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Learning to write and paint using a liquid rope trick GAURAV CHAUDHARY, Harvard University, MIT, STEPHANIE CHRIST, Harvard University, A. JOHN HART, MIT, L. MAHADEVAN, Harvard University — The range and speed of direct ink writing, the workhorse of 3d and 4d printing, is limited by the practice of liquid extrusion from a nozzle just above the surface. This is to prevent instabilities that lead to folding and coiling instabilities that cause deviations from the required print path. But what if we could harness and control the liquid rope coiling trick, whereby a thin stream of viscous fluid falling from a height spontaneously folds or coils, to write specified patterns on a substrate? Here, we show that a type of machine learning known as Reinforcement Learning can be used to control the motion of a liquid extruding nozzle and thence the fluid patterns that are deposited on the surface. The learner (nozzle) repeatedly interacts with the environment (a viscous filament simulator), and improves its strategy using the results of this experience. We demonstrate the results in an experimental setting where the learned motion control instructions are used to drive a viscous jet to accomplish complex tasks such as cursive writing and paintings a la Pollock.

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