



Aerodynamic Concept Testing Of a Sports 2000 MCR Using Driver In The Loop Simulation

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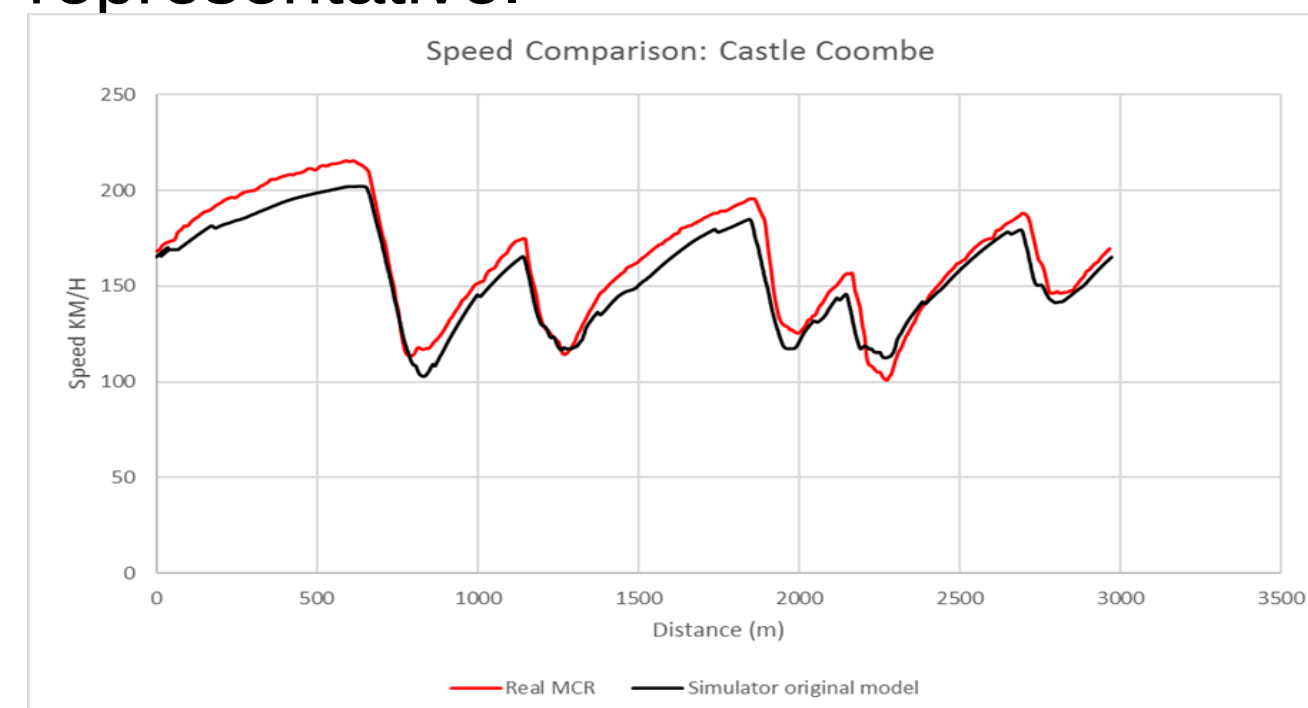
BEng (Hons) Motorsport Engineering

Introduction

The aim of this report is to investigate the dynamic characteristics of different aerodynamic concepts of a Sports 2000 MCR, which is owned by the university. The university's Base Performance simulator 4.8 was utilized to simulate the new concept designs previously produced in other projects within the university.

