-IL aerofoil winglets on the motorcycle through the observation of produced downforce and dragforce.

- Computer Simulation of motorcycle CAD model for enhanced downforce under acceleration and steady speeds ($\alpha = 0^\circ, 10^\circ$).

- Computer Simulation of motorcycle CAD model for enhanced drag force to assist in motorcycle braking activity ($\alpha = 90^\circ$).

- Validate the computer simulation results through Wind Tunnel Testing. ($C_L$ and $C_D$ values of Stock vs. Concept Motorcycle Design.)
IDEAL OUTCOMES

The aim of this project is to help the real-world motorcyclists. Accidents take lives. Crash statistics show that motorcycle accidents cause serious fatalities and life threatening injuries. Thus, the benefits of this concept would be as follows:

• Reduced front wheel lift during hard acceleration

• Improved straight line motorcycle traction.

• Improved straight line braking performance and reduced braking distance.

• Promoting safe braking under intense conditions.

• Reduced brake wear.

• The chance of a serious crash is reduced by a significant margin.
MEDIA

STAGES OF ACTIVE AERODYNAMICS IN COMPUTER AIDED DESIGN

No Aerofoil                                             Aerofoil at 0 Degrees                              Aerofoil at 10 Degrees                                Aerofoil at 90 Degrees

SCREENSHOTS OF COMPUTATIONAL FLUID DYNAMICS SIMULATIONS

PHOTOS OF 3D PRINTED AND PAINTED MODELS

MINNESOTA STATE UNIVERSITY MANKATO
REFERENCES


