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Deep Reinforcement Learning for Efficient Navigation in Vortical Flow Fields[1] PETER GUNNARSON, California Institute of Technology, IOANNIS MANDRALIS, GUIDO NOVATI, PETROS KOUMOUTSAKOS, ETH Zurich, JOHN DABIRI, California Institute of Technology — Efficient point-to-point navigation in the presence of a background flow field is important for robotic applications such as ocean surveying. In such applications, robots may only have knowledge of their immediate surroundings rather than the global flow field, which limits the use of optimal control theory for planning trajectories. Here, we investigate the application of deep reinforcement learning to discover efficient navigation policies for a fixed-speed swimmer through steady and unsteady 2D flow fields. The algorithm entails encoding the swimmer policy as a deep neural network that uses as input the swimmers location and local vorticity, and outputs a swimming direction. We find that the resulting deep reinforcement learning policies significantly outperform a simple policy of swimming towards the target. The present navigation policies exploit the vorticity field to reach the target quickly and reliably.

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