

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

Big ideas. Real-world thinking.

CONTENTS

- INTRODUCTION
- BASIC CONCEPT & CURRENT RESEARCH
- THESIS CONCEPT
- THESIS RESEARCH ASPECTS
- IDEAL OUTCOMES
- MEDIA
- REFERENCES

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.



THE EVOLUTION OF MOTORCYCLE AERODYNAMICS

MOTOGP:

- 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. →→→

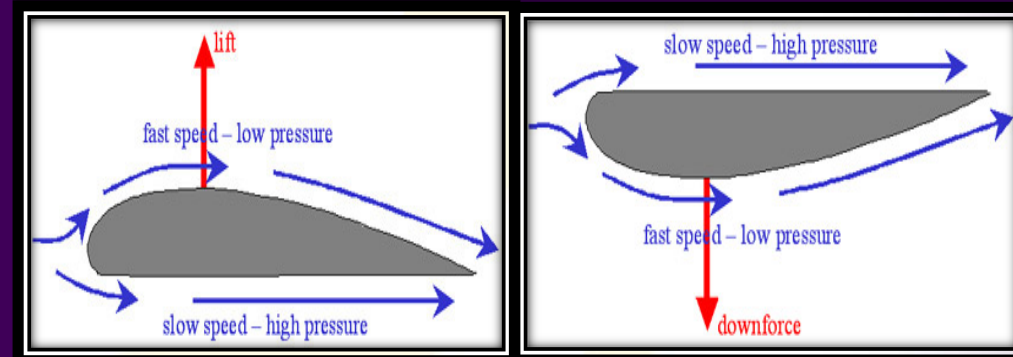
CONCEPT OF AERODYNAMIC WINGLETS IN MOTOGP



BASIC CONCEPT & CURRENT RESEARCH

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.

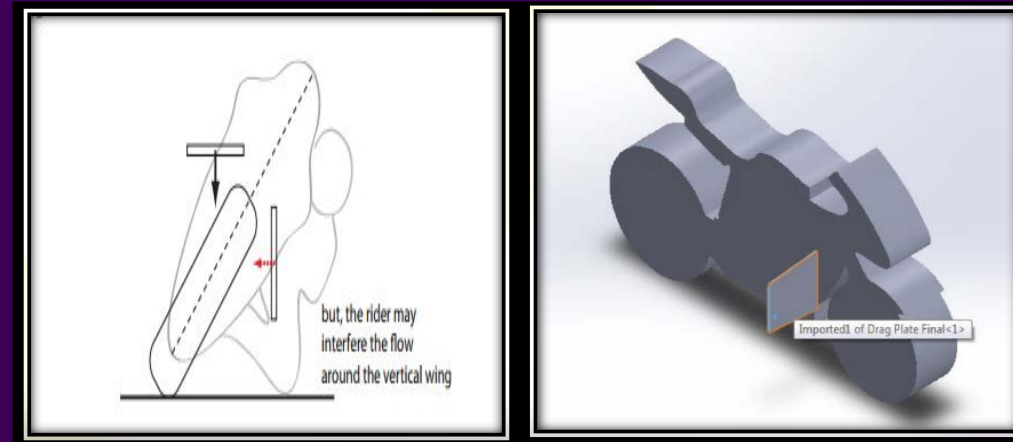


BASIC CONCEPT OF AERODYNAMICS

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. ➡➡➡

ILLUSTRATIONS OF CURRENT RESEARCH WORK



THESIS 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.

