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| Title : | Nonlinear robust tracking control of a quadrotor | |
| Institution name and address : | Labo-Imvia, 12 rue de la Fonderie, Le Creusot, , France | |
| Training place : | Labo-Imvia | |
| Dates of internship :<br>MSCV2 Dates (01 Feb. to 30 June 2023) | From 01/02/2023 | To 30/06/2023 |
| Supervisors (names and emails): | ABADI Amine<br>Amine.abadi@u-bourgogone.fr | |
| Stipend: | 550 € /month | |
| Other benefits (free accomodation, ...) : | subsidized lunches | |
| Deadline for application:<br>(Note that paperwork may take up to 10 weeks) | Nov. 30th | |

**Brief Description of the project**

In recent years, special attention has been paid to UAV quadrotors due to their structure, economic cost and ability to perform stationary flights. The field of the application of these flying machines has become very varied, such as monitoring motorway traffic, evaluating sensitive areas, preventing fire, collecting weather data or inspecting structures. Despite this advantage, the tracking problem of the quadrotor is still a big challenge because it has a strongly non-linear and underactuated system with multi-variables for control and states.

In the last decade, many nonlinear controls has been extensively used for tracking quadrotor trajectories such as flatness control [1], feedback linearization [2], backstepping control [3], …. etc.

Although the tracking controller gives a strongly satisfactory performance in a perfect scenario, it suffers from some inconveniences when put into practice. Usually, the nonlinear control method permits an asymptotic tracking of the desired trajectory just when the uncertain parameters and disturbances are considered negligible in the model and when the feedback states are accurately measured. Really, these conditions are difficult to satisfy. Consequently, the tracking control may not give good performances. Therefore, a robust nonlinear tracking control that compensates all disturbance effects is needed to improve the quadrotor performance.

**The main aim of this master thesis is to develop a robust nonlinear tracking controller of a quadrotor subject to uncertain parameters and external disturbances. The approach should be confirmed both by simulation and in a laboratory experiment.**

**The work plan for this master is defined as follows :**

- **Bibliographic survey of nonlinear control.**
- **Bibliographic survey of robust control.**
- **Developing a robust nonlinear tracking control of quadrotor and applying it.**

**[REF]**

[1] Nguyen, N. T., Prodan, I., Stoican, F., & Lefevre, L. (2017). Reliable nonlinear control for quadcopter trajectory tracking through differential flatness. IFAC-PapersOnLine, 50(1), 6971-6976..

[2] Bonna, R., & Camino, J. F. (2015, February). Trajectory tracking control of a quadrotor using feedback linearization. In International Symposium on Dynamic Problems of Mechanics. Sao Paulo, Brazil: University of Campinas.

[3] Madani, T., & Benallegue, A. (2006, October). Backstepping control for a quadrotor helicopter. In 2006 IEEE/RSJ International Conference on Intelligent Robots and Systems (pp. 3255-3260). IEEE.

**Software/Hardware needs and skills**

Matlab/Simulink, Python, C++, Ros (Robotic Operating System).