

9.5 Drafting of two swimmers

Bolon Baptiste¹, Prétot C.¹, Clanet C.², Larrarte F.³ & Carmigniani R.¹

¹LHSV, ENPC, EDF R&D, ²LadHyX, Ecole Polytechnique, ³Université Gustave Eiffel

baptiste.bolon@enpc.fr

Open water swimming is a tactical sport. As in cycling, competitors often swim in peloton formations. Therefore, their position in the group is crucial to optimize drafting, either to preserve their physical strength, to quickly pass a lead swimmer or to impede the passing of an opponent. Our work is an experimental study of the drag on 2 swimmers scaled models ($L = 40\text{cm}$). It carries on the work of J. Westerweel [1]. The measurements take place in a current flume at EDF Lab and forces are measured using 1D-shear force sensors designed by *Phyling* [2].

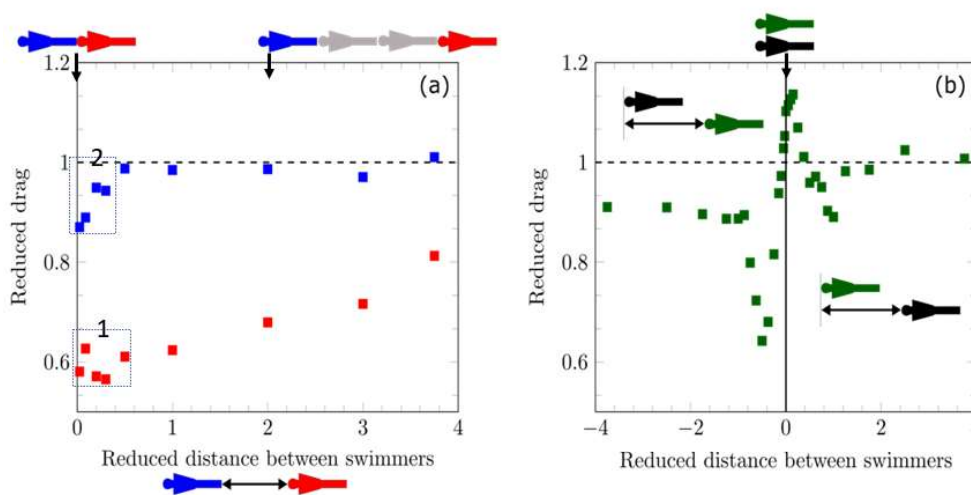


Figure 23: (a) Reduced drag at one given speed in line. (b) Reduced drag at one given speed in alongside swimming. The reduced drag is defined by $(\text{Drag})/(\text{Alone swimmer's drag})$ and reduced distance by $(\text{Distance between swimmers})/(\text{Swimmer's length})$ as shown in the sketches.

First consider two swimmers in line (fig.1-a) and measure the passive drag for different swimming speeds through a Froude similitude to represent both usual speeds during the 10 km race and sprint speed at the end of the race. Froude is defined by $Fr = \frac{V}{\sqrt{gL}}$ and its values are 0.28, 0.34 and 0.38. Concerning the drafted swimmer, his drag force is reduced up to about 40% when just behind the leader (zone 1 in figure 23.a). The further from the leader, the bigger the drag. The leader also experienced a drag reduction when the drafted is directly behind (zone 2 in figure 23.a), but only by about 10% and this effect disappears quickly as the drafted is further away.

Secondly, we study multiple configurations of 2 swimmers being alongside (23.b). Here, we measure both drag and transverse forces, at the same Froude numbers as described above. In terms of drag, it is maximum when swimmers are perfectly side by side. It is minimum when the head of one is 0.5 body length behind the head of the other one (around the hip). That means swimmers should avoid the first position and favor the second one when forced to swim alongside.

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References

- [1] J.Westerweel, K.Aslan, P.Pennings, B.Yilmaz, *Advantage of a lead swimmer in drafting*, 2016
- [2] Phyling, Drahi-X-Innovation Center, <https://www.phyling.fr/>