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Using machine learning to discover shape descriptors for predicting emulsion stability in a microfluidic channel[1] JIAN WEI KHOR, Stanford University, Department of Mechanical Engineering, NEAL JEAN, CHIEN-YI CHANG, Stanford University, Department of Electrical Engineering, STEFANO ERMON, Stanford University, Department of Computer Science, SINDY TANG, Stanford University, Department of Mechanical Engineering — In concentrated emulsions, drop shapes at the micro-scale carry important information about local forces and their interactions with the local environment, which can be related to its bulk properties. However, the shape descriptors used in prior work on single drops and dilute emulsions, where inter-drop interactions are minimal, are insufficient to capture the broad range of drop shapes in a concentrated system. To solve this problem, we design a convolutional autoencoder that learns to discover a low-dimensional code to describe drop shapes within a concentrated emulsion of monodisperse drops and predict whether the drop becomes unstable and undergo break-up. The model is able to faithfully reconstruct drop shapes, as well as achieve a classification accuracy of 91.7% in drop break-up prediction, compared with ∼60% using conventional scalar descriptors based on drop elongation. Finally, the method presented is expected to facilitate follow-on work to identify the relationship between drop shapes and drop interactions, and to identify potentially new modes of break-up mechanisms in concentrated system.

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