SuperSix EVO

TECHNICAL REPORT 2019

cannondale

New SuperSix EVO Aerodynamic Performance Technical Report

Aerodynamic Performance

The new SuperSix EVO was designed to minimise drag within a classic race bike package. Aerodynamic evaluation of the new SuperSix EVO was conducted at the San Diego Wind Tunnel. Experimental wind tunnel testing remains the most precise and controlled method for measuring true aerodynamic performance.

The new SuperSix EVO was tested against its predecessor, in addition to a selection of its direct competitors in the lightweight race category. Competitors were selected based on expected performance leaders within the category.

Competitors Selected for this test were:

- Specialized S-Works Tarmac Disc
- Cervelo R5 Disc
- Trek Emonda SLR Disc
- BMC Roadmachine SLR 01 (2018)

All bikes were tested as sold in the highest manufacturers' specification with Shimano Dura-Ace Di2 builds. Testing was conducted on a bicycle in isolation with two water bottles fitted. Fit coordinates and saddles were held constant on all bikes.

Figure 1 shows the drag of each bike plotted as C_DA against yaw angle. Drag measurements are taken at a wind speed of 48.3 km/h (30 mph). Uncertainty in C_DA measurements is approximately +/- 0.0005 m^2

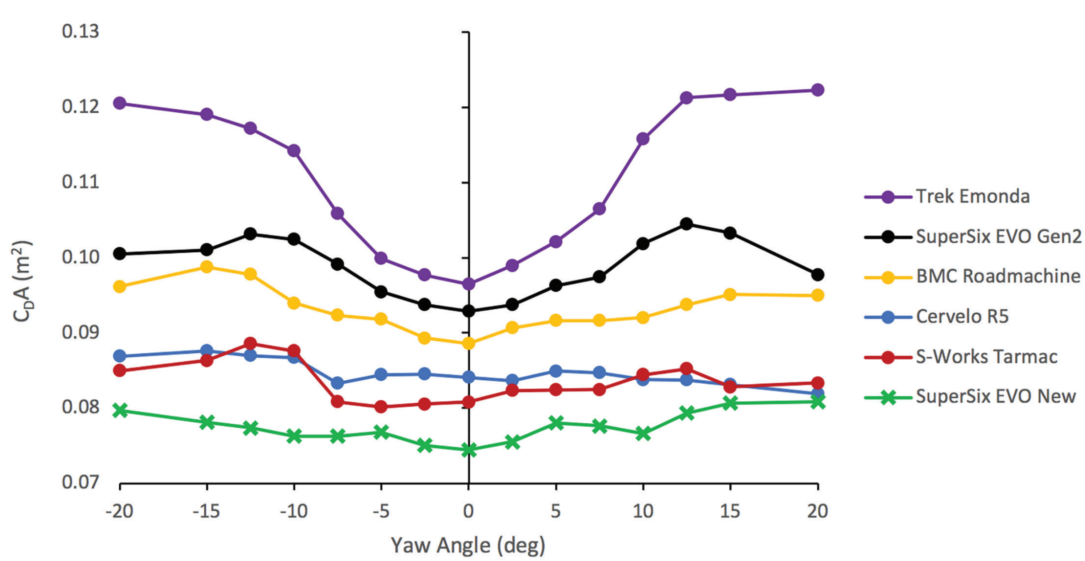

Figure 1 – C_DA of SuperSix EVO and competitor complete bikes. Test speed = 48.3 km/h (30 mph)

Results show that the all new SuperSix EVO has lower drag than its competitors across the tested yaw spectrum. This range of yaw angles has been shown to encompass 95% of riding conditions (Barry 2018).

Using the method of Yaw Weighted Drag (Barry 2018) it is possible to combine aerodynamic performance across the yaw spectrum with the probability of riding at any given yaw angle. This condenses a complex data set into a single unit of drag that represents combined on-road aerodynamic performance. Figure 2 shows the differences in yaw weighted drag represented as differences in power at 48.3 km/h (30 mph).