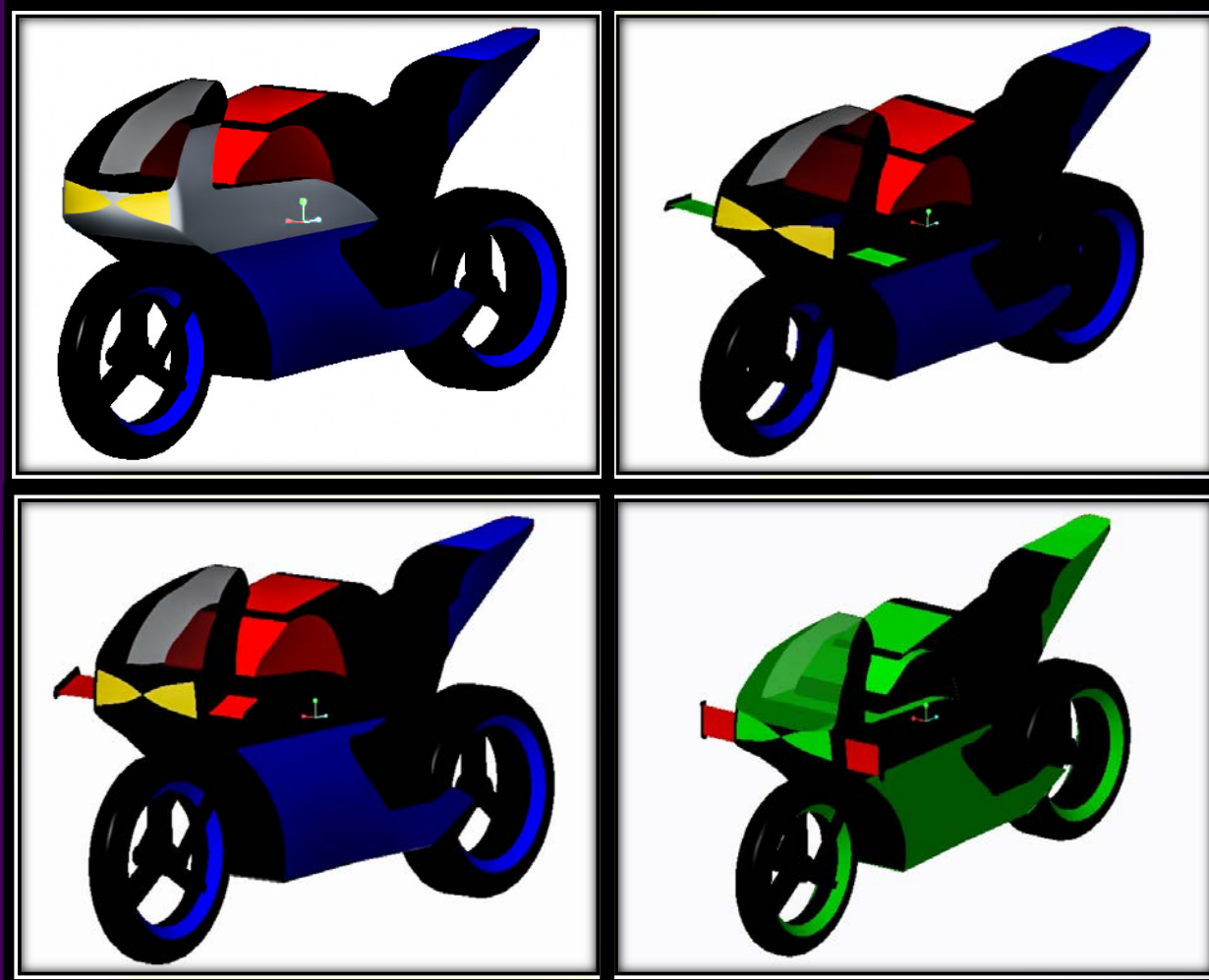


ILLUSTRATION OF THE PROJECT PROTOTYPE DESIGN
FOR THE FOUR ACTIVE AERODYNAMICS STAGES

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.)

