



Optimisation of radio-controlled car rear wings for aerodynamic efficiency

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Introduction

Within the GT12 class of Radio-controlled car racing, there is scope for small changes to the configuration of the car to drastically affect lap times. To this end, One thing that is strictly controlled within the British Radio Car Association regulations [1] is the bodyshell, which is a component that is homologated, but the rear wing attached to it is an open component, provided it fits within the maximum width of 165mm and has a chord length no more than 50mm.

Project Aims

The first aim of the project was to gather an idea of the performance of the baseline rear wing included with the MLGT3 bodyshell using ANSYS FLUENT to acquire the lift and drag coefficients of the baseline wing at two different levels of trim.

The second aim is to redesign the rear wing and analyse the performance of several redesigned wing schemes to gather the aerodynamic efficiency of each wing schemes based on the lift to drag ratio.

Methodology

Initially, a calculation was made to work out the potential maximum windspeed for the study using equation 1. To validate this, several runs were made with two different gear ratios on a GT12 car with four bodyshell packages to ensure that the theoretical maximum speed is consistent over the five-metre test course. Timing would be carried out using a camera mounted to get a shot of the whole course which would then have the footage reviewed to gather the actual time for each run.

$$V_{max} = \frac{\frac{T_{pin} * D_{tyre} * \pi}{T_{spur}} * \frac{KV_{motor} * V_{batt}}{60}}{1000}$$

Equation 1 – The equation used to calculate the maximum theoretical windspeed for the wind tunnel and CFD studies. [2]

Once the straight-line test had been carried out, the highest speed gathered from this would be fed into ANSYS fluent and used as the windspeed as the lower speed in a Computational Fluid Dynamics (CFD) study for each test scheme shown in figure 1. The data for this study would then be validated using these test schemes in a wind tunnel test at the same speeds as the CFD study.



Figure 1 – Physical models of the test schemes used in the CFD study.

Results

Figure 2 shows the results from the straight-line test that was carried out to validate the top speed calculations. The top speed for each bodyshell increased in line with the increased pinion size on the top line of the X axis.

