

SECO is the control engineering unit of the Faculty of Engineering at the University of Mons. It was established in 1976 and comprises around fifteen members of ten different nationalities. Affiliated with the Department of Electrical Engineering, SECO has contributed to a large number of scientific publications.

SECO's expertise is based on systems theory and control engineering techniques in the broadest sense (mathematical modelling of dynamic systems, parametric identification, state estimation, optimal control and process optimisation). These theoretical foundations are now enriched by contributions from machine learning and artificial intelligence, notably through the development of Physics-Informed Neural Networks (PINNs) and hybrid models combining physical knowledge and data.



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For some thirty years, these tools have been applied primarily to bioprocesses, in sectors as varied as biopharmaceuticals, agri-food, bioenergy and the environment. Research areas have since expanded to include smart farming, battery monitoring and condition assessment, local energy communities, mobile robotics and drone systems (with the installation of a flight cage dedicated to UAVs (unmanned aerial vehicles) and addressing the challenges of robust control, optimal trajectory planning and fleet coordination).



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Systems and Models

More fundamentally, SECO's 'systems and models' approