PhD/Postgraduate Research Opportunity 2016

Numerical investigations in multi-rider cycling aerodynamics

Objective:

To develop highly refined computational models, supported by experimental investigations, of the unsteady flow around multiple athlete bodies in Olympic road and track cycling events.

Outline:

Fractions of a second is often all that differentiates the top teams and athletes from their competitors in many Olympic cycling events. In cycling significant time savings can be achieved through relatively small reductions in the aerodynamic drag force as it contributes the largest proportion to the total resistive forces. The importance of aerodynamics in cycling can be observed in the design of sporting equipment, positions athletes adopt on the bicycle and tactics employed during racing. To date the optimisation of the aerodynamic performance of cyclists has primarily treated riders in isolation to one another. However in the majority of events cyclists ride in groups of riders or tightly formed pace lines. The inclusion of multiple interacting bodies adds to the complexity of the system where aerodynamic forces can increase or decrease in magnitude, direction, and frequency depending on the nature of the fluid interactions between the bodies. In cycling the aerodynamics is also further complicated due to additional flow unsteadiness that is generated as a result of the motion of the legs around the crank cycle and the pedalling frequency.

Fundamental to the development of aerodynamic performance in these sports is a more complete understanding of the key flow mechanisms that have the greatest impact on aerodynamic drag of cyclists riding in close proximity to one another. This study will use numerical techniques (computational fluid dynamics) to investigate the aerodynamics associated with multi-rider Olympic cycling events. Particular focus will be placed on understanding how the fluid dynamics is coupled between multiple riders traveling in a pace line (eg: as observed in the team-pursuit). This study will be performed in parallel with experimental investigations at the Monash wind tunnels to assess the validity of computational findings and also enable the implementation of findings directly on the athletes. The successful outcome of the project will not only contribute to the further fundamental understanding of unsteady bluff-body aerodynamics but have direct applications to the improved aerodynamic design of sporting equipment, identification of superior cycling postures and race tactics in multi-rider events.

This project is part of a wider collaboration between Monash University and the Australian Institute of Sport and ties in with current studies at the Monash Wind Tunnels looking into other areas of bluff-body research (truck/train & passenger vehicle aerodynamics). Successful applicants will be given the opportunity to work with Australia's Olympic cycling teams, attend cycling events, travel to overseas conferences and use world class computing facilities to improve Australia's sporting performance through optimising aerodynamics. The successful applicant will need to demonstrate a good understanding of aerodynamics and computational fluid dynamic techniques, have first class honours or equivalent, and high marks in related subjects (e.g, final year aerodynamics, fluid mechanics and computational fluid dynamics related subjects will be considered favourably).

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