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Flutter-Enhanced Mixing: Flow-Induced Flutter of Flexible Membranes in Small Scale Mixers AARON RIPS, NASA/Jacobs Space Exploration Group, RAJAT MITTAL, Johns Hopkins University — Flow-induced flutter of flexible membranes in small scale mixers is explored. Fully-coupled fluid-structure-scalar interaction (FSI) simulations are used to examine the mixing enhancement in duct-style small scale mixers due to fluttering flags and the sensitivity of the dynamics and the mixing performance to Reynolds number is examined. The fluid and structural dynamics are explored and the resultant mixing enhancement is characterized according to existing performance measures as well as two new analysis techniques. A new performance measure called the Equivalent Mixing Length is developed to examine the connection between increased mixing performance and the corresponding increase in pressure loss which can serve as a measure of performance efficiency of flutter mixers or of any micromixer design. Additionally, a technique is developed to extract an estimate of the interface path length in the flow so as to characterize the impact of increased convection due to the presence of the flutter mixer. Through these measures it is shown that flutter mixers can significantly improve the mixing performance of a small scale mixer over a very short duct length by way of generating vortical structures even at low Reynolds numbers which leads to complex stretching and folding of the interface in the mixer.

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