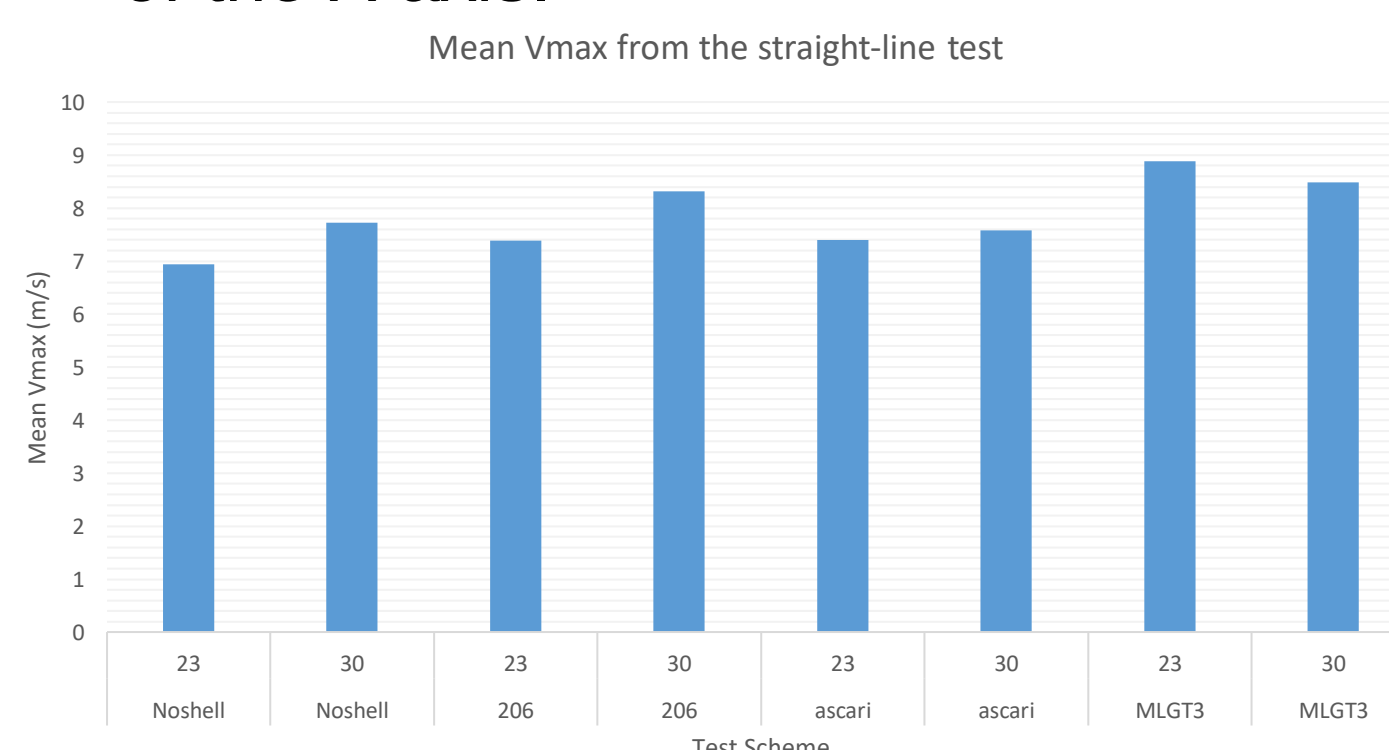


Figure 2 – The maximum measured Vmax of each of the schemes in the straight-line study

