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Practical Control Applications

Abdel Rodriguez Abed, PhD

Artificial intelligence specialist

Addiva AB

abdel.rodriguez@addiva.se

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Machine Learning

- Learning (Oxford): The acquisition of knowledge or skills through study, experience, or being taught.

- Learning (thelearningcoach.com): Relatively permanent change in a person’s knowledge or behavior due to experience.

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Machine Learning

- Supervised learning: recognition, detection, vision
- Unsupervised learning: exploratory analysis
- Semisupervised learning: control

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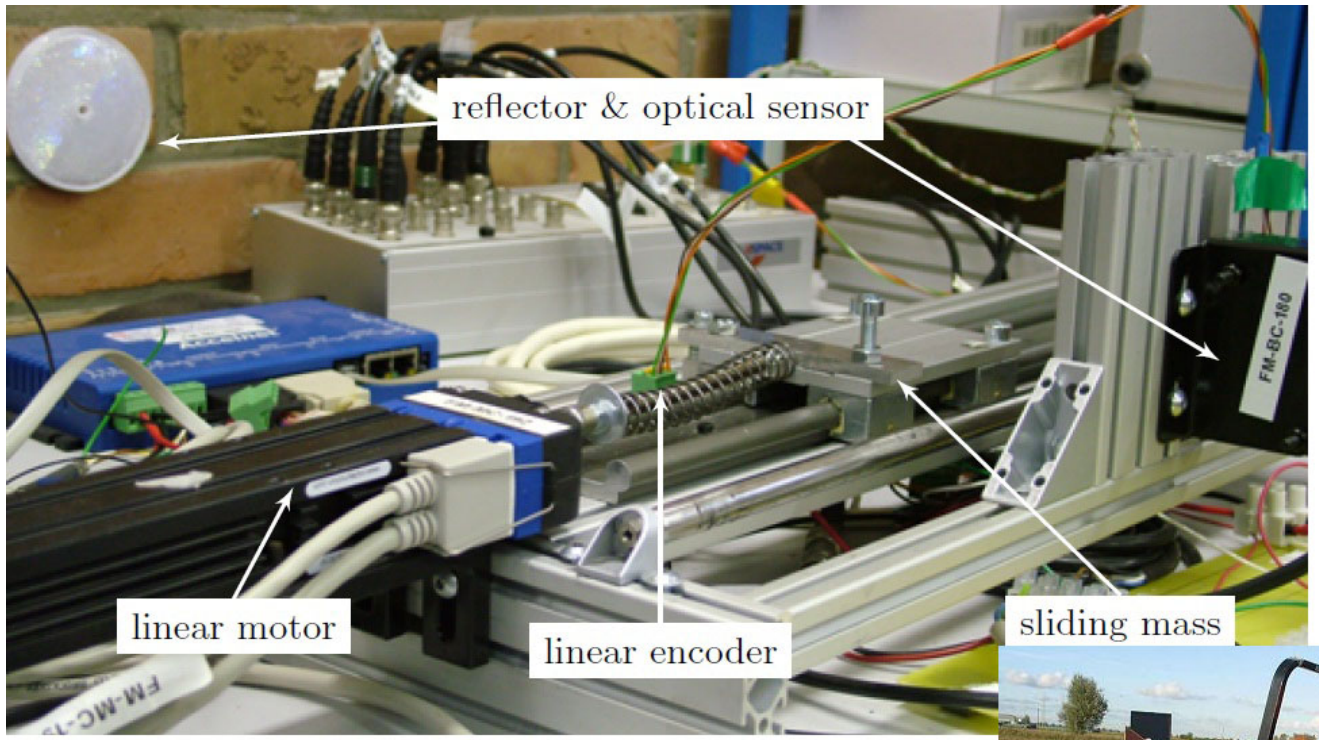
Practical Applications



