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Aerodynamic Interaction between Two Speed Skaters Measured in a Closed Wind Tunnel

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Abstract : Team pursuit is a relatively new event in international long track speed skating. For a single speed skater the aerodynamic drag will account for up to 80% of the braking force, thus reducing the drag can greatly improve the performance. In a team pursuit the interactions between athletes in near proximity will also be essential, but is not well studied. In this study, systematic measurements of the aerodynamic drag, body posture and relative positioning of speed skaters have been performed in the low speed wind tunnel at the Norwegian University of Science and Technology, in order to investigate the aerodynamic interaction between two speed skaters. Drag measurements of static speed skaters drafting, leading, side-by-side, and dynamic drag measurements in a synchronized and unsynchronized movement at different distances, were performed. The projected frontal area was measured for all postures and movements and a blockage correction was performed, as the blockage ratio ranged from 5-15% in the different setups. The static drag measurements where performed on two test subjects in two different postures, a low posture and a high posture, and two different distances between the test subjects 1.5T and 3T where T being the length of the torso (T=0.63m). A drag reduction was observed for all distances and configurations, from 39% to 11.4%, for the drafting test subject. The drag of the leading test subject was only influenced at -1.5T, with the biggest drag reduction of 5.6%. An increase in drag was seen for all side-by-side measurements, the biggest increase was observed to be 25.7%, at the closest distance between the test subjects, and the lowest at 2.7% with ∼ 0.7 m between the test subjects. A clear aerodynamic interaction between the test subjects and their postures was observed for most measurements during static measurements, with results corresponding well to recent studies. For the dynamic measurements, the leading test subject had a drag reduction of 3% even at -3T. The drafting showed a drag reduction of 15% when being in a synchronized (sync) motion with the leading test subject at 4.5T. The maximal drag reduction for both the leading and the drafting test subject were observed when being as close as possible in sync, with a drag reduction of 8.5% and 25.7% respectively. This study emphasize the importance of keeping a synchronized movement by showing that the maximal gain for the leading and drafting dropped to 3.2% and 3.3% respectively when the skaters are in opposite phase. Individual differences in technique also appear to influence the drag of the other test subject.

Keywords : aerodynamic interaction, drag force, frontal area, speed skating
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