TECHNISCHE UNIVERSITÄT MÜNCHEN
LEHRSTUHL FÜR STEUERUNGS- UND REGELUNGSTECHNIK
PRIV.-DOZ. DR.-ING. HABIL. DIRK WOLLHERR

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I N G E N I E U R P R A X I S

Development of a Watering System and Actuator Control for a Plant Station

Problem description:

With the ever-increasing global population, and the effects of climate change, the question of how cities can be used for local cultivation, urban gardening, and vertical farms is becoming increasingly important. Vertical farms in particular are a promising approach to address these issues but they bring several problems, the most important of which is energy consumption [1]. For this reason, optimal control of crops to minimize energy costs and maximize yield in a closed environment is beneficial.
The goal of this project is to expand a scaled-down version of a vertical farm in order to create a framework for a "talking plant." This includes not only the evaluation of sensors but also the design of controllers for existing actuators and for a watering system that needs to be implemented in hardware and software. The plant used is space wheat, which is very robust and suitable for indoor cultivation. Parameters to be considered include temperature, light intensity, soil moisture and CO_2.
The data and control strategy will be based on a nonlinear discrete-time state-space model of a plant [2] and will be used to identify the parameters for this specific set-up and that particular plant.

Requirements:

- Hands-on experience with Raspberry Pis and sensors/actuators or strong interest in gaining some hands-on experience in this field
- Interest in mathematical methods and control engineering

Work schedule:

- 1st - 2nd week: Get familiar with the SIMPLE model and the existing plant station
- 3rd - 4th week: Design the watering system
- 5th - 6th week: Research and design controllers for the actuators
- 7th week: Validate the performance of the overall system
- 8th - 9th week: Write the report and prepare the presentation

[1] S. Asseng, J. R. Guarin, M. Raman, O. Monje, G. Kiss, D. D. Despommier, F. M. Meggers, and P. P. Gauthier, "Wheat yield potential in controlled-environment vertical farms," *Proceedings of the National Academy of Sciences*, vol. 117, no. 32, pp. 19131–19135, 2020.
[2] C. Zhao, B. Liu, L. Xiao, G. Hoogenboom, K. J. Boote, B. T. Kassie, W. Pavan, V. Shelia, K. S. Kim, I. M. Hernandez-Ochoa, *et al.*, "A SIMPLE crop model," *European Journal of Agronomy*, vol. 104, pp. 97–106, 2019.

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