Thomas CHAFFRE
doctorant au
Lab-STICC UMR CNRS 6285 and CROSSING IRL CNRS 2010

soutiendra sa thèse intitulée

« Reinforcement Learning and Sim-to-Real Transfer for Adaptive Control of AUV»

Mardi 13 décembre 2022 à 9 h 00 (French time)

Tuesday 13th of Decembre 2022 at 18 :30 (Adelaide time)

Flinders University, Tonsley Campus, main theatre
And on video (MS TEAMS link)

Composition du jury / Panel :

Rapporteurs / Reviewers:
- M. FILLIAT David, Professeur, ENSTA Paris
- M. BANDYOPADHYAY Tirthankar, Senior Researcher, CSIRO, Brisbane

Examinateurs / Examiners :
- M. BUCHE Cédric, Professeur des Universités, IRL CROSSING / ENIB, Adelaide
- M. CREUZE Vincent, Professeur des Universités, Université de Montpellier
- Mme FANTONI Isabelle, Directrice de Recherche, LS2N, Nantes
- M. SAMMUT Karl, Professeur, Flinders University, Adelaide, *co-directeur de thèse*
- M. CLEMENT Benoît, Professeur, ENSTA Bretagne, IRL CROSSING, Adelaide, *co-directeur de thèse*

Invités / invited:
-M. LE CHENADEC Gilles, Enseignant Chercheur, ENSTA Bretagne, Lab-STICC, Brest
-M. SANTOS Paulo, Associate Professor, Flinders University, Adelaide
-Mme CHAUVEAU Estelle, Docteur, Ingénieur de recherche, Naval Group, Ollioules

Résumé/Abstract: Sea disturbances vary unrelentingly making it necessary for autonomous underwater vehicles (AUVs) to continuously adapt their control systems to accommodate such changes. The complexity and dynamics of underwater processes are, however, difficult to be described analytically. While adaptive control systems could potentially be used to handle such changes, the field of adaptive control faces three main challenges: the dependency on the availability of a priori knowledge of the underlying processes; the need for well defined governing equations; and the implementation of these equations on physical systems. In the context of the underwater environment, these descriptions are not readily available. The objective of this thesis was to formalize a novel learning-based adaptive control using deep reinforcement learning and adaptive pole placement control to compensate for the known part of the process and to extract information on the unknown part directly from sensors feedback so as to compensate for the unobservable current disturbance. In addition, we proposed a novel experience replay mechanism that considers the characteristic of the biological replay mechanism. The methods were validated in simulation and in real life, demonstrating the benefits of combining both theories against using them separately. Mots clés: Adaptive Control, Deep Reinforcement Learning, Robotics, Underwater Vehicles

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