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Harnessing wake vortices for efficient collective swimming via deep reinfrcement learning[1] SIDDARTHA VERMA, GUIDO NOVATI, PETROS KOUMOUTSAKOS, ETH - Zurich, CHAIR FOR COMPUTING SCIENCE TEAM — Collective motion may bestow evolutionary advantages to a number of animal species. Soaring flocks of birds, teeming swarms of insects, and swirling masses of schooling fish, all to some extent enjoy anti-predator benefits, increased foraging success, and enhanced problem-solving abilities. Coordinated activity may also provide energetic benefits, as in the case of large groups of fish where swimmers exploit unsteady flow-patterns generated in the wake. Both experimental and computational investigations of such scenarios are hampered by difficulties associated with studying multiple swimmers. Consequentially, the precise energy-saving mechanisms at play remain largely unknown. We combine high-fidelity numerical simulations of multiple, self propelled swimmers with novel deep reinforcement learning algorithms to discover optimal ways for swimmers to interact with unsteady wakes, in a fully unsupervised manner. We identify optimal flow-interaction strategies devised by the resulting autonomous swimmers, and use it to formulate an effective control-logic. We demonstrate, via 3D simulations of controlled groups that swimmers exploiting the learned strategy exhibit a significant reduction in energy-expenditure.

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Petros Koumoutsakos
ETH - Zurich

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