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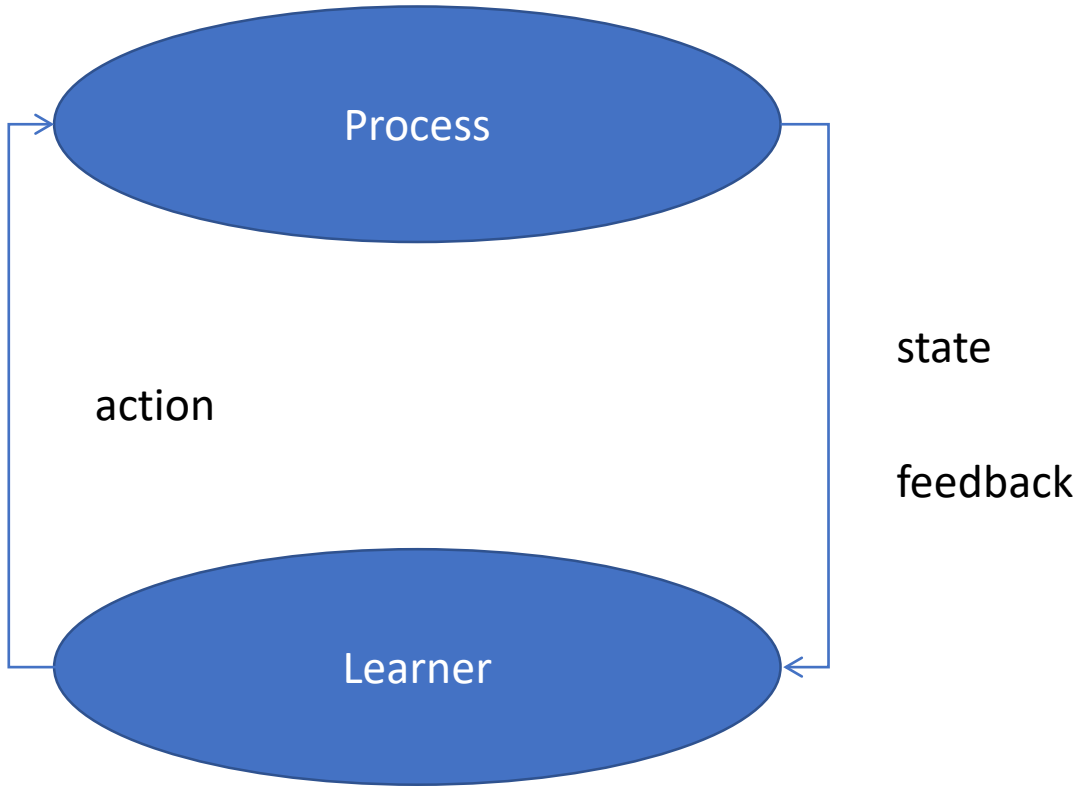
Reinforcement Learning



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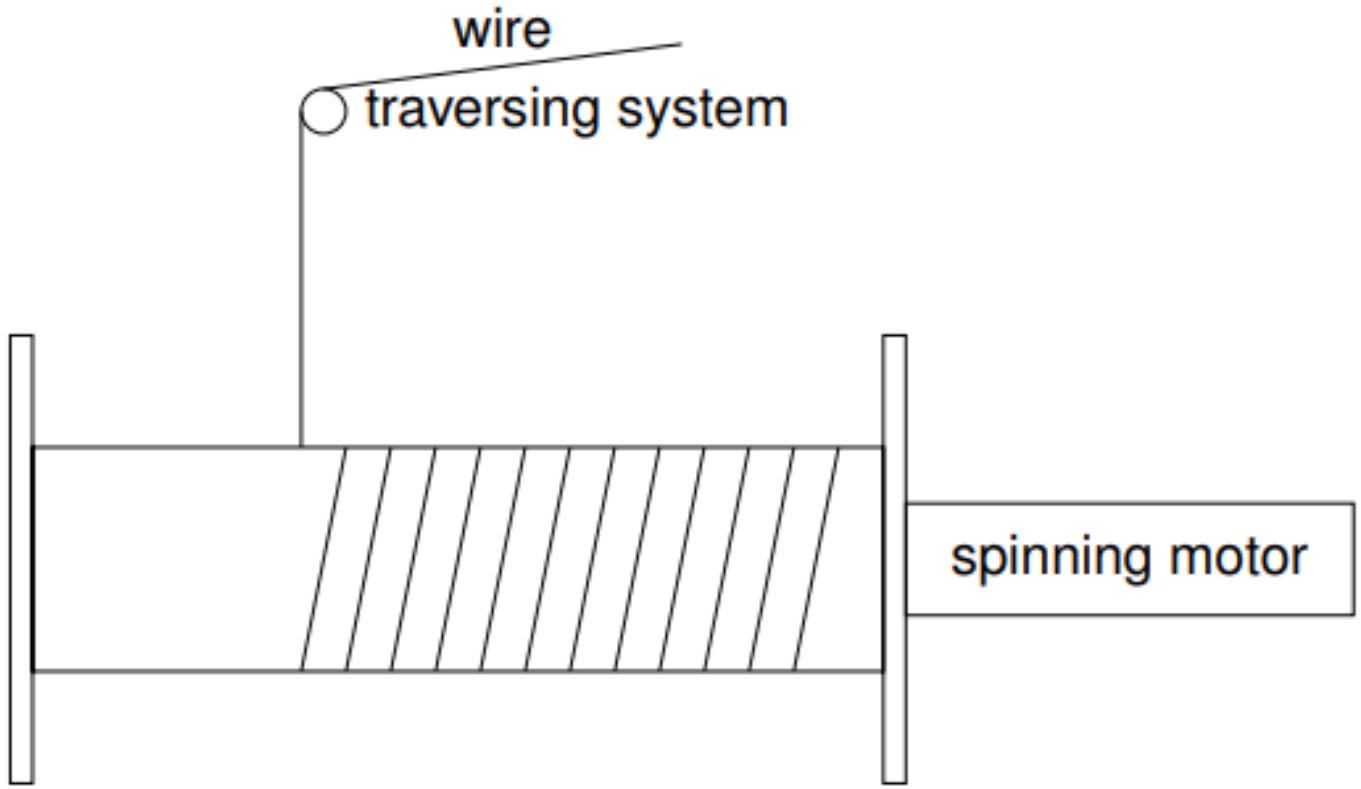
Wire Winding Machine



