# Model Predictive Control Foot Placement

## Context:

The EPFL Xplore Research Pole has the objective of building a legged robot. The robot is designed to autonomously navigate through challenging terrain using its on-board sensors. To achieve this, the project aims to enhance the robot's foot control.

## Project description:

The objective of this project is to implement a Model Predictive Control aimed at enhancing the foot placement of the Robot locomotion system. The algorithm is based on the research paper titled: "***Perceptive Locomotion through Nonlinear Model Predictive Control***" from *Nikita Rudin and al*.
The input to the Model comprises sensor data from a stereo camera and a potential lidar. The model will be trained to accurately learn a precise representation of the environment.
Furthermore, the student will be an integral part of the Xplore Legged Robot Team, actively participating in its weekly meetings and working sessions. This collaboration will facilitate close interaction with other team members, and the student is expected to share their findings and progress with the team regularly.

## Tasks:

The project involves a series of tasks, outlined below (note that this list is not exhaustive):

- **Literature Review and Familiarization** – Thoroughly understand the paper and conduct a literature review focused on Model Predictive Control for leg Control.
- **Model Testing** – Conduct comprehensive testing of the implemented Model on Simulation with Isaac Sim. Configure pertinent testing scenarios to evaluate the model's performance in simulating various robotic scenarios.
- **Algorithm Effectiveness Validation –** Demonstrate the efficacy of the algorithm.

## Requirements:

- Prior experience with Control in Robotics.
- Familiarity with ROS is also a plus, but not required.
- Basic knowledge of programming (C++ or Python) is however required

## Source:


- R. Grandia, F. Jenelten, S. Yang, F. Farshidian, M. Hutter. (2022, August) Perceptive Locomotion through Nonlinear Model Predictive Control. arXiv:2208.08373
- **Another potential paper**: Rathod, N., Bratta, A., Focchi, M., Zanon, M., Villarreal, O., Semini, C., & Bemporad, A. (2021). Model predictive control with environment adaptation for legged locomotion. *IEEE Access*, *9*, 145710-145727.


## Contact:


| Name<br>Position<br>Pole | Matthias Schuller<br>Team Leader Legged Robot<br>EPFL Xplore Research (XRE) | Emile CHARLES<br>Project Manager Research<br>EPFL Xplore Research (XRE) |
|---|---|---|
| Email address | matthias.schuller@epfl.ch | emile.charles@epfl-xplore.ch |
| Mailing list | legged.robot@epfl-xplore.ch | |