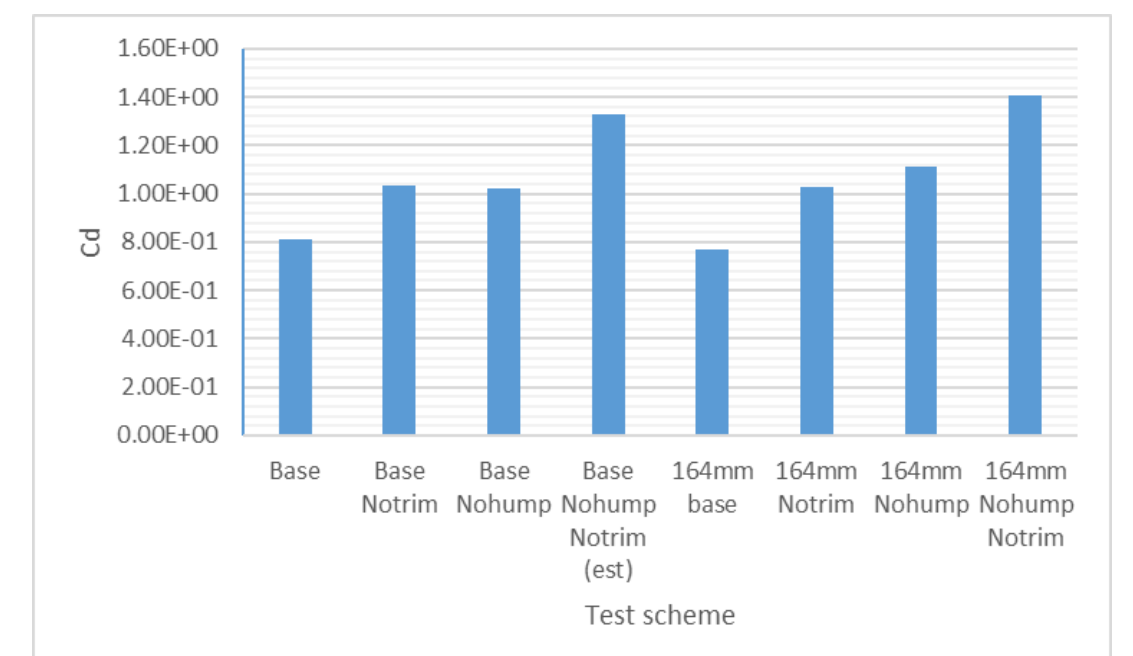


Figure 3 – The results for the Cd of each wing in the CFD study

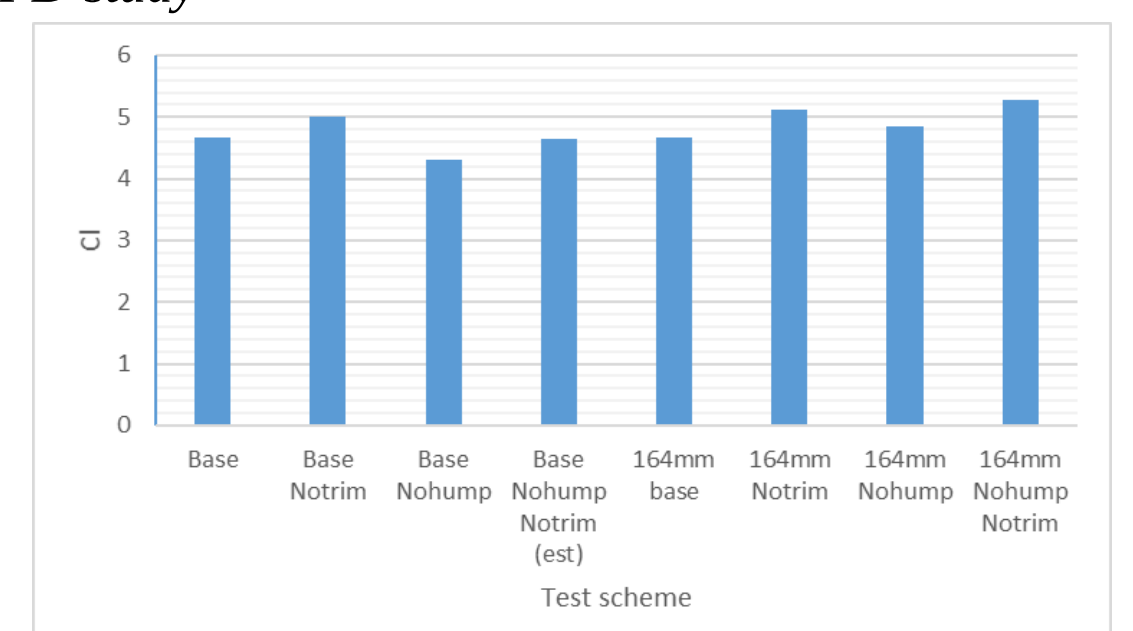


Figure 3 – The results for the Cl of each wing in the CFD study – note that the absolute values were taken so these values are negative.

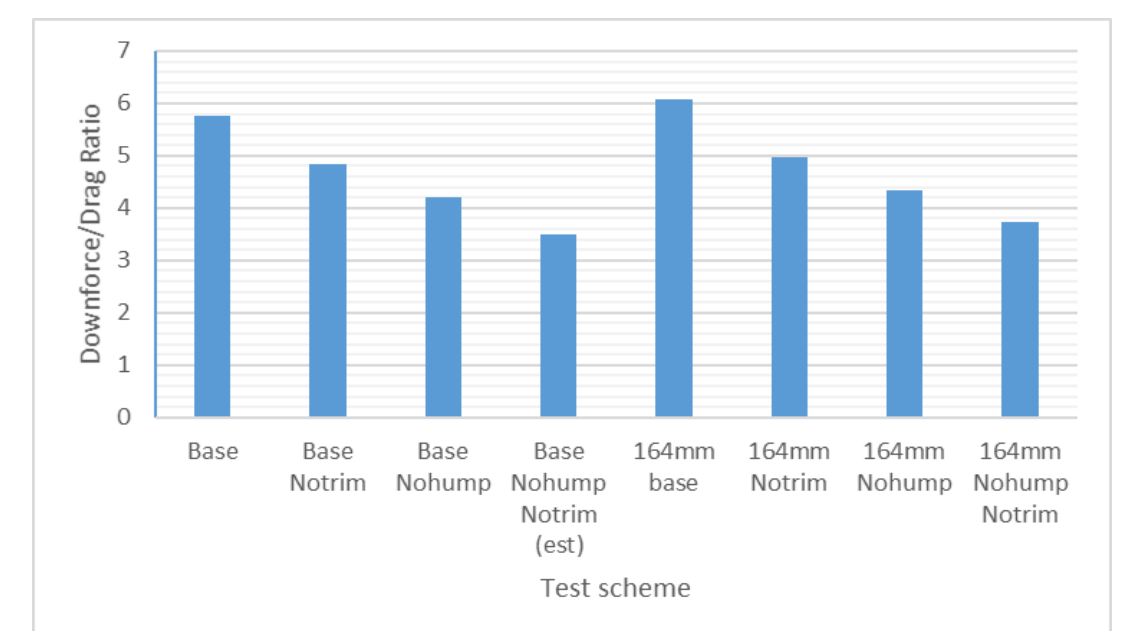


Figure 4 – The downforce to drag ratio of each wing tested

Conclusions

From the results for the downforce-to-drag ratio, the 164mm version of the base scheme was the most efficient of those tested, with the baseline scheme coming second. It was also found that despite the extra surface area afforded by not trimming the wings did in fact aid the coefficient of downforce, the increase in drag largely offset the benefits of doing so.

References

- [1] British Radio Car Association. (2020, March 3). *BRCA GT12 Technical Rules v4.0*. Retrieved from BRCA.org: <https://brca.org/gt-circuit-documents/44-current/1316-brca-gt12-technical-rules-v4-0>
- [2] Coult, T. (2007). *Roll-out charts*. Retrieved 11 29, 2019, from CarsRCracing.co.uk: http://www.carsrcracing.co.uk/?page_id=33