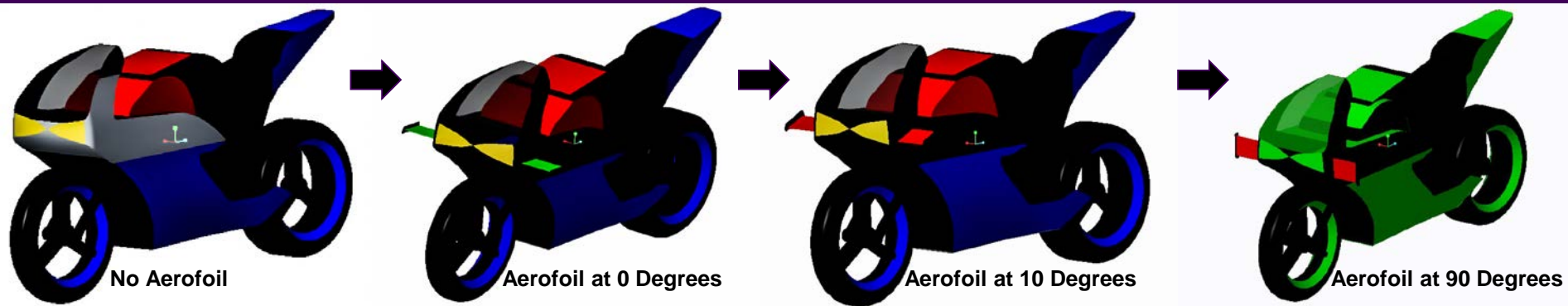
IDEAL OUTCOMES

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:

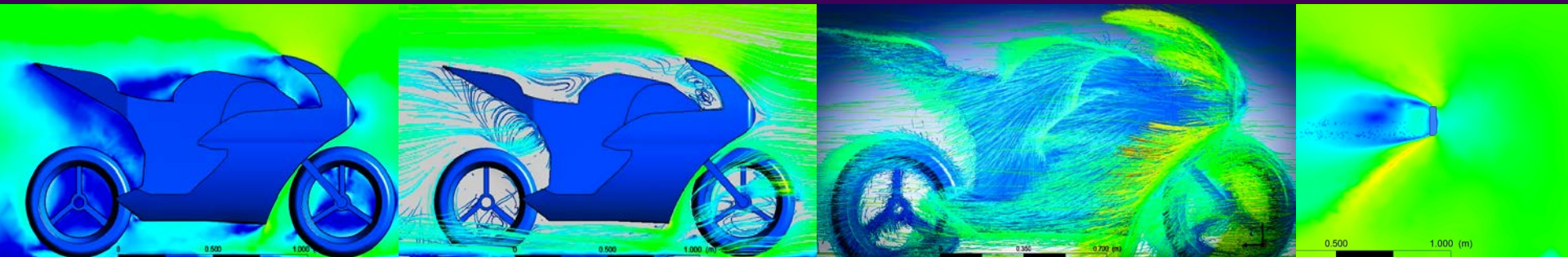
- **Reduced front wheel lift during hard acceleration**
- **Improved straight line motorcycle traction.**
- **Improved straight line braking performance and reduced braking distance.**
- **Promoting safe braking under intense conditions.**
- **Reduced brake wear.**
- **The chance of a serious crash is reduced by a significant margin.**

MEDIA

STAGES OF ACTIVE AERODYNAMICS IN COMPUTER AIDED DESIGN



SCREENSHOTS OF COMPUTATIONAL FLUID DYNAMICS SIMULATIONS



PHOTOS OF 3D PRINTED AND PAINTED MODELS



REFERENCES

1. Motorcycle Cornering Improvement: An Aerodynamical Approach based on Flow Interference – Vojtech Sedlak – KTH 2012.
2. Aerodynamic Braking for High-Speed Motorcycles - Goudar N. and Lalwani B. – SAE 2014-01-2488.
3. Validation of Equations for Motorcycle and Rider Lean on a Curve – Neal Carter, Nathan A. Rose, and David Pentecost – SAE 2015-01-1422.
4. Computational Evaluation of Aerodynamic Forces on a Racing Motorcycle during High Speed Cornering – Tom Van Dijck – SAE 2015-01-0097.
5. Class Lecture Notes – AET 364 – Chassis Design and Performance Testing – Dr. Craig T. Evers.
6. Airfoil Tools NACA 6412 – IL specifications and characteristics. <http://airfoiltools.com/airfoil/details?airfoil=naca6412-il>