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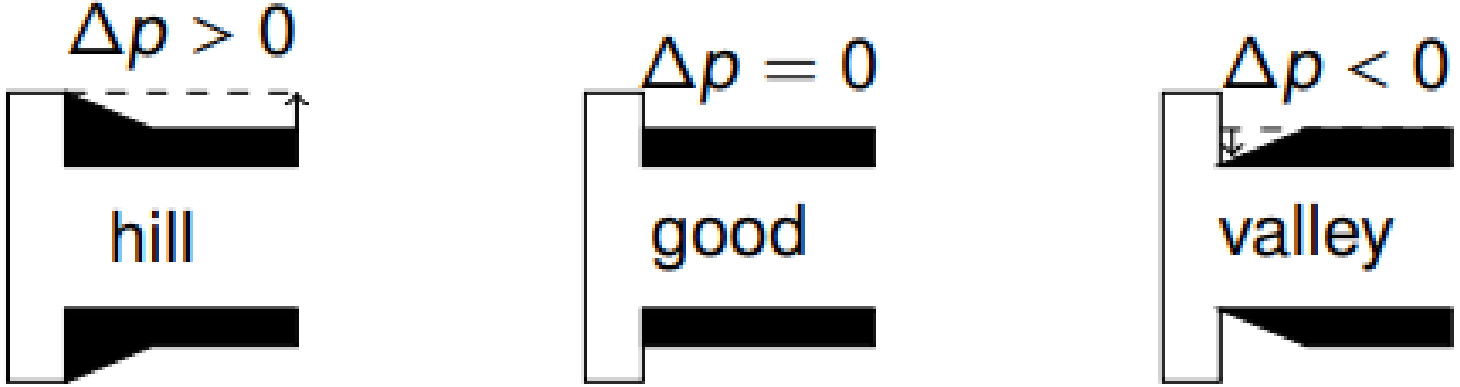
Wire Winding Machine

Left hand-side controller:



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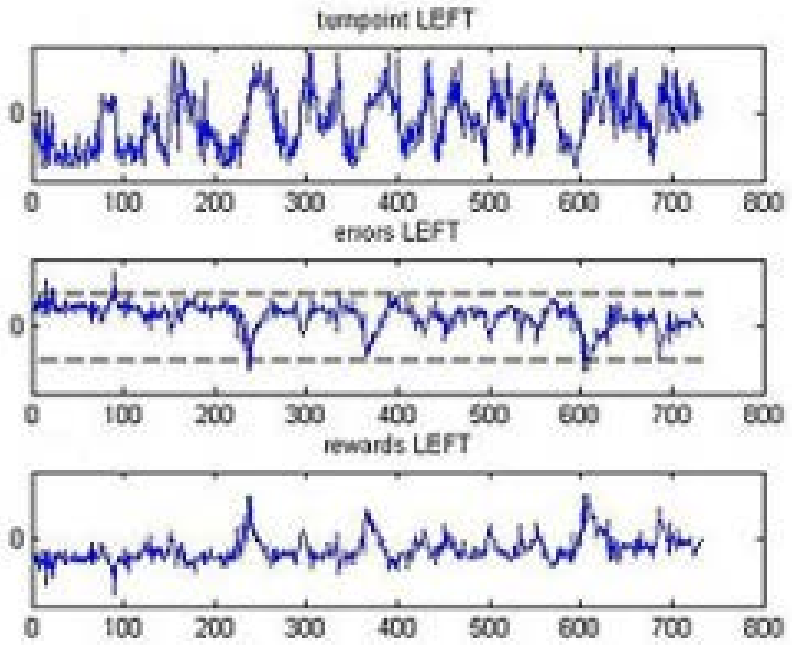
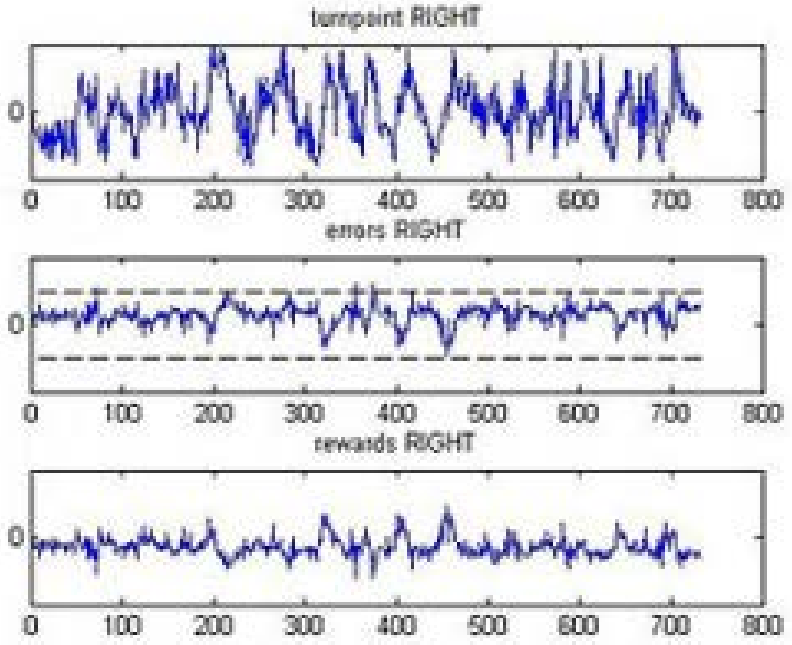
Results: Flat Flanges





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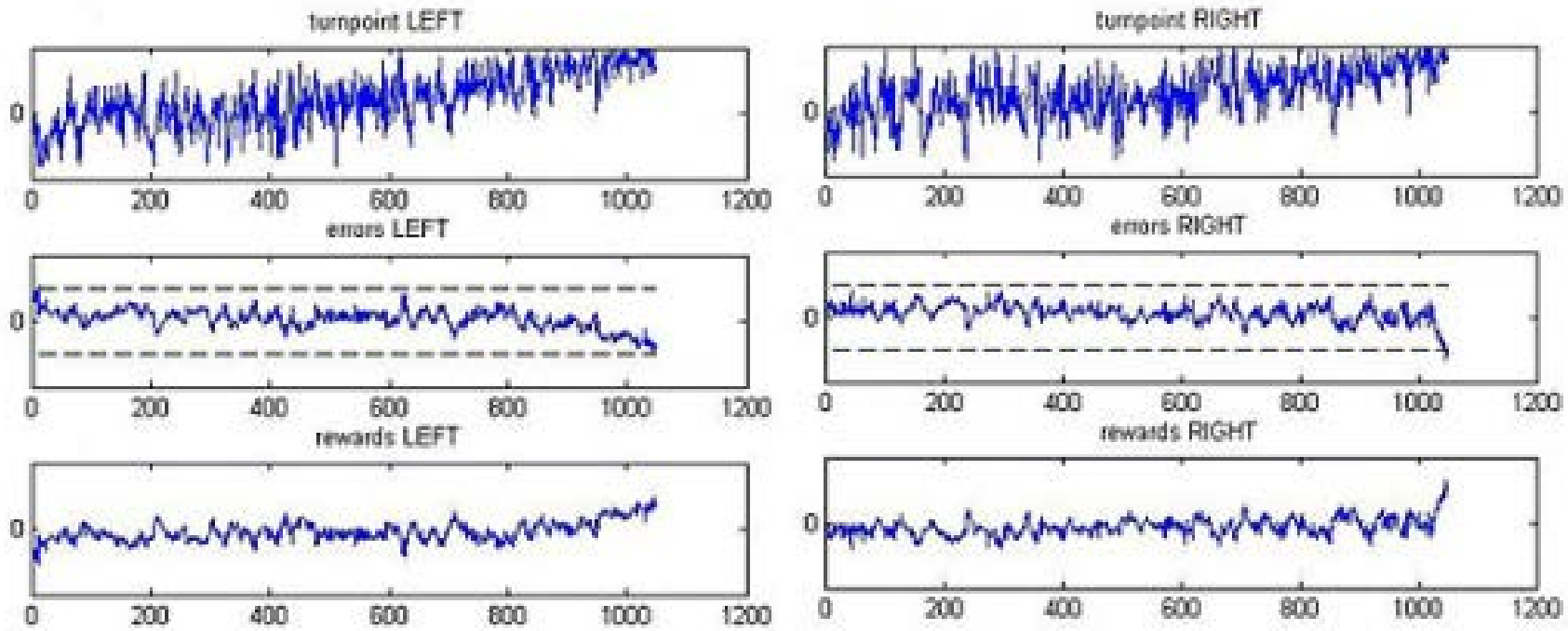
Results: Bending Flanges