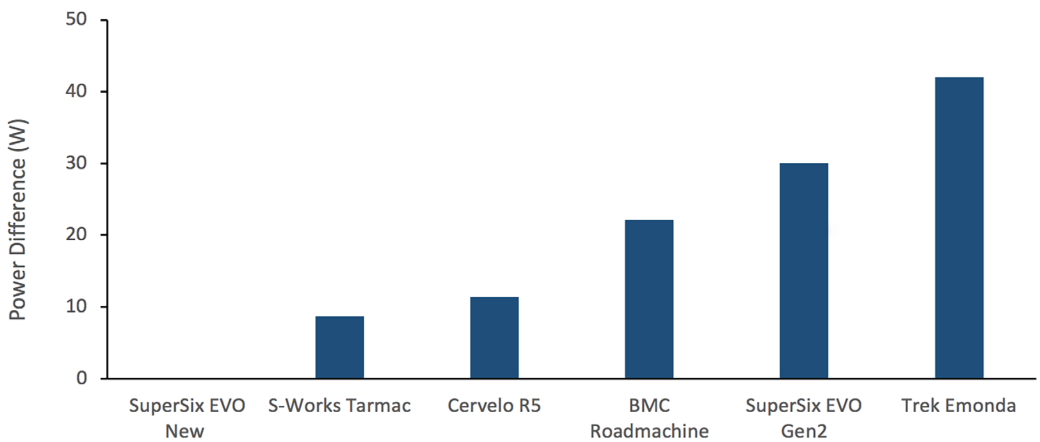

Figure 2 – Yaw weighted power difference at velocity of 48.3 km/h (30 mph). Yaw weighting method (Barry 2018)

In this format, the difference in aerodynamic performance is clear, with SuperSix EVO having nearly 9 W less drag at 48.3 km/h compared to its nearest rival in this test.

New Family of Tube Shapes

One of the key reasons for this dramatic improvement in aerodynamic performance over the previous generation bike is a whole new family of frame tube shapes. In redesigning SuperSix EVO we needed to maintain the characteristics of the platform that have made it a rider and racer favourite; light weight and responsive stiffness.

To reduce drag without compromising on weight or stiffness required a whole new approach to our frame tubes. All the main tubes on the new SuperSix EVO utilise a family of low aspect ratio, highly truncated airfoil sections. These shapes utilise only a very small segment of the airfoil chord. This maintains a low aspect ratio which provides more balanced stiffness and much lower weight compared to complete airfoils. However, when carefully defined, the use of this small airfoil segment can improve control over the flow and drive separation at the trailing edge of the tube. This reduces the size of the wake compared to a round tube and results in a significant reduction in drag. These shapes can result in the same weight and the same or better stiffness compared to a round shape but with as much as 30% lower drag for the fundamental cross section.

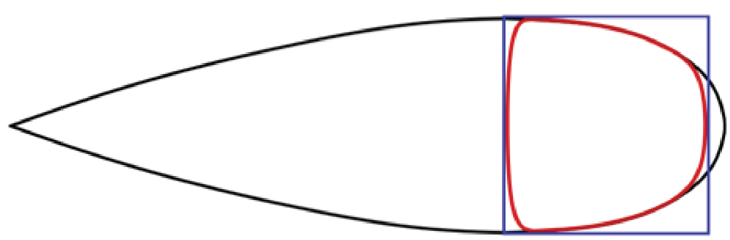

Figure 3 – Sketch of a low aspect ratio highly truncated form, as used on SuperSix EVO. Underlying airfoil profile is shown in black for reference.

