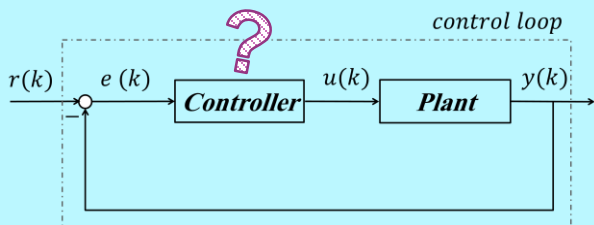
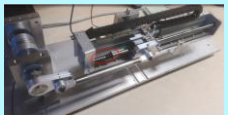


Goal

Design a data-driven nonlinear controller for an unknown plant

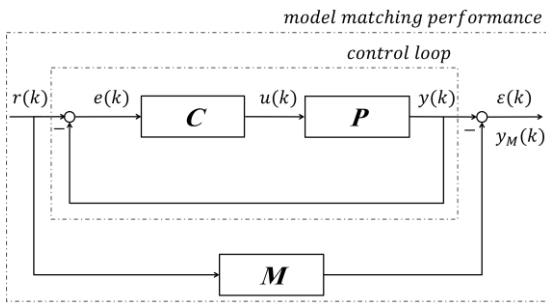


Motivation

- Motivation
 - Minimal expert user intervention
 - No prior knowledge of the plant and controller
- Challenges
 - Unknown dynamical structure
 - Noisy data
 - Physical interpretation

Approach

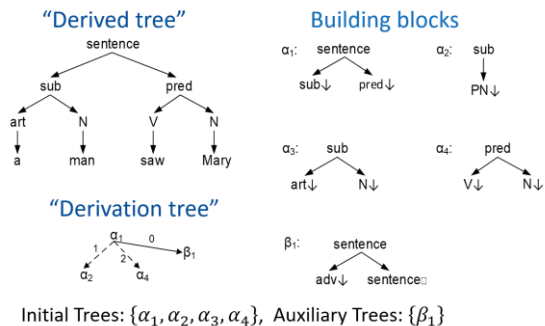
- Virtual Reference Feedback Tuning (VRFT)



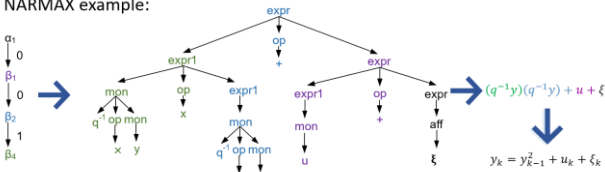
Approach

- Tree Adjoining Grammar (TAG)

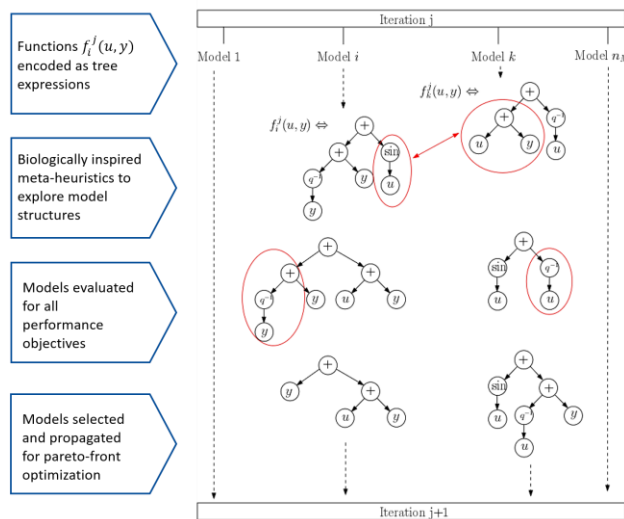
Linguistics example: "A man saw Mary" [Joshi, Schabes, '97]



NARMAX example:

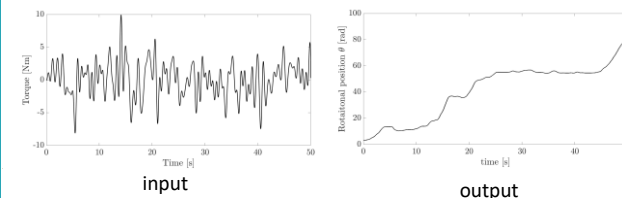
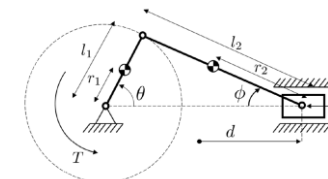


- Genetic Programming

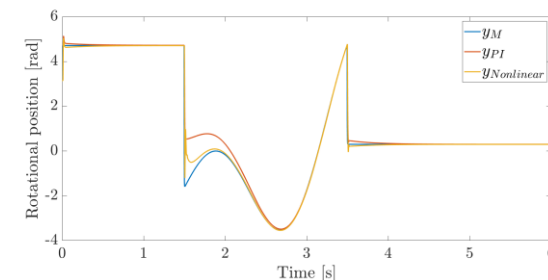


Results

- Numerical example: Slider Crank



- Controller performance



A comparison between: Nonlinear controller closed-loop output response $y_{Nonlinear}$, PI controller closed-loop output response y_{PI} and the desired output response y_M .

Key take-aways

- Successful discovery of both the structure and parameters of the controller only by using numerical input/output data.
- Future work: Experimental validation using noisy data

Further reading

- Khandelwal, D., M. Schoukens, and R. Tóth. "A Tree Adjoining Grammar Representation for Models Of Stochastic Dynamical Systems." *arXiv preprint arXiv:2001.05320* (2020).