The hydrodynamics of propulsion in rowing

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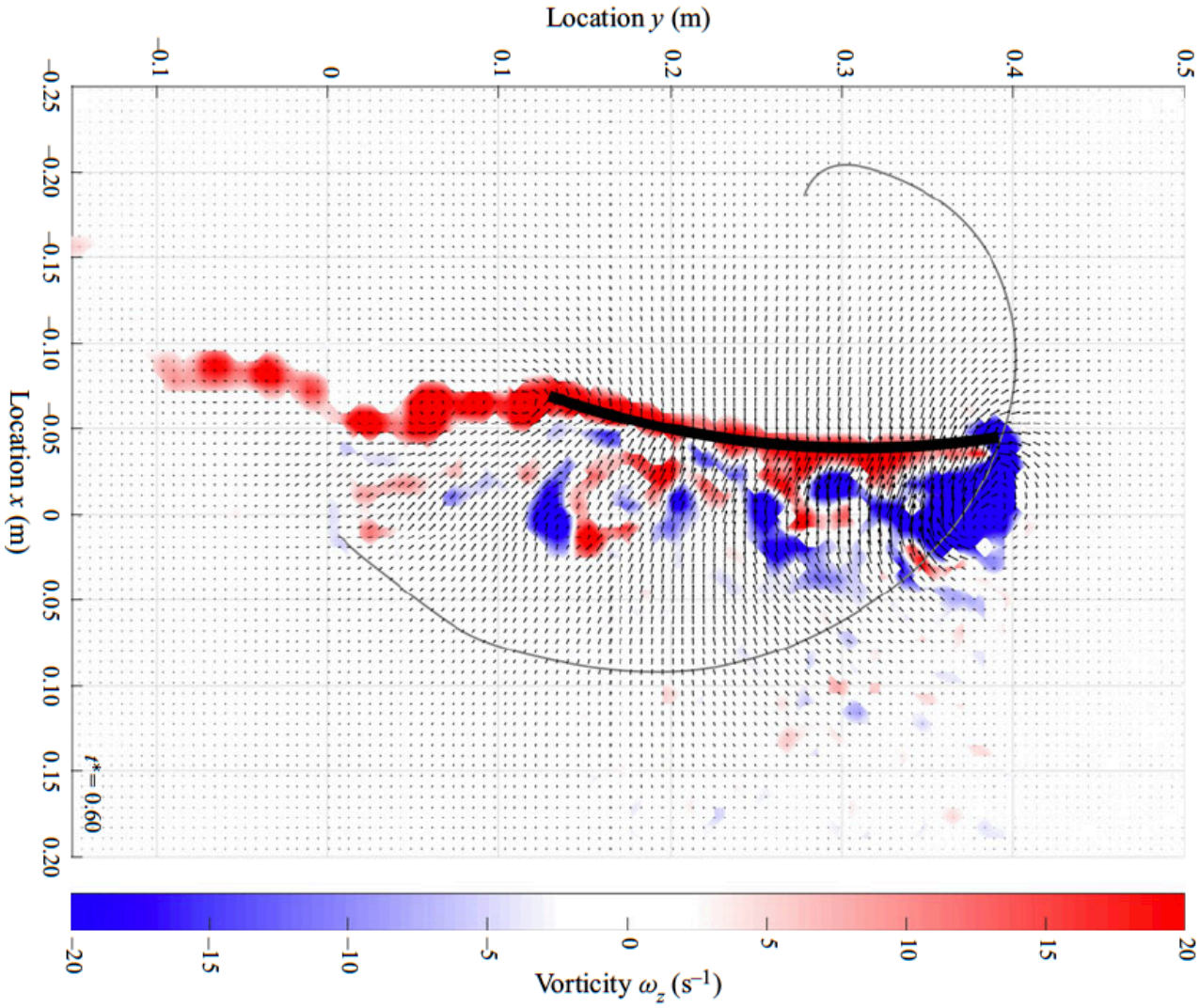
In order to improve the performance in rowing contests, we built a Ro(w)bot in which we can perform detailed measurements around a 1:2 scale model of an actual rowing blade that moves along a realistic path through water. The set-up allows us to measure both the forces and the impulsive flow by means of time-resolved PIV. We first investigated a more academic case of an accelerating rectangular plate along a straight path, which matches the first stroke at the start of a race. This showed that the forces during the acceleration phase are considerably higher than for steady motion. Also, it demonstrated that there is an optimal depth below the water surface that maximises the drag force. In the second phase of this study we considered the complete motion of an actual rowing blade. This revealed that the generated impulse is not aligned with the propulsive direction, indicating that the propulsion is suboptimal. A simple adjustment is proposed to optimise the alignment of the leading and trailing edge vortices that achieves an improved alignment of the generated impulse with respect to the motion of the boat.



Biosketch:

J. Westerweel obtained is M.Sc. degree in applied physics in 1988 at the Delft University of Technology, where he also obtained in Ph.D. degree in 1993. He then became a Research Fellow at the Royal Netherlands Academy of Arts and Sciences, and worked as a visiting scholar at Stanford University, the California Institute of Technology, and the University of Illinois at Urbana-Champaign. In 2001 he was appointed as a Anthoni van Leeuwenhoek professor at the Delft University of Technology, and since 2005 he holds the fluid mechanics chair at the Faculty of Mechanical, Maritime and Materials Engineering. His research interests are turbulence, dispersed multiphase flows, microfluidics, biological fluid dynamics, impulsive flows, and the fluid dynamics of sports. He is the (co-) author of a text book on particle image velocimetry and one on turbulence. He has been an Editor-in-Chief for ‘Experiments in Fluids’ since 2012.