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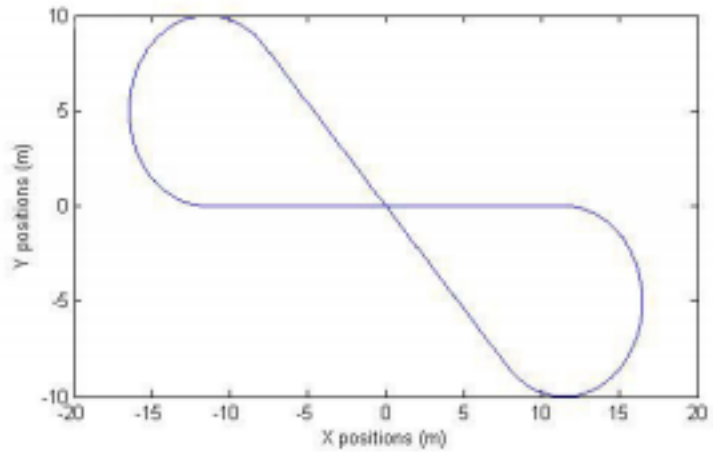
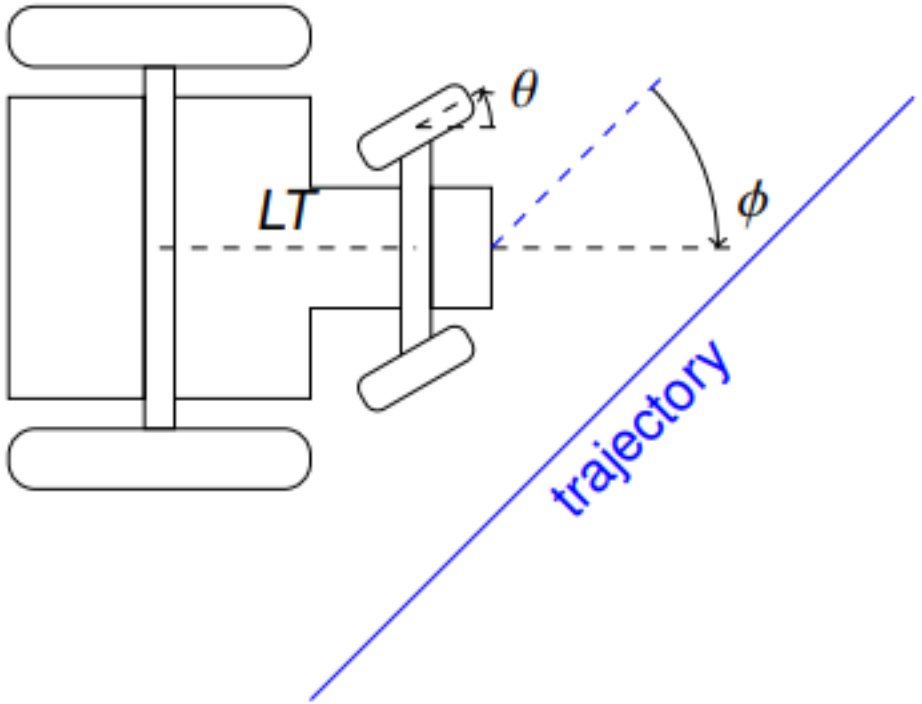
Tuning a PID For Controlling a Tractor





