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On the cost-effectiveness of mixing optimization OLEG GUBANOV, LUCA CORTELEZZI, McGill University — We consider the problem of estimating the cost-effectiveness of an optimal mixer (Gubanov & Cortelezzi, *J. Fluid Mech.*, vol. 651, 2010), a mixer able to generate a mixture with a desired level of homogenization over a wide range of operating conditions while minimizing the homogenzation time and cost. We generate a family of optimal mixers by extending the formulation of the sine flow (Liu et al., *Chaos, Solitons and Fractals*, vol. 4, 1994). We derive the Fourier sine flow, an egg-beater type of flow, which stirs a mixture by blinking velocity fields whose profile is defined as a Fourier sine series. We generate the four lower-level mixers by truncating the Fourier representation of the velocity profile to one, two, three and four modes, respectively. We formulate a constrained optimization problem for the velocity profiles. We use the mix-norm (Mathew *et. al*, *Physica D*, vol. 211, 2005) as a cost function. We couple profile and protocol optimizations and solve the problem every time the velocity fields are blinked. We compare the homogenization times achieved by the mixers. We show that, unexpectedly, the homogenization time does not decrease monotonically with increasing power input. Our results indicate that mixing optimization is most cost-effective at lower power inputs, it should be avoided in the low-middle range and becomes less attractive for higher power inputs.

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