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Why do mayflies switch from rowing to flapping as they grow?¹ RODOLPHE CHABREYRIE, Department of Mechanical and Aerospace Engineering, The George Washington University, KHALED ABDELAZIZ, Department of Mechanical Engineering, University of Maryland, ELIAS BALARAS, Department of Mechanical and Aerospace Engineering, The George Washington University, KEN KIGER, Department of Mechanical Engineering, University of Maryland — In order to maintain its metabolism, many species of mayfly nymph utilizes an oscillating array of wing-shaped gills to augment its extraction of dissolved oxygen from the surrounding water. As the nymph develops, the kinematics of these gills are observed to abruptly change from a rowing-like to flapping-like motion. In order to understand the role of this abrupt kinematic change, we consider a pure Lagrangian approach, looking at the mayfly as a stirring device. Using this Lagrangian approach we are able to provide the reason behind the observed kinematic transition during ontogeny. More precisely, recent and powerful tools from chaos theory are applied to in-sillico mayfly nymph experiments. In this talk, we show both qualitatively and quantitatively how the change of kinematics enables a better attraction, stirring and confinement of dissolved oxygen charged water within the near proximity of the gills surface. From the computational velocity field we reveal attracting barriers to transport, i.e. attracting Lagrangian coherent structures (LCS), that form the transport skeleton between and around the gills. In addition, we quantify how well advected particles and consequently dissolved oxygen is spread and mixed within the gills region.

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