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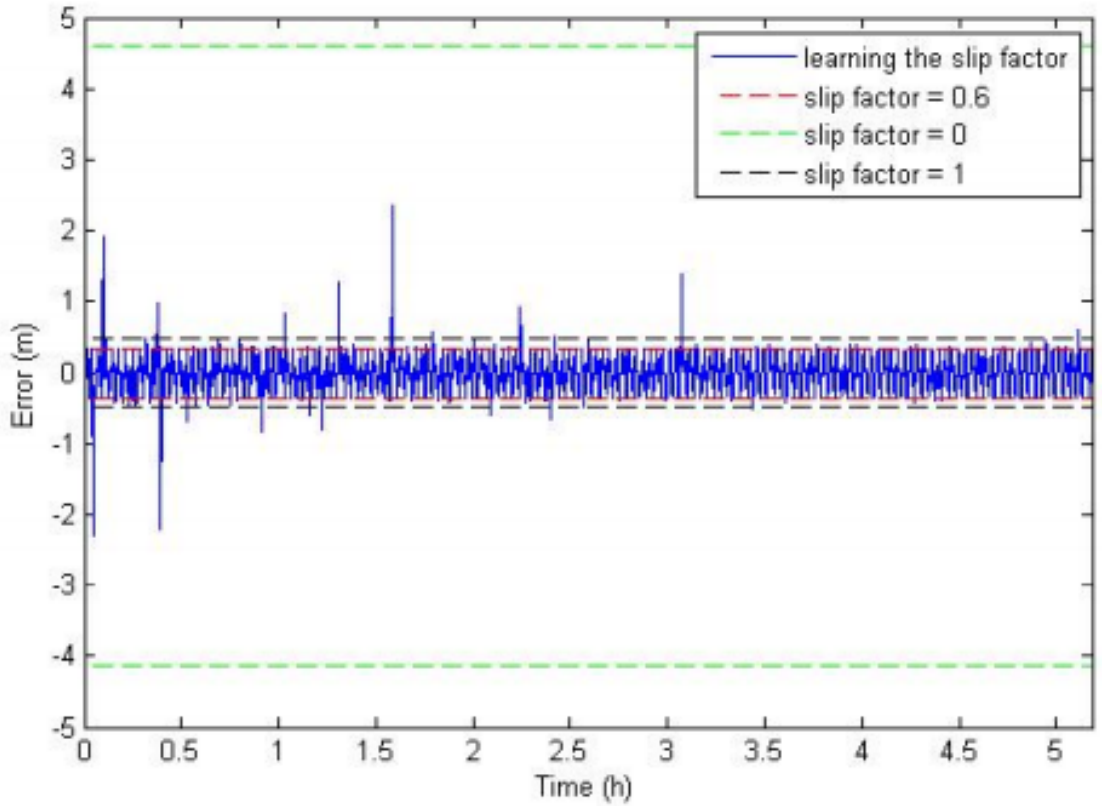
Results

Error



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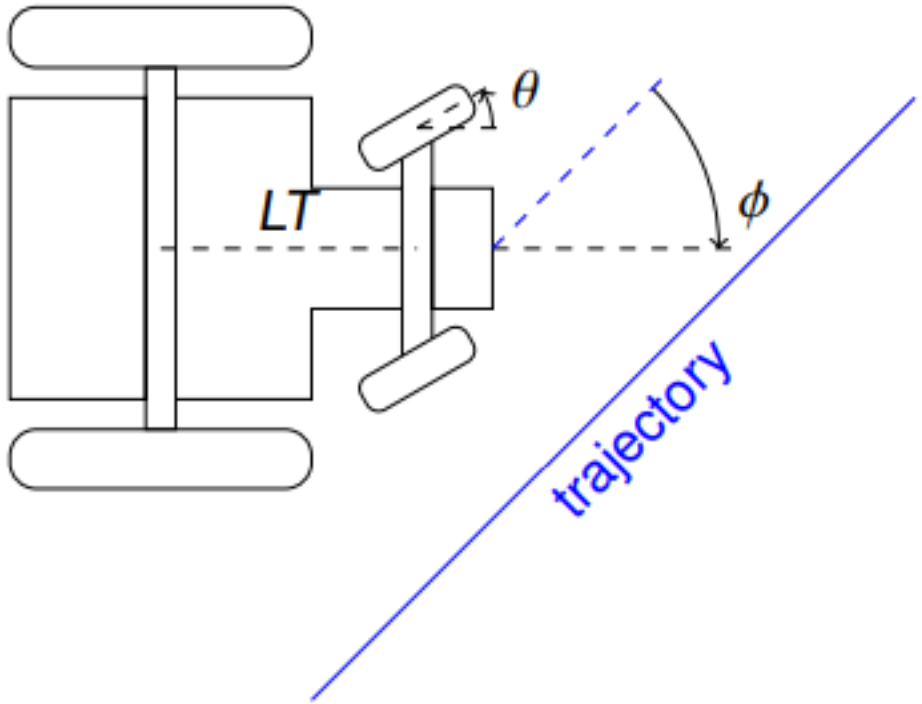
Autonomous Tractor

