Online system identification in a Duffing oscillator by free energy minimisation

Wouter Kouw

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Bayesian Intelligent Autonomous Systems lab

Online system identification

Natural agents learn how to move by “motor babbling”
→ Send out control signals to muscles and observe the resulting limb pose.

System identification refers to learning the mapping between input and output for electromechanical systems

Goal: online system identification using a biologically plausible inference procedure.

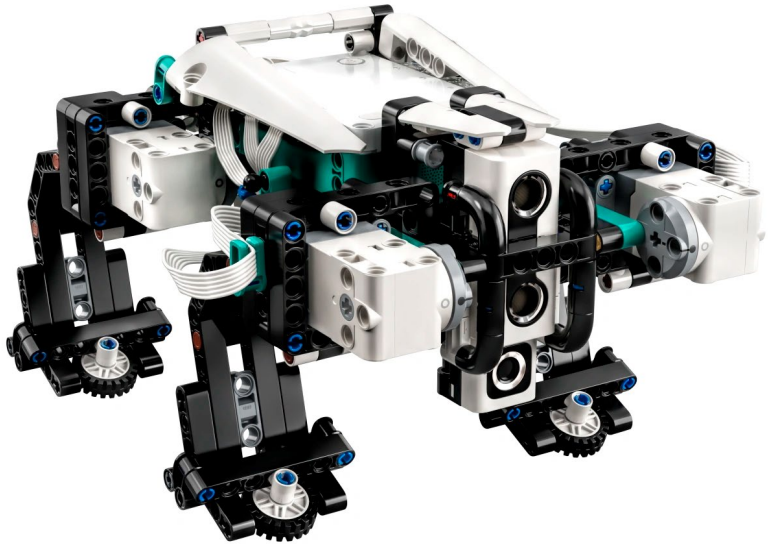
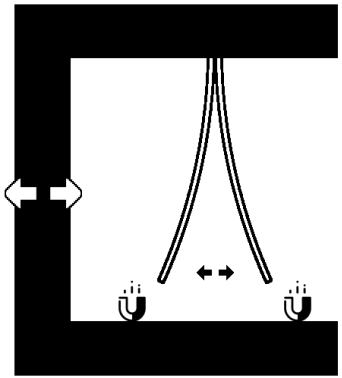
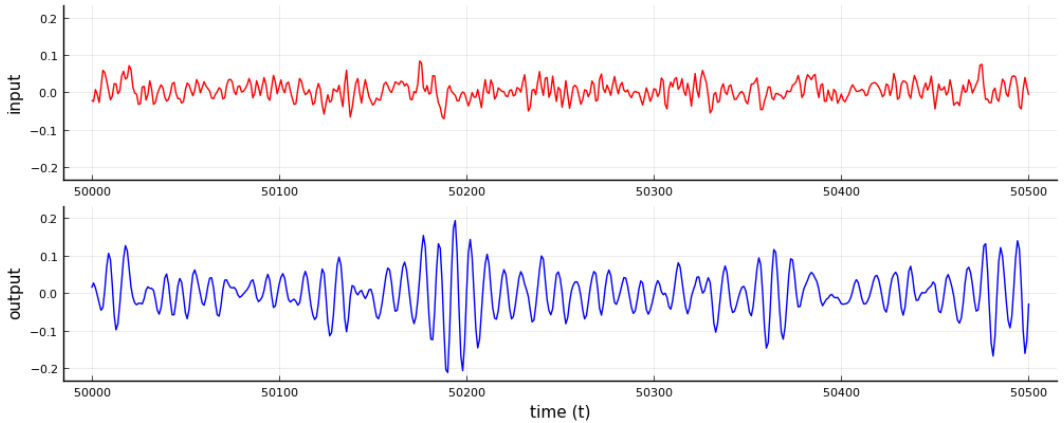


Image courtesy of lego.com

Duffing oscillator

A Duffing oscillator is a driven, damped harmonic osscilator with a cubic nonlinearity:



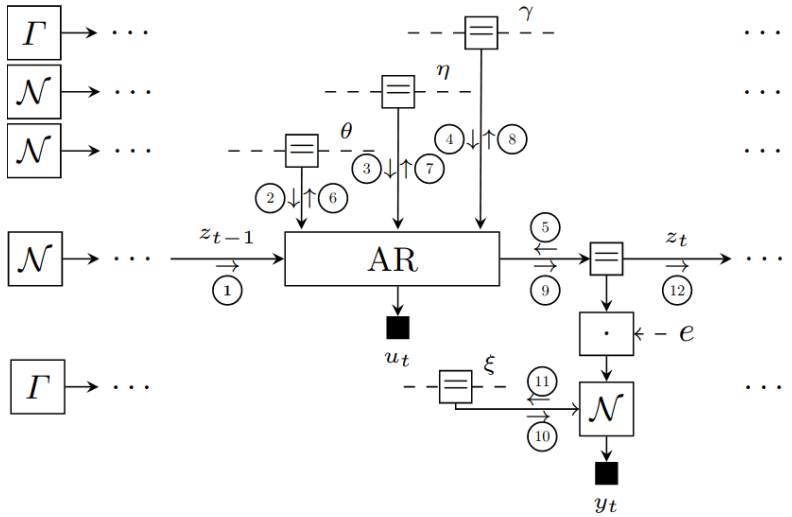


It represents a simple problem setting to benchmark the free energy minimisation procedure.

Free energy minimisation

We employ a recursive inference procedure in a Forney-style factor graph:

→ At each time-step, priors beliefs over parameters and states are combined with observations to produce posteriors for the next time-step.



Beliefs are updated by variational message passing.

→ Green messages represent incoming priors.

→ Red messages represent belief updates.

If you're interested in the results, come see my poster.