Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Flow Navigation by Smart Microswimmers via Reinforcement Learning[1] SIMONA COLABRESE, LUCA BIFERALE, Department of Physics and INFN, University of Rome Tor Vergata, ANTONIO CELANI, Quantitative Life Sciences, The Abdus Salam International Centre for Theoretical Physics, KRISTIAN GUSTAVSSON, Department of Physics, University of Gothenburg — We have numerically modeled active particles which are able to acquire some limited knowledge of the fluid environment from simple mechanical cues and exert a control on their preferred steering direction. We show that those swimmers can learn effective strategies just by experience, using a reinforcement learning algorithm. As an example, we focus on smart gravitactic swimmers. These are active particles whose task is to reach the highest altitude within some time horizon, exploiting the underlying flow whenever possible. The reinforcement learning algorithm allows particles to learn effective strategies even in difficult situations when, in the absence of control, they would end up being trapped by flow structures. These strategies are highly nontrivial and cannot be easily guessed in advance. This work paves the way towards the engineering of smart microswimmers that solve difficult navigation problems.

[1]ERC AdG NewTURB 339032

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Date submitted: 31 Jul 2017 Electronic form version 1.4