$$x_k = \begin{bmatrix} e_k \\ \dot{e}_k \\ R_t \end{bmatrix}$$

$$r_k = -\left(x_k^T Q x_k + u_k^T R u_k\right)$$

$$Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$R = [0]$$



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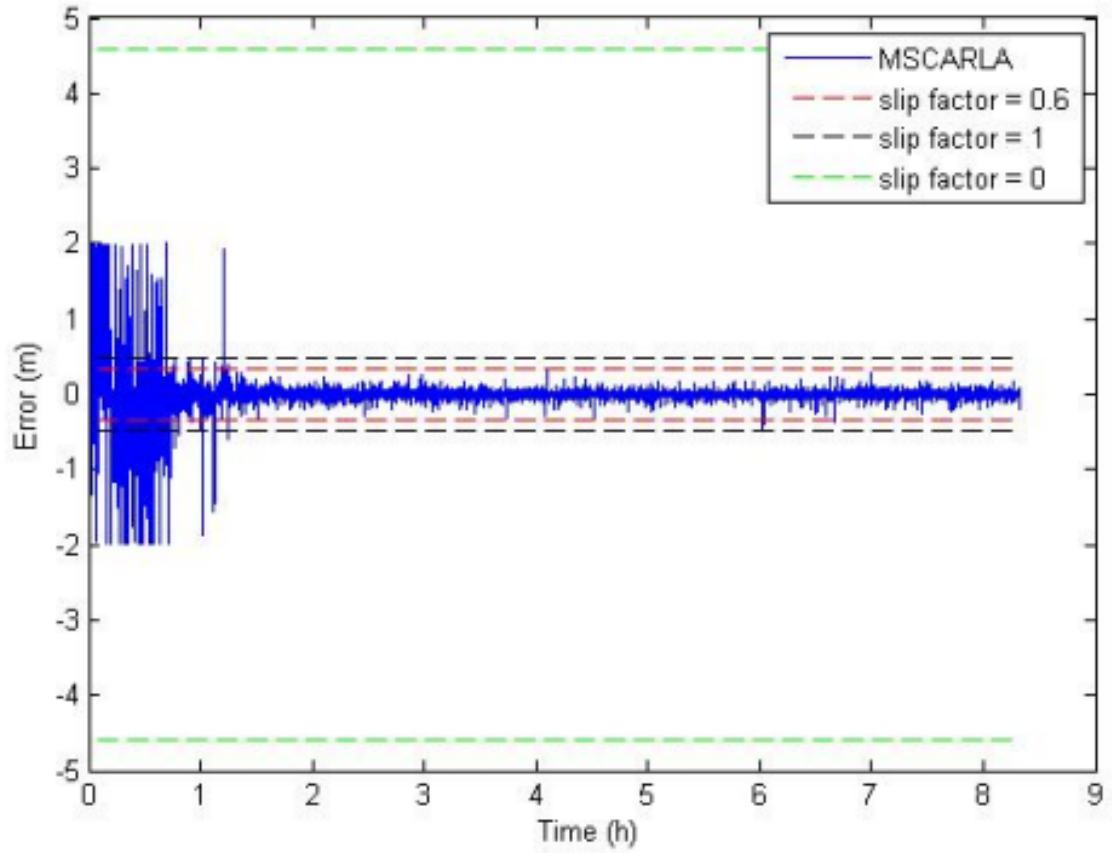
Results

Error



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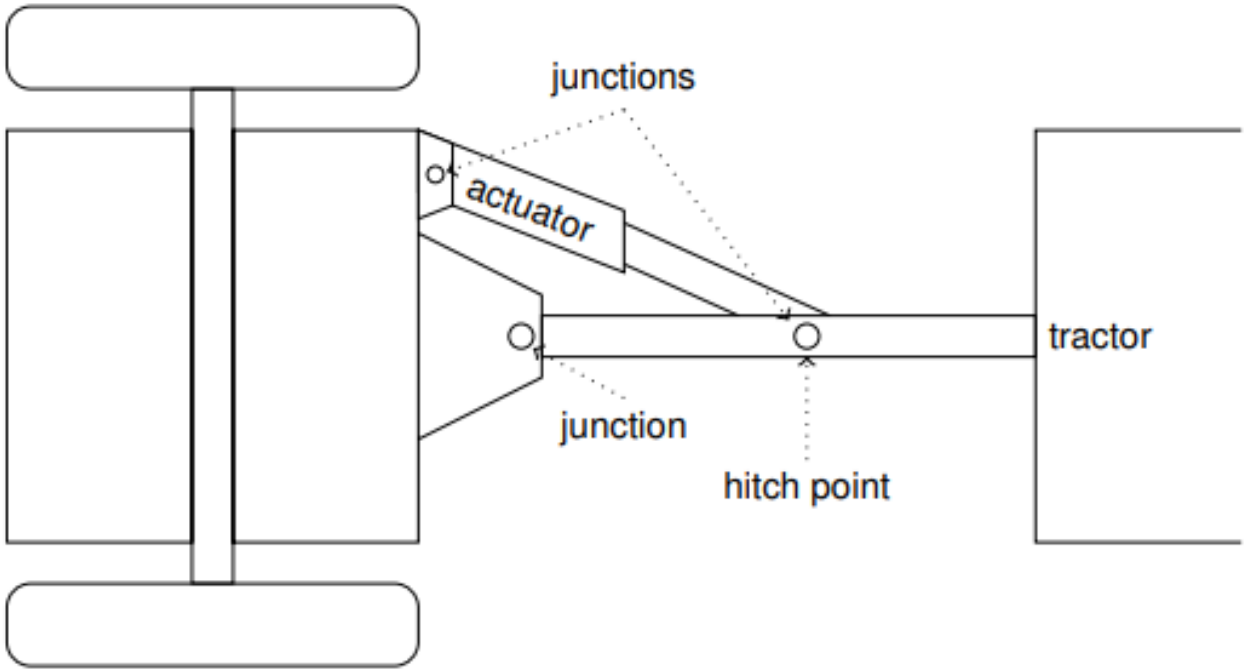
Plus An Implement