Baseline model

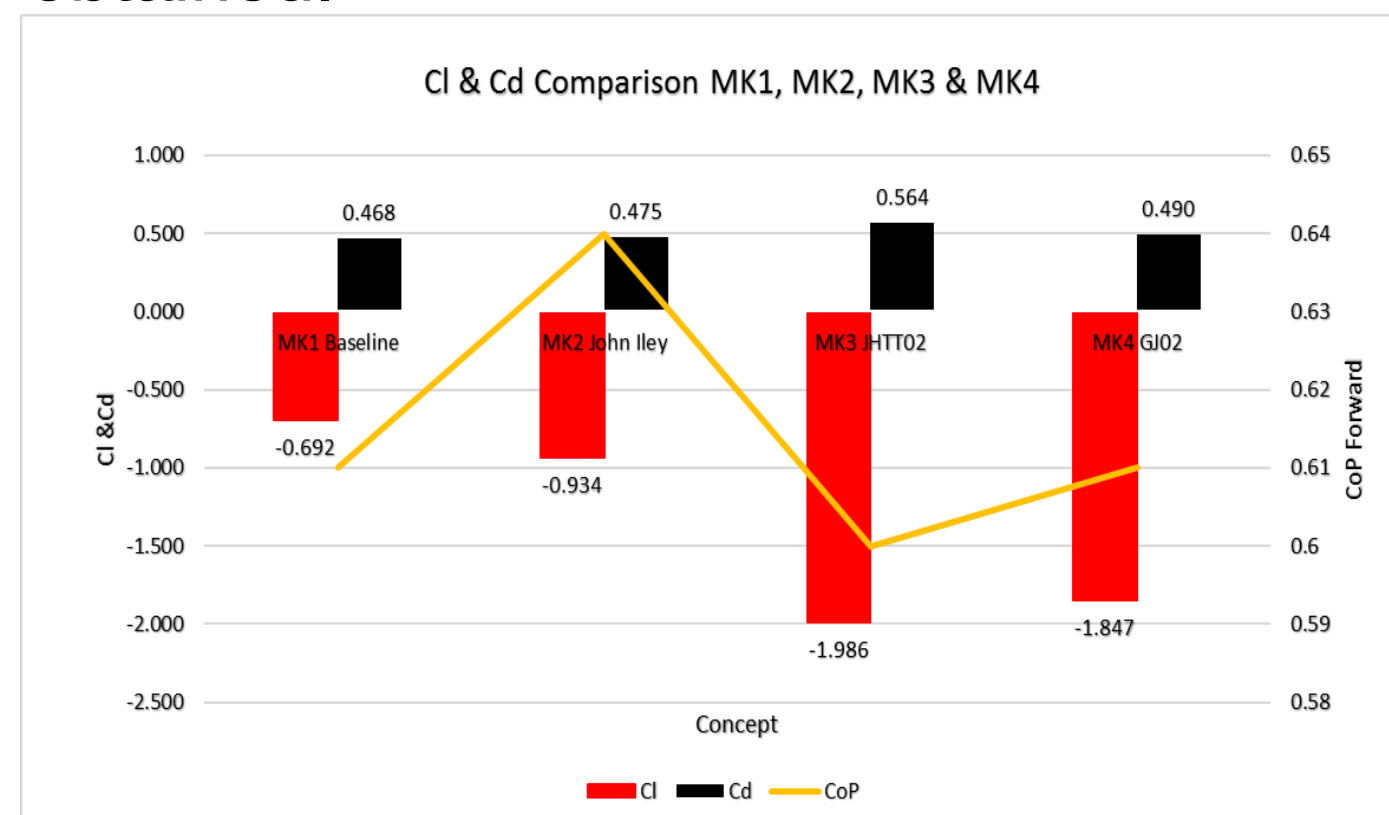
A pre-existing simulation model exists of the MCR which was compared to the real MCR 2018 race data and was proven to not be representative.



