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Shape optimization of stirrers for mixing binary fluids MAXIMILIAN EGGL, PETER SCHMID, Imperial College London — Mixing is an omnipresent process in a wide-range of industrial applications. It thus seems prudent to devise techniques for optimizing mixing processes under time and energy constraints. To this end, we present a computational framework based on nonlinear direct-adjoint looping for the enhancement of mixing efficiency in a binary fluid system. The governing equations consist of the nonlinear Navier-Stokes equations, complemented by an evolution equation for a passive scalar. Immersed and moving stirrers are treated by a Brinkman-penalization technique, and the full system of equations is solved using a Fourier-based pseudospectral approach. The adjoint equations provide gradient and sensitivity information which is used to improve an initial mixing strategy, based on shape, rotational and path modifications. We utilise a Fourier-based approach for parameterising and optimising the embedded stirrers and consider a variety of geometries to achieve enhanced mixing efficiency. We study a restricted optimisation space by limiting the time for mixing and the rotational velocities of all stirrers. In all cases, non-intuitive shapes produced better mixing.

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