

INTERNATIONAL RELATIONS



INTERNSHIP SUBJECT

2880 - Neural controllers for optimal control: application to bioreactors

The Greenowl team aims to apply control theory for investigating the resilience of microbial ecosystems under the pressures of climate change, with a particular focus on optimizing the biological and environmental processes. Microorganisms play a crucial role in ecosystem function, and understanding how to control and optimize their dynamics is essential for different applications.

Considering non-linear optimal control problems inspired by the dynamics of microorganisms in bioreactors, we study the use of neural networks as parametrized controls. The connection between the optimal control solutions, as given by the Pontryagin Maximum Principle (PMP), can benefit from the power of neural networks.

Neural networks as a way to approximate optimal control solutions have attracted the attention of the control community, but few works discuss the comparison between the solutions offered by neural networks and the actual optimal solutions.

The neural network is trained using the cost function of the optimal control problem, and possibly integrates the necessary conditions derived from the PMP. The objective of the work is to study the optimal solutions learned from a trained neural controller. What are the best structures to efficiently approximate the optimal control ? Can a neural network learn the optimal control for any initial condition of the system ? What are the gains in term of computing time ? Can the structure be used for closed loop control ?


Required Skills

Applied Mathematics: Ordinary differential equations, machine learning, Optimal control, Neural Networks.

Programming: Python or Julia.

General Information

- **Research Theme :** Modeling and Control for Life Sciences
- **Locality :** Sophia Antipolis
- **Level :** Master
- **Period :** 1st February 2026 -> 30th April 2026 (3 months)

 *These are approximative dates. Please contact the training supervisor to know the precise period.*

- **Deadline to apply :** 1st July 2025 (midnight)

Contacts

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More information

- **Inria Team :** GREENOWL
- **Inria Center :** Centre Inria d'Université Côte d'Azur