Anticipatory Active Inference from Learned Recurrent Neural Forward Models

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Abstract: We demonstrate that inference-based goal-directed behavior can be done by utilizing the temporal gradients in recurrent neural network (RNN). The RNN learns a dynamic sensorimotor forward model. Once the RNN is trained, it can be used to execute active-inference-based, goal-directed policy optimization. The internal neural activities of the trained RNN essentially model the predictive state of the controlled entity. The implemented optimization process projects the neural activities into the future via the RNN recurrences following a tentative sequence of motor commands (encoded in neurons akin to recurrent parametric biases). This sequence is adapted by back-projecting the error between the forward-projected hypothetical states and desired (goal-like) system states onto the motor commands. Few cycles of forward projection and goal-based error backpropagation yield the sequences of motor commands that control the dynamical systems. As an example, we show that a trained RNN model can be used to effectively control a quadrocopter-like system.