Requirements for Adaptive Control Project

Prof. Yang Wang

April 6, 2022

The course project of EE264 is about the reading a very recent paper on Adaptive Control, understand the control problem with adaptive methodology and implementation and evaluation of the proposed algorithm. The results of the project contain a public presentation, and a project report. Each one of you need to do the project independently. You can propose a journal article of your own choice, or you can pick one of the recommended papers given in the appendix.

If you have determined your project topic, please notify TA via email before **April 22nd**. Your presentation will be arranged on 15th or 16th week and you should submit your report (along with the code) before **18th week**.

1 Main Requirements on the Project

The goal of this project is to study an state-of-art adaptive control technique, understand the significance of the problem addressed, the novelty of the proposed solution and how it achieves the control objective, both in theory and in simulation. The main tasks of the project are as follows:

1. (30%) Clarify the control problem addressed by the paper and write it in mathematical description.
   Specifically, explain what problem it solves and *define your preliminary control goal. clarify the assumptions* on the nominal models (for instance unknown parameter, desired performance, signal property). Then you might emphasis why it is a research topic of interest.

2. (30%) *Demonstrate the control scheme* Summarize the algorithm presented in the article (given in a pseudo code form). Briefly go through the theoretical analysis for the stability or convergence analysis, identify the critical lemma or theorem.

3. (40%) *Reproduce the simulation results presented in the paper and investigate its performance* and robustness via some test problems, such as test them under measure noise. And you're encouraged to: i) find a test where your controller fails to stabilize the system due to some reasons. ii) Discuss how the tuning parameters influence the performance of the overall system. iii) compare with more advanced solution found in the reference.

2 Presentation

Everyone will get a 25-30mins time slot to present project. The presentation should consist of max 30 slides, preferably in pdf format. In order to get your points, you will need to:

1. prepare clean and efficient English slides containing: 1) your project title and the name of all authors 2) introducing/explaining the problem that you are solving 3) the designed scheme 4) numerical results 5) summarizing and assessing your results.

2. present your work freely in Chinese / English and by using your own words

3. answer questions by the professor, or other people from the audience.

3 Report

Write a report of at least 6 pages (preferably in LaTeX) containing the following sections:

1. *Title and Authors* (find a good title + name of the author)
2. *Introduction* (describe the problem that you want to solve and cite relevant literature)
3. *Problem Formulation* (introduce a suitable mathematical notation do define the problem that you are trying to solve)
4. *Adaptive Control Method* (explain how the proposed technique designed and show its efficiency theoretically)
5. *Numerical Results* (plot/visualize and explain your numerical results)
6. *Conclusion* (analyze and summarize the highlights of your results)

4 Reference

This reference collects a few suggestions for possible articles for the project.

1. K. P. Tee, S. S. Ge, and F. E. H. Tay, "Adaptive neural network control for helicopters in vertical flight," IEEE Trans. Control Syst. Technol., vol. 16, no. 4, pp. 753–762, 2008.
2. D. N. Gerasimov, R. Ortega, and V. O. Nikiforov, "Relaxing the high-frequency gain sign assumption in direct model reference adaptive control," Eur. J. Control, vol. 43, pp. 12–19, 2018.
3. M. Mansouri, M. Mojiri, M. A. Ghadiri-Modarres, and M. Karimi-Ghartemani, "Estimation of Electromechanical Oscillations from Phasor Measurements Using Second-Order Generalized Integrator," IEEE Trans. Instrum. Meas., vol. 64, no. 4, pp. 943–950, 2015.
4. P. Tomei and C. M. Verrelli, "Adaptive Learning Control for Non-Minimum Phase Linear Systems," Eur. Control Conf., no. 1, pp. 2066–2071, 2014.
5. H. I. Basturk and M. Krstic, "Adaptive wave cancelation by acceleration feedback for ramp-connected air cushion-actuated surface effect ships," Automatica, vol. 49, no. 9, pp. 2591–2602, Sep. 2013.
6. X. Chen and M. Tomizuka, "A minimum parameter adaptive approach for rejecting multiple narrow-band disturbances with application to hard disk drives," IEEE Trans. Control Syst. Technol., vol. 20, no. 2, pp. 408–415, Mar. 2012.
7. H. Liu, T. Ma, F. L. Lewis, and Y. Wan, "Robust Formation Trajectory Tracking Control for Multiple Quadrotors with Communication Delays," IEEE Trans. Control Syst. Technol., vol. 28, no. 6, pp. 2633–2640, Nov. 2020.

Each topic can have no more than *Two* students to choose. Hence, please tell TA your choice as soon as you make up your mind. We will obey first come first served principle.