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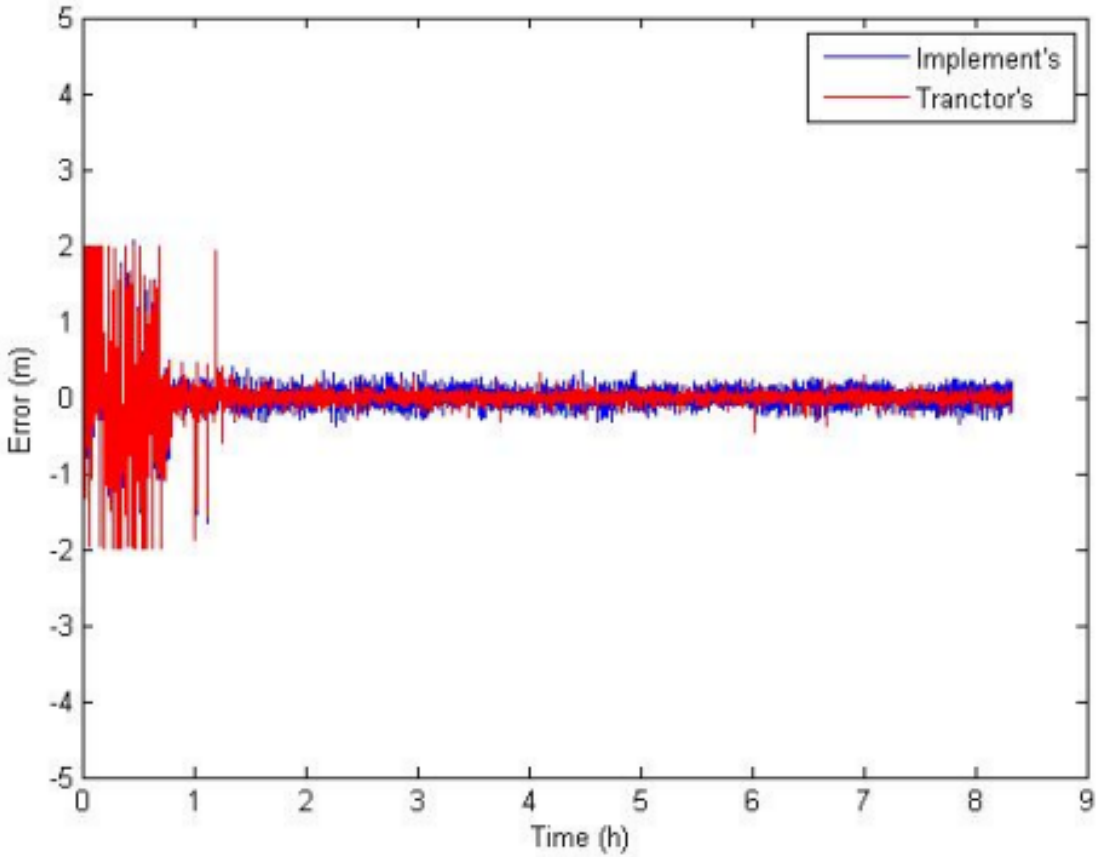
Results

Error



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Conclusions

- Reinforcement Learning is a interesting building block for learning controllers:
  - Nice exploration strategies
  - Good performance in non-stationary environments
  - Good results in colaborative settings

- Deep Reinforcement Learning (Nature DQN) has been proven to beat humans while playing Atari Games