Graph 1 – Speed Comparison of Standard and Real Vehicle Data

Computational Fluid Dynamics (CFD)

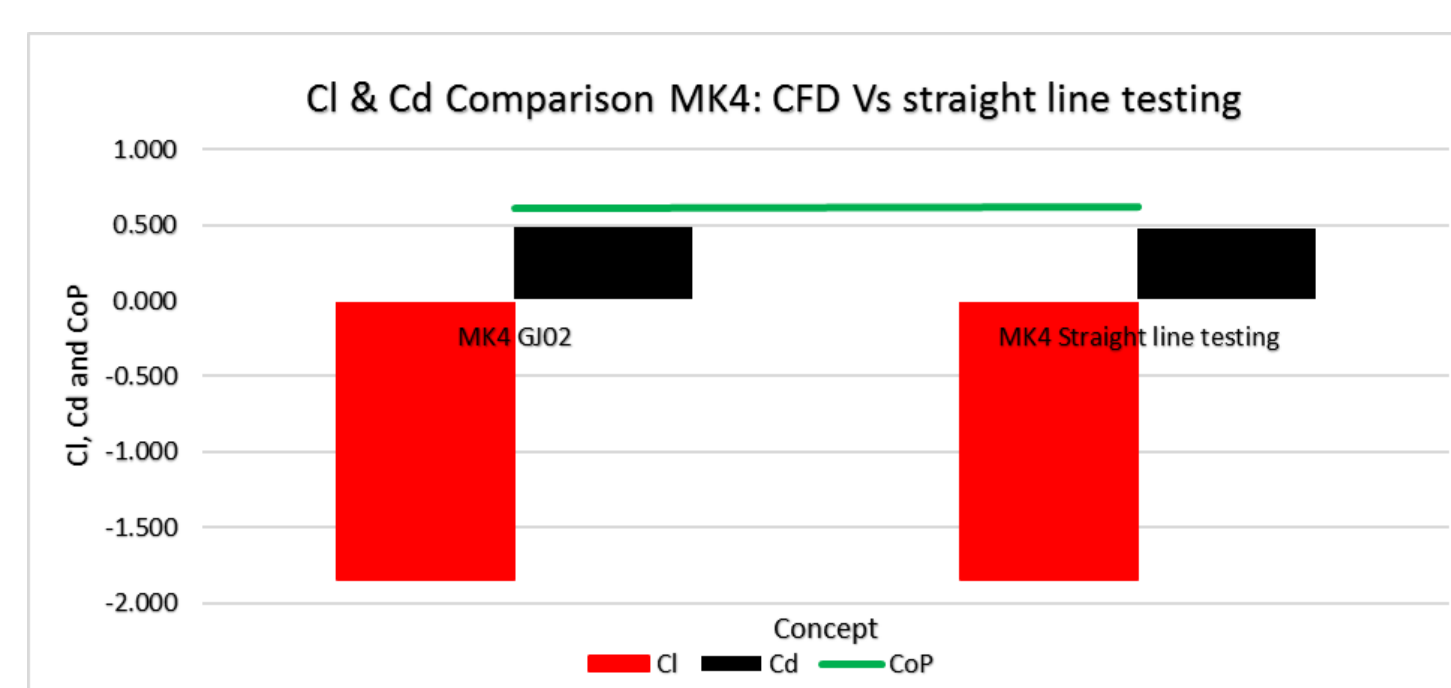
CFD was used to predict the aerodynamic characteristics of each of the concepts (Lanfrit, 2005). The three things that are important to making an accurate simulation model is the C_L , C_d and C_oP . Each model was tested and the results below were obtained.



Graph 2 – Concept aerodynamic value comparison

Simulation Validation

The simulator models needed to be validated to confirm that the physics engine was predicting the aerodynamic values accurately. An investigation was undertaken to validate the C_L , C_d and C_oP of each simulation concept using industry relevant tests which are the constant speed test and a coast down test.