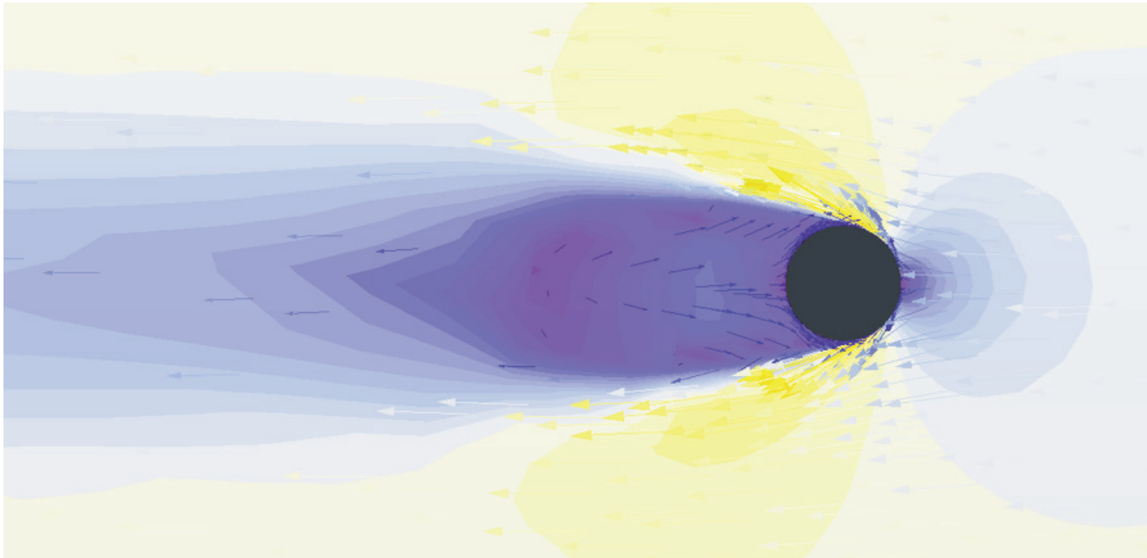

Figure 4 – Velocity field around a circular cylinder. Flow separates ahead of the widest point creating a wake region significantly wider than the body.

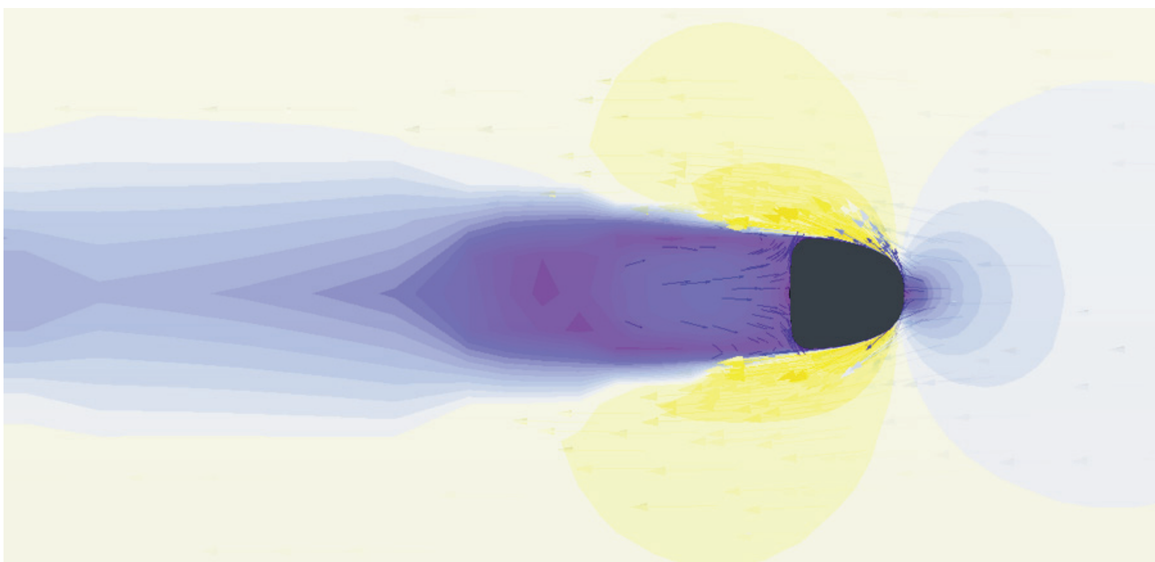

Figure 5 – Velocity field around an example of a low aspect ratio, highly truncated profile. Flow separates at the trailing edge of the body resulting in a significantly narrower wake compared to the round tube (Fig. 4)

References

Barry N, 2018, *A new method for analysing the effect of environmental wind on real world aerodynamic performance in cycling*, Proceedings, 2, p 211, doi:10.3390/proceedings2060211

Competitor Specifications

Bike	Handlebar	Stem	Wheels	Tyres
Specialized Sworks Tarmac	S-Works Shallow Bend	S-works SL	Roval CLX 50	Specialized Sworks Turbo Cotton 26C
Cervelo R5	Cervelo	Cervelo AB06	DTSwiss PRC 1400 Spline 35	Continental GP 4000S II 25C
BMC Roadmachine	BMC Ergo bar	BMC ICS Stem	Enve AR 4.5	Vittoria Corsa Control 28C
Trek Emonda SLR	Bontrager XXX bar-stem integrated cockpit		Bontrager Aeolus XXX 2	Bontrager R4 25C