Influence of Diffusion on Optimal Mixing Protocols

ALESSANDRA ADROVER, STEFANO CERBelli, MASSIMILIANO GIONA, Università la Sapienza, LUCA CORTELEZZI, McGill University — In recent years several studies have addressed the optimization of mixing protocols. These studies can be divided in two classes depending on the treatment of molecular diffusivity. In the first class of studies, diffusivity is neglected, and the characterization of the flow is, in general, purely kinematic. In the second class of studies, diffusivity is included, and the flow is characterized by analyzing and solving the advection-diffusion equation or performing an experiment. In general, it is not obvious if an optimal protocol derived for a given purely advective flow is still optimal for the corresponding flow with nonzero diffusivity and vice versa. We consider the optimization of mixing protocols for a prototypical flow: the sine flow. We choose this flow because its dynamics is quite realistic and has been extensively studied. We consider a fluid with and without diffusivity and derive finite-horizon optimal mixing protocols for a prescribed initial data. We obtain insight about the role played by diffusivity by applying protocols derived in the diffusive case to the purely advective case and vice versa. Results are discussed emphasizing the role of diffusivity and horizon length.