Graph 3 – Simulation Validation Test Results

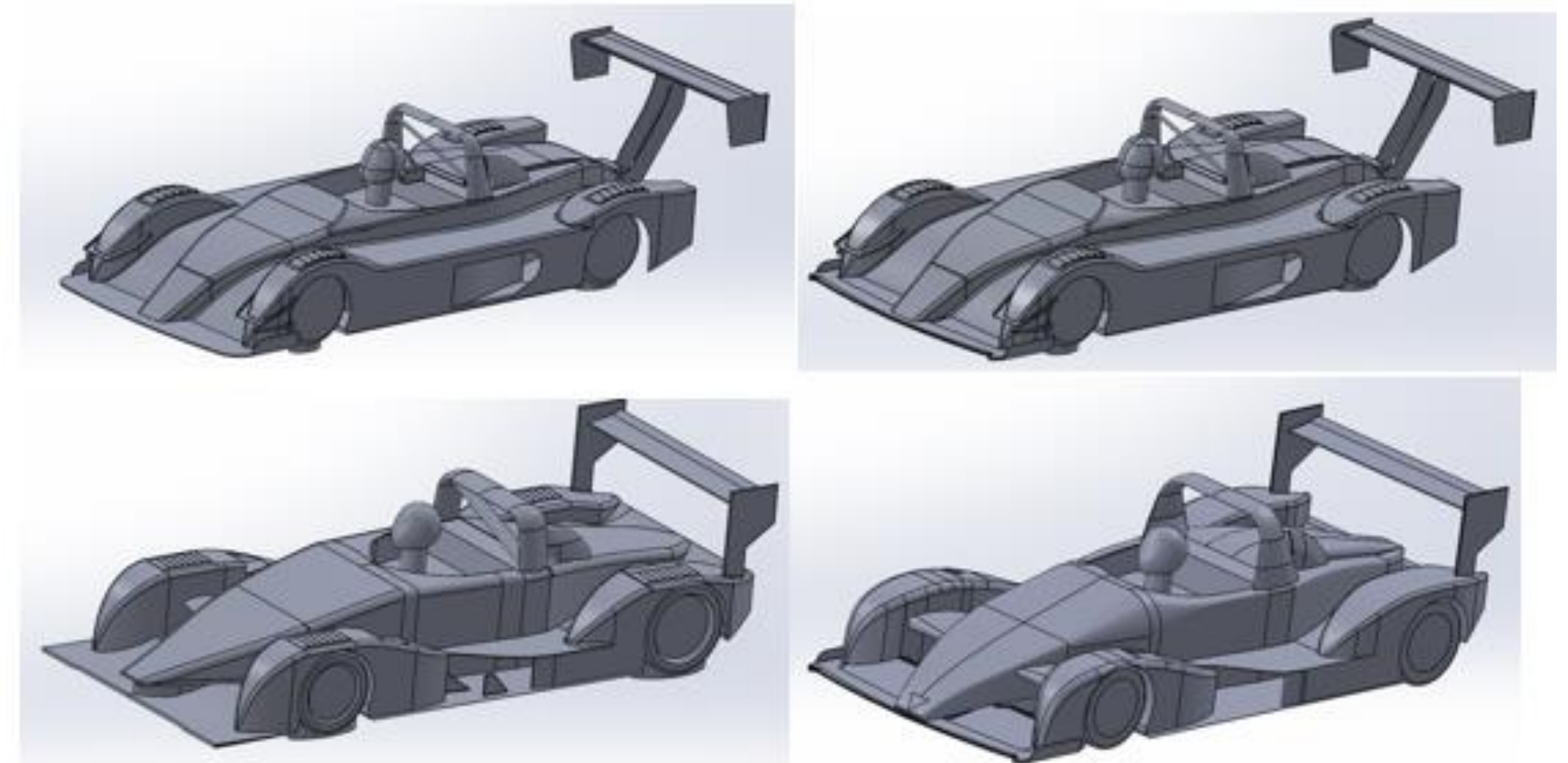


Figure 3 – The Four Concepts Being Investigated

Practical Testing

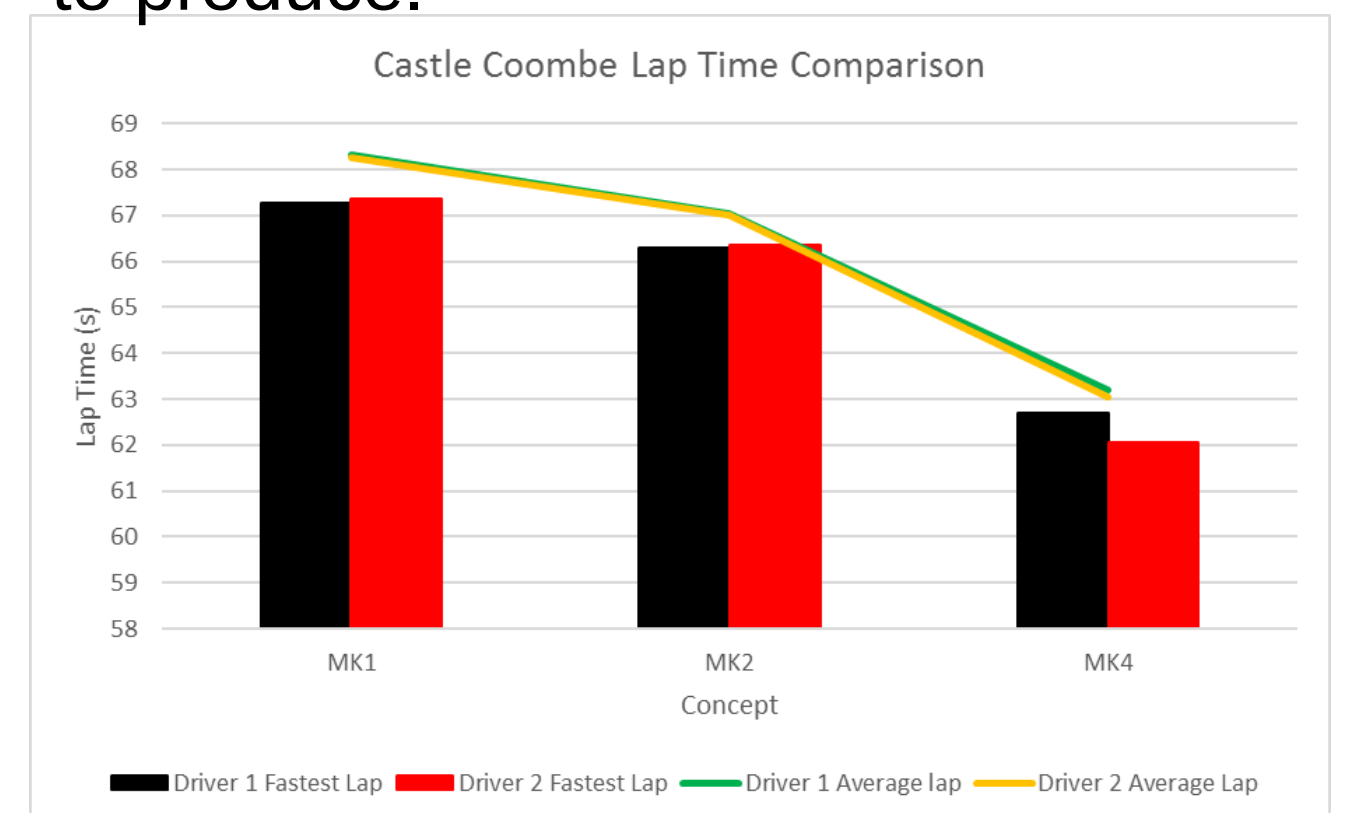
Practical testing was performed to program the physical figures of the vehicle, these are outlined below:

- Mass Distribution – using Intercomp corner weight scales.
- Engine power – using the Maha Dynamometer.
- Spring rates – using a spring rate compressor.

These were programmed to compare the original simulation model to the real vehicle race data which made the model correlate with greater accuracy.

