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Numerical Optimization Strategy for Determining 3D Flow Fields in Microfluidics[1] ALEX EDEN, MARIN SIGURDSON, IGOR MEZIC, CARL MEINHART, Univ of California - Santa Barbara — We present a hybrid experimental-numerical method for generating 3D flow fields from 2D PIV experimental data. An optimization algorithm is applied to a theory-based simulation of an alternating current electrothermal (ACET) micromixer in conjunction with 2D PIV data to generate an improved representation of 3D steady state flow conditions. These results can be used to investigate mixing phenomena. Experimental conditions were simulated using COMSOL Multiphysics to solve the temperature and velocity fields, as well as the quasi-static electric fields. The governing equations were based on a theoretical model for ac electrothermal flows. A Nelder-Mead optimization algorithm was used to achieve a better fit by minimizing the error between 2D PIV experimental velocity data and numerical simulation results at the measurement plane. By applying this hybrid method, the normalized RMS velocity error between the simulation and experimental results was reduced by more than an order of magnitude. The optimization algorithm altered 3D fluid circulation patterns considerably, providing a more accurate representation of the 3D experimental flow field. This method can be generalized to a wide variety of flow problems.

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Carl Meinhart
Univ of California - Santa Barbara

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