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Optimal transport of a drop II – externally actuated case[1] VIDYA RAJU, SURAJ SHANKAR, L MAHADEVAN, John A. Paulson School of Engineering and Applied Sciences, Harvard University — The Monge-Kantorovich problem of optimal mass transport is an old one, with deep connections to optimization theory and inviscid hydrodynamics and a range of applications to image analysis, machine learning etc. But can one use it or its variants to also construct policies to optimally transport real matter that obey complex physical dynamics? As a second example, we consider the motion of a thin drop by dynamically controlling the spatial profile of an external driving stress such as gravity or capillarity. Within the lubrication approximation, we use optimal control theory pose and solve the problem of optimally transporting such a drop subject to some constraints. Using a minimal parametrization in terms of the position, size and shape of the drop allows us to recast the problem using Pontryagin's Maximum Principle and uncover the limits of controllability of the drop. Our analysis marries hydrodynamics and optimal control in a tractable and interpretable framework, paving the way forward for the design of strategies for the spatio-temporal manipulation of thin drops and films.

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