

Réunion CT CPNL

Vendredi 3 juin 2022

CNAM Paris
10h00 - 16h30

LIEN POUR LA VERSION A JOUR DE CE PROGRAMME :

<https://docs.google.com/document/d/1yOlx5t6RPYqel6zhQ0G97YPBNRY4YNLcleTnbp8uHk/edit?usp=sharing>

Lieu : SALLE 11A-3.33 (accès 11A, 3ème étage) au CNAM
292 rue Saint-Martin, Paris 75003 ([plan d'accès](#))

Session Zoom : Join Zoom Meeting <https://grenoble-inp.zoom.us/j/6496005771>
Meeting ID: 649 600 5771 Passcode: 637606

Programme de la journée :

- 10h-10h15 : accueil
- 10h15-10h30 : introduction à la journée (Ionela Prodan & Sylvain Bertrand)
- 10h30-11h15: Evgeny Shulga (PSA)
Définition d'une approche de contrôle optimal et robuste adapté à des systèmes non linéaires - Application dans le cadre des systèmes d'air de chaînes de traction
- 11h15-11h45 : Antonello Venturino (ONERA - CentraleSupélec-L2S)
Distributed Moving Horizon Localization for Multi-Vehicle System over a Sensor Network with Sporadic Measurements
- 11h45-13h15 : Déjeuner
- 13h15 - 14h15 : Hoai Nam Nguyen (Telecom-SudParis)
Optimal Control of Wave Energy Converters: From Adaptive PI Control to Model Predictive Control
- 14h15- 15h00 : Ahmed Chemori (LIRMM)
An Assistive MPC-Based Control Framework for a Robotic Knee Rehabilitation Exoskeleton
- 15h00-15h45 : Sylvain Bertrand (ONERA)
Guidage d'un drone à voilure fixe par commande prédictive et réseaux de neurones pour la prise en compte des risques induits au sol
- 15h45 - 16h30 : Huu Thinh Do (LCIS - Grenoble INP)
Tracking control for a class of flat system under disturbances. Insights on flatness-based MPC for a multicopter

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Résumés

Auteurs : E. Shulga, Patrick Lanusse, Tudor-Bogdan Airimitoiaie, Stéphane Maurel

Titre: *Définition d'une approche de contrôle optimal et robuste adapté à des systèmes non linéaires - Application dans le cadre des systèmes d'air de chaînes de traction*

Résumé : TBD

Auteurs : Antonello Venturino, Cristina Stoica Maniu, Sylvain Bertrand, Teodoro Alamo, Eduardo Camacho

Titre: *Distributed Moving Horizon Localization for Multi-Vehicle System over a Sensor Network with Sporadic Measurements*

Résumé : This work presents a Distributed Moving Horizon Estimation (DMHE) approach implemented on a static sensor camera network. Its purpose is to localize a Multi-Vehicle System from sporadic measurements. In this application, the measurements are indeed available at time instants a priori unknown. The proposed DMHE technique is conceived to face this issue by utilizing time-dependent parameters in the local optimization problem. Moreover, this technique is well-suited to better estimate the system state due to its capability to efficiently exploit environment information via constraints. In fact, when dealing with sporadic measurements and biased sensor data, the use of output constraints can contribute to enhance the estimation accuracy locally. In order to confirm its effectiveness, the proposed method is validated on an experimental setup within an indoor arena equipped with a motion capture system. The considered experimental scenario is for the localization of a multi-vehicle system composed of five ground mobile robots. The proposed DMHE technique is performed using sporadic position measurements provided by low-cost cameras. The estimated localization is comparable to the actual position given by the motion capture system.

Auteur : Hoai Nam Nguyen

Titre : *Optimal Control of Wave Energy Converters: From Adaptive PI Control to Model Predictive Control*

Résumé: Advanced control strategies play a crucial role in increasing the energy extraction capacity of Wave Energy Converters (WECs). So far, the most promising control schemes have predominantly been studied in simulation, based on the idealized assumption of the conversion efficiency of the Power-Take-Off (PTO) system. This is not the case in practical WEC implementations. The power that is withdrawn from the grid and used to accelerate the float is always more expensive than the power that is produced by the float motion and delivered to the grid via the PTO system.

In this presentation, two approaches that can take into account the PTO efficiency are presented. The first one is based on an adaptive PI control with an online estimation of the dominant wave frequency, while model predictive control is employed for the second one. The proposed control methods are validated and compared through experiments for irregular sea states. Some classical results from the literature are also recalled and compared.

The MPC method presented in this presentation won the international WECCOMP – WEC control competition - both in the simulation and experiment phases.

Auteurs : Ines Jammeli, Ahmed Chemori, Huiseok Moon, Salwa Elloumi, and Samer Mohammed

Titre : *An Assistive MPC-Based Control Framework for a Robotic Knee Rehabilitation Exoskeleton*

Résumé: This work focuses on the control of an actuated knee joint orthosis. The proposed solution is a novel model predictive control framework dedicated to assistive and rehabilitation purposes. This framework includes 1) an exact input-to-state feedback linearization, 2) a model predictive controller (MPC or EMPC), considering input/output constraints, 3) a least-squares dynamic parameters identification, 4) a nonlinear disturbance

observer for the estimation of the wearer's torque, 5) a Lyapunov-based stability analysis of the resulting closed-loop system, and 6) a reference trajectory generator. The proposed framework has been validated through real-time experiments performed on three healthy subjects wearing the knee joint orthosis. Various experimental scenarios have been considered, including assistive and resistive rehabilitation tasks in a sitting position and walking with normal/abnormal gait patterns. The obtained experimental results show the efficiency of the proposed predictive controllers with respect to a conventional PID controller in terms of tracking performance, required torque, and wearer comfort.

Auteurs : Paul Bérard, Sylvain Bertrand, Baptiste Levasseur

Titre : *Guidage d'un drone à voilure fixe par commande prédictive et réseaux de neurones pour la prise en compte des risques induits au sol*

Résumé : L'utilisation d'un drone à voilure fixe (type avion) pour l'inspection de grandes infrastructures linéaires pose le problème de la sécurité vis-à-vis des tiers survolés. En particulier, le risque pour les personnes au sol en cas de chute du drone suite à une panne ou une perte de contrôle doit être évalué et maîtrisé. Cette évaluation peut se faire en préparation de la mission, par une analyse safety du véhicule et une évaluation des risques liés à la mission.

Le travail présenté concerne le développement d'un algorithme de guidage permettant d'assurer la maîtrise de ce risque en cours de mission, dans les cas où la trajectoire du drone viendrait à différer de celle planifiée en préparation de mission (aérologie, changement de trajectoire dû à un incident, etc.). Une loi de commande prédictive est utilisée afin de calculer les consignes de guidage du drone pour le suivi de trajectoire tout en tenant compte du risque engendré au sol. La prédiction de ce risque est calculée par des réseaux de neurones pour assurer un bon compromis représentativité / temps de calcul et pouvoir envisager une implémentabilité de l'approche proposée.

Auteurs : Huu Thinh Do, Ionela Prodan

Titre : *Tracking control for a class of flat system under disturbances. Insights on flatness-based MPC for a multicopter*

Résumé : This paper considers a class of systems admitting several flat representations and proposes a trajectory tracking controller design which accounts for disturbance rejection. Set invariance is used for characterizing the tracking and estimation error dynamics. Furthermore, some insights on the benefits of flatness in MPC for a multicopter are highlighted via simulations and comparisons.