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Enhanced scalar transport through predictive reorientation of flow fields RUUD LENSVELT, MICHEL SPEETJENS, HENK NIJMEIJER, University of Technology Eindhoven — Enhancements to scalar transport by fluid flows involves improved redistribution of heat/chemicals through advection. Improvements will be beneficial for a large span of industrial applications ranging from inline mixing in food production to subsurface resource extraction. A common feature in the applications of interest is reorientation of boundary driven laminar base flows to promote scalar transport. In conventional approaches a fixed, periodic reorientation scheme (in space or time) is optimized to accomplish chaotic advection. However, it is unclear whether such approaches produce the most effective promotion of transport in the presence of significant diffusion and/or chemical reactions. In this work, we explore an optimization scheme to predict the optimal orientation to enhance scalar transport over a certain time horizon. Spectral decomposition of the base flow allows for a compact model to ensure efficient prediction of the scalar field in this scheme. We investigate boundary heating of a cold fluid in a 2D circular domain with reorientation of the base flow based on both schemes. The optimization approach shows significant acceleration towards homogenization of the scalar field which demonstrates its potential to improve transport with reorientation of flow fields.

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