Final Concept Lap Testing

Each concept was tested by utilising two different tracks with two different drivers. The results are shown below (Graph 4). The Mk2 displays a small improvement and the MK4 shows the best outcomes, resulting in a faster lap time compared to the MK1 baseline model. Consequently, the MK4 being the most effective concept to produce.



Graph 4 – Concept Lap Testing Results

Acknowledgements

I would also like to thank fellow students Andrew Noble, John Hughes and George Jones.

References

- Morse, P., 2016. Race car tuning with driver in the loop simulators.
- Lanfrit, M., 2005. Best practice guidelines for handling Automotive External Aerodynamics with FLUENT.
- Bridgeland, J. B. & Noble, A., 2018. Group Project Report - Simulation

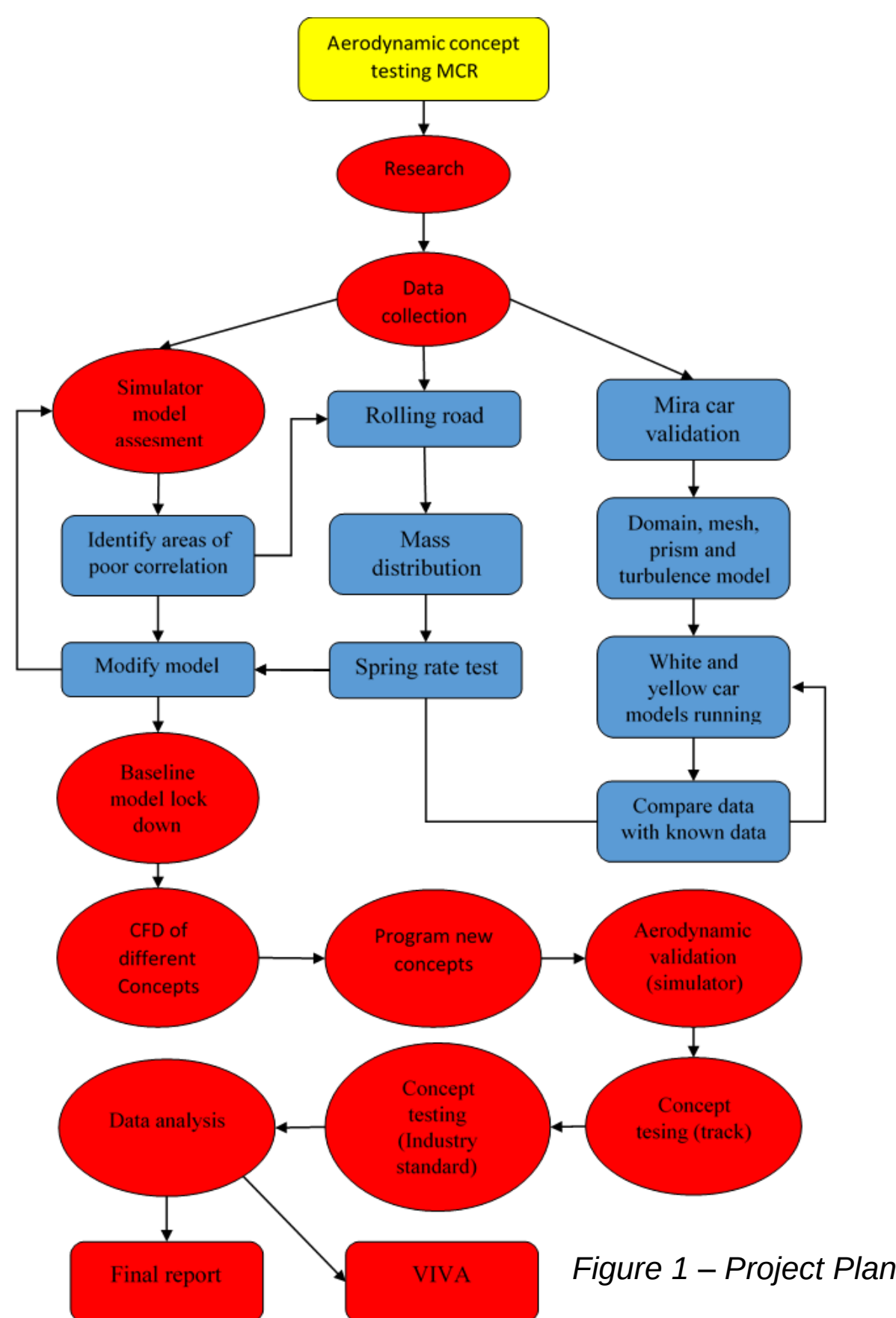


Figure 1 – Project Plan

Simulation

The simulator runs from software based on the ISI motor which was produced for use in motorsport and especially Formula One to optimize and test changes without having the extra cost of track time (Morse, 2016).

The coding of the simulator has a main folder called the HDV file which is where the base of the physics is programmed.

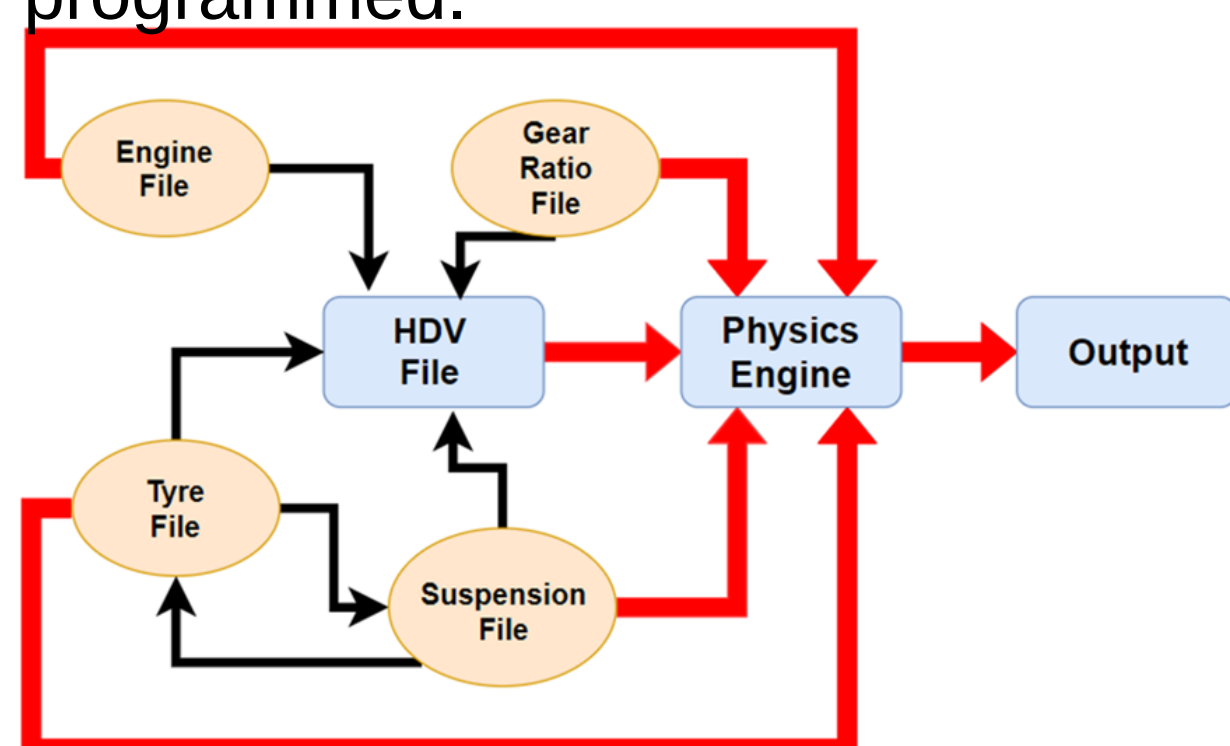


Figure 2 – Simulator File Structure(Bridgeland & Noble, 2018)