Neuranimat: neurobiologically inspired sensorimotor control based on inverse action objectives

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The NEURANIMAT project explores a neurobiologically inspired approach to controlling soft robotic systems, drawing from the architecture and function of the vertebrate spinal cord. As a first step towards reaching that goal, here we leverage recurrent neural networks (RNNs) trained via distillation learning to mimic spinal circuits that transform high-level goals into low-level motor commands. A two-joint four-muscle arm was implemented using the MuJoCo physics engine [1] and controlled by an RNN trained in a combination of reinforcement and supervised learning to reach random targets in horizontal space. After training, the in silico system reproduced a core feature of spinal motor control—convergent force fields (CFFs)—when tested in a simulated replicate of a seminal experiment in the field [2]. However, these patterns did not directly map onto neurons with the initially expected characteristics. Nonetheless, these preliminary results suggest promising directions for identifying general principles in neural motor control, and support the viability of biologically plausible controllers for soft robotic systems.

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