SOUTENANCE DE THÈSE

M^me^ Belem Isabel Rojas-Ramirez

Soutiendra sa thèse de **doctorat** sur le sujet **:**

Modeling and control of aerial vehicles using teleoperation with input delay

Unité de recherche : ***Heudiasyc – UMR CNRS 7253***

Le vendredi 4 décembre 2020 à 16h, salle GI42, Laboratoire Heudiasyc, à l'université de technologie de Compiègne et en suivant le lien suivant :

https://utc-fr.zoom.us/j/88133966771?pwd=UDhNc1g5MWgxSFFSWHBBM2R1VVBNUT09

Devant le jury composé de :

Mme Véronique Cherfaoui, professeure, membre examinateur
Université de technologie de Compiègne, laboratoire Heudiasyc, Compiègne

Mme Reine Talj Kfoury, chargée de recherche, membre examinateur
Université de technologie de Compiègne, laboratoire Heudiasyc, Compiègne

M. Claude Pegard, professeur, membre examinateur,
Université de Picardie Jules Verne, Robotique, Amiens

M. Juan Antonio Escareño Castro, membre examinateur
Institut de recherche XLIM, mécatronique, Limoges

M. Pedro José Garcia Gil, professeur, membre rapporteur
Universidad Politécnica, automatique, Valencia, Espagne

M. Sergio Rosario Salazar Cruz, chercheur, membre rapporteur
CINVESTAV, automatique, Mexico, Mexique

M. Rogelio Lozano-Leal, chercheur, directeur de thèse
Université de technologie de Compiègne, laboratoire Heudiasyc, Compiègne

M. Pedro Castillo-Garcia, chargé de recherche, directeur de thèse
Université de technologie de Compiègne, laboratoire Heudiasyc, Compiègne

Modeling and control of aerial vehicles using teleoperation with input delay

Unmanned Aerial Vehicles (UAVs) are receiving increasing interest from industry and academia due to their wide application in search and rescue, infrastructure inspection, surveillance, among others. This thesis focuses on research in the area of teleoperation systems for quadrotor vehicles.Throughout this thesis, a teleoperation system for a quadrotor vehicle was developed. In this system, the user interface is based on a virtual telepresence approach. Control algorithms were developed and implemented within the master and slave systems.

The first part of this thesis consists of developing mathematical models of the dynamics of a quadrotor aircraft. Most works currently found in the literature for quadrotors are based on classical approaches such as Euler angles. These representations can lead to problems such as discontinuities, singularities, gimbal-locks, and highly non-linear equations. An alternative to these classical representations is unit quaternions. These have the advantages of the lack of singularities and gimbal lock effects.

The second part of this work was dedicated to the development of a quadrotor teleoperation system. This system consists of a virtual user interface in a local environment and a quadrotor in a remote environment. UDP communication was used to communicate in both environments. The user manipulates a virtual drone in the local environment, and a real drone follows the position and orientation references in a remote environment. The user receives virtual feedback on the states of the real vehicle in the virtual environment. Results of the implementation of the proposed teleoperation system in real-time are presented.

The last part of this thesis addresses the delay problem in the teleoperation system. Delays due to system latency and the distance between environments were modeled as a delayed control input. Then, a predictor-based controller was developed in order to maintain the stability of a drone's flight. This approach was applied to the classical Euler-Lagrange model and to the quaternion-based model in order to analyze performance. Simulations of both models with delayed inputs are presented.