Imposing a Weight Norm Constraint for NeuroAdaptive Control

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Outline

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Background and Contributions

Introduction to NeuroAdaptive Control

NeuroAdaptive Control

- Neuroadaptive control is a control strategy that combines neural networks (NNs) with adaptive control techniques.

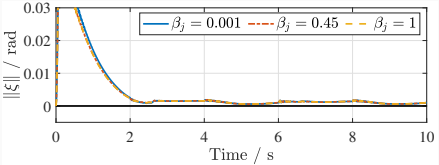

Figure: Architecture of the constrained optimization-based neuro-adaptive controller (CONAC).

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NeuroAdaptive Control

- Neuroadaptive control is a control strategy that combines neural networks (NNs) with adaptive control techniques.
- It is used to handle uncertainties and nonlinearity in dynamic systems [1].

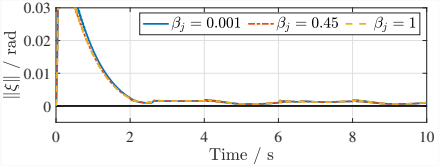

Figure: Architecture of the constrained optimization-based neuro-adaptive controller (CONAC).

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Effectiveness of NeuroAdaptive Control

Background and Contributions

Limitations of NeuroAdaptive Control

Flux theme comes with three pre-defined block style collections.

Default

Block content.

Alert

Block content.

Example

Block content.

Background and Contributions

Research Objectives

Research Objectives

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Proposed Method

Constrained Optimization Problem Formulation

Objectives:

- Minimize the tracking error by adapting the NN weights $\widehat{\boldsymbol{\theta}}$.
- Guarantee the stability of the system and the NN weights $\widehat{\boldsymbol{\theta}}$.

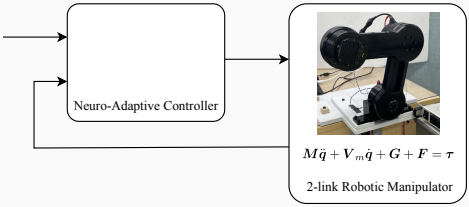

Figure: Architecture of the constrained optimization-based neuro-adaptive controller (CONAC).

Notations: M: Inertia matrix, C: Coriolis matrix, G: Gravity vector, $\boldsymbol{\tau}$: Control input, q: Joint position, $\widehat{\boldsymbol{\theta}}$: Estimated NN weights.

Proposed Method

Adaptation Law Derivation

Proposed Method

Stability Analysis

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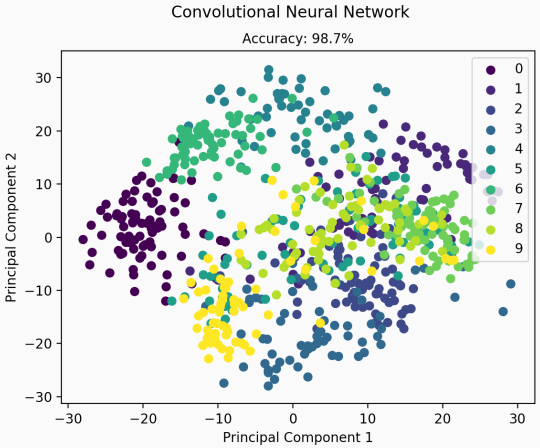
Numerical Validation

Simulation Setup

Numerical Validation

Simulation Results



Binary Softmax classifier

$$\sigma(\sum_i w_i x_i + b)$$

Loss function

$$L_i = -\log(\frac{e^{f_{y_i}}}{\sum_j e^{f_j}})$$

cross entropy

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Table: Largest cities in the world (source: Wikipedia)

City	Population
Mexico City	20,116,842
Shanghai	19,210,000
Peking	15,796,450
Istanbul	14,160,467

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Weight Norm Constraint

Items

- Cats
- Dogs
- Birds

Enumerations

1. First
2. Second
3. Last

Descriptions

Apples	Yes
Oranges	No
Grappes	No

Note the following demo slides are directly taken from metropolis theme. Copyright 2014 Matthias Vogelgesang.
Give a look at https://github.com/matze/mtheme/tree/master/demo

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Conclusion

Conclusion and Future Work

Conclusion

Thank you for your attention!

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References I

[1] E. Arefinia, H. A. Talebi, and A. Doustmohammadi, "A robust adaptive model reference impedance control of a robotic manipulator with actuator saturation," IEEE Transactions on Systems, Man, and Cybernetics: Systems, vol. 50, no. 2, pp. 409–420, 2020.

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