DESIGNING AN AERODYNAMICS PACKAGE FOR THE FSAE CAR

INTRODUCTION

Aerodynamics Package

Advantages : Downforce increases cornering speed

Faster Lap Times, more points

Disadvantages : Drag decreases linear acceleration

Package increases weight and Centre of Gravity (COG)

Knowledge Gap : Never designed for RMIT's car

Objective : Design an aerodynamics package that can keep RMIT competitive by increasing points.

ANALYTICAL APPROACH

Target Downforce : 170 N at 40 km/hr

Points : Gain 38 points

Cornering Situation : Exiting out of corner, Braking into corner, Mid Corner

Decision Matrix : Focus resources on front and rear wing

Centre of Pressure (COP) : Net moment created by all aerodynamic forces (Figure 1)

10 % forward bias of COG to reduce understeer

Front Wing downforce : 90 N at 40 km/hr

Rear Wing downforce : 78 N at 40 km/hr

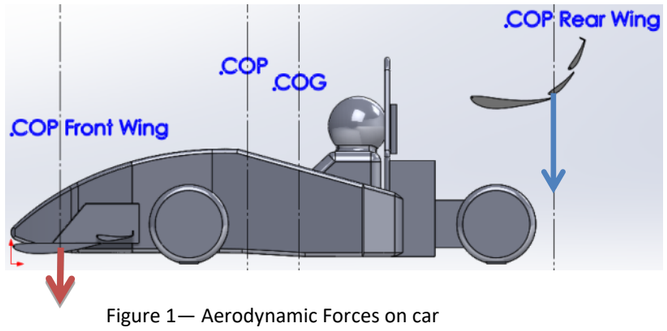

Figure 1— Aerodynamic Forces on car

SIMULATIONS

EVALUATING WING—ISOLATION

2D Design of Experiments (DOE)

Run Time : 1 min

Purpose : Capture general trends

Force Prediction : Over estimate

3D Validation

Run Time : 1 hour

Purpose : Validate 2D DOE

Force Prediction : Accurate

EVALUATING WING—ON R16

Evaluation Aerodynamic Package

Aerodynamic Model— Figure 4

Exiting out of corner :

Car Model : 0^{o} pitch, 0^{o} yaw, 0^{o} roll

Downforce : 180 N at 40km/hr

COP : 11% forward bias of COG

Braking into corner :

Car Model : 1.5^{o} pitch forward, 0^{o} yaw, 0^{o} roll

Downforce : 198 N at 40km/hr

COP : 5% forward bias of COG

Mid Corner :

Car Model : Rotating Domain (Figure 5,6)

0^{o} pitch, 10^{o} yaw, 1.5^{o} roll

Downforce : 130 N at 40km/hr

COP : 11% forward bias of COG

CONCLUSION

Downforce : 10 % more than required

COP : Kept forward of COG

Points : Able to capture 38 points

RECOMMENDATION

Future : Wind Tunnel Validation

Track Testing

Increase ground clearance on Front wing

Triple Element Front Wing

Diffuser

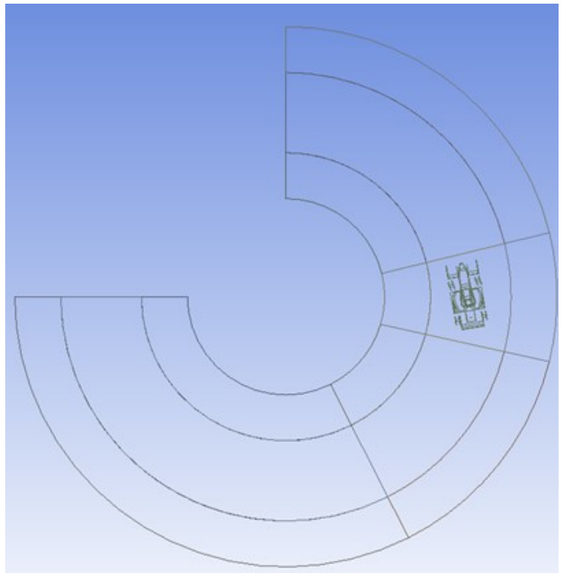

Figure 5—Rotating Domain

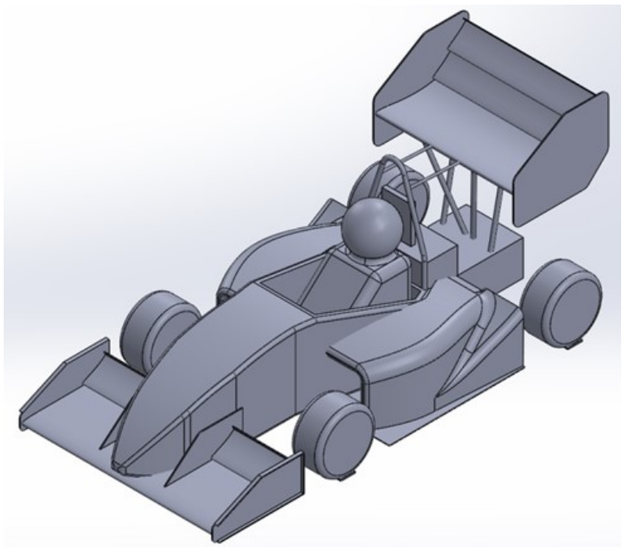

Figure 4—Simulation 3D model with Aerodynamic Package

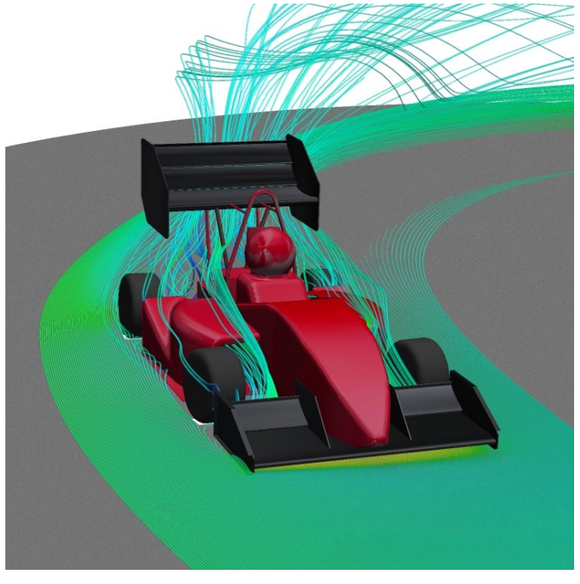

Figure 6—Mid Corner flow structure

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