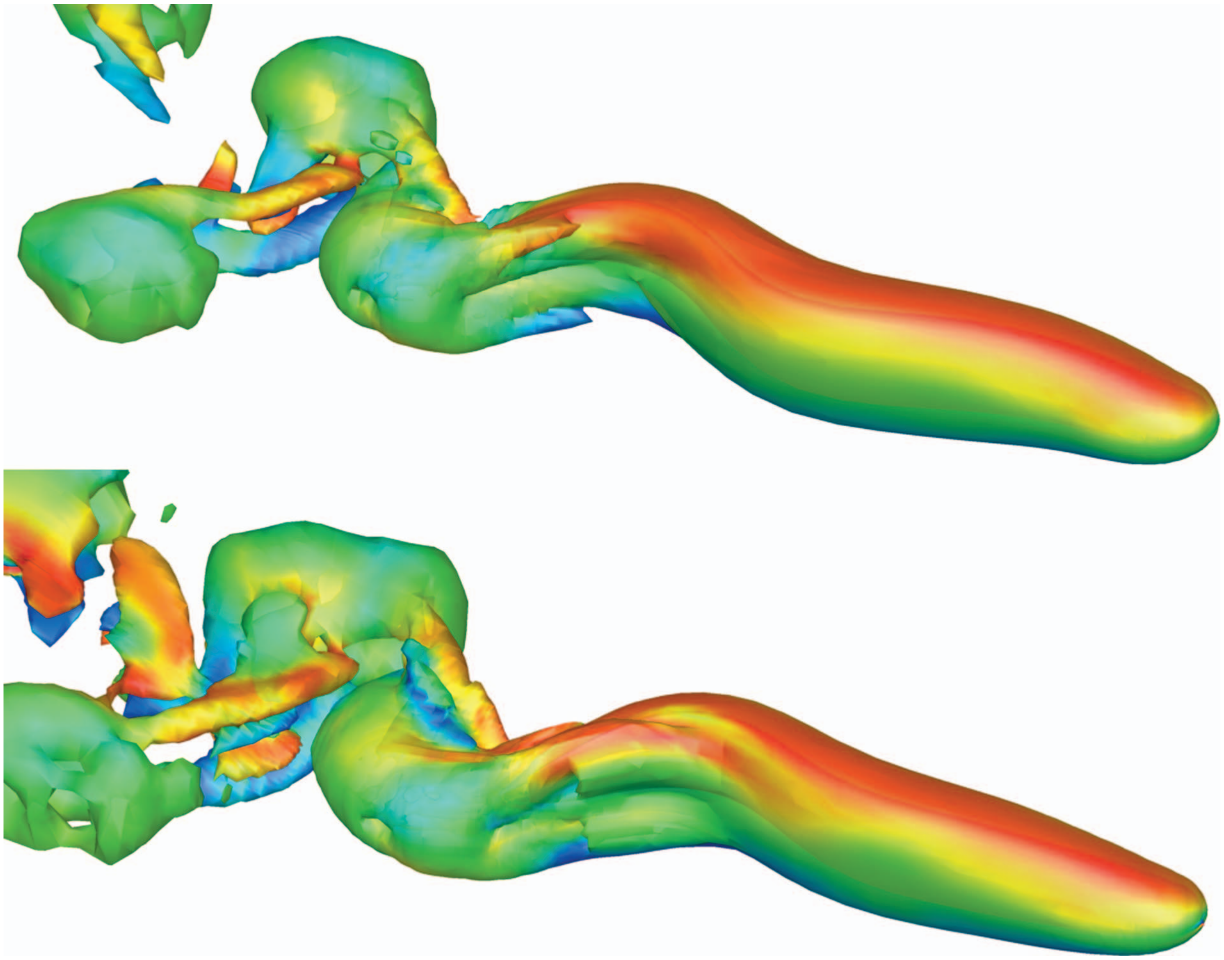

FIG. 1. (Color) Flow structure of the efficient (top) and fast (bottom) swimming motions visualized by plotting isosurfaces of vorticity magnitude $\|\omega\| \equiv 2$ colored by spanwise vorticity ω_y (enhanced online).

Optimization of anguilliform swimming

S. Kern and P. Koumoutsakos
ETH Zurich, 8092 Zurich, Switzerland
Kristina Eschler
HGK Zurich, 8031 Zurich, Switzerland
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The European eel (*Anguilla anguilla*) migrates from the coasts of Europe to its spawning grounds in the Sargasso Sea. As the eels cover this 6000 km distance without feeding, anguilliform swimming has been regarded as a prime example of highly efficient aquatic propulsion.[1] We investigate the hydrodynamics of anguilliform swimming motions using three-dimensional simulations of the fluid flow past a self-propelled body. An evolutionary optimization algorithm[2] is used to determine the motion of the body for different objectives, linking swimming motion and biological function in a systematic fashion. The objectives are the swimming efficiency and the burst swimming speed of the swimmer as they pertain to migration and hunt/escape behavior, respectively. The kinematics of burst swimming is characterized by the large amplitude undulations of the tail and the straightness of the anterior part of the body. In contrast, during efficient swimming, significant lateral undulations are present along the entire length of the body. In burst swimming, the majority of the thrust is generated at the tail, whereas in efficient swimming, in addition to the tail, the central part of the body contributes significantly to the thrust.[3] The wake, for both swimming modes, consists largely of a double row of vortex rings and corresponding lateral jets with an axis aligned with the swimming direction (Fig. 1) and is consistent with experimental results.[4]

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