Impact of hull-asymmetry in rowing performance

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Figure 1: Quadruple scull

Subject

Rowing is a challenging sport, and not just for athletes. It mixes physiology, mechanics, and fluid dynamics [1]. As of today, hull optimisation is of very empirical nature. Understanding the drag force on the hull is essential to improve hull design; a matter that is back on the agenda for the french sports community given the soon to come Paris 2024 olympic games. At the air-water interface, one dominant drag force – coined the "wave drag" – is related to the waves generated by the moving body which continually remove energy to infinity.

Ever since the seminal work of Havelock [2] and Mitchell [3], no significant progress has been reported regarding the theoretical aspects of wavedrag. In particular both theories are insensitive to the effects of hull asymmetry. In other words – and as absurd as it may sound – the theoretical wave-drag of a sail boat moving forward is the same as that of the same body moving backwards. This is related to the fact that the theory only considers reversible laminar flow, when we suspect that limit boundary layers and turbulence play a crucial role on real wave drag.

The internship – consisting in unravelling the effects of hull asymmetry on the wave drag – will have both an experimental and theoretical components. The experiments will consist in measuring the drag on different symmetric and asymmetric hull shapes in a brand new towing tank. In parallel, we will develop a theoretical framework to address this important issue.

References

[1] J.-P. Boucher, R. Labbé, and C. Clanet, *Row bots*, Physics Today, 70 (2017), pp. 82–83.

[2] T. Havelock et al., *The propagation of disturbances in dispersive media*, Cambridge tracts in mathematics and mathematical physics; no. 17., (1914).

[3] J. H. Michell, *Xi. the wave-resistance of a ship*, The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 45 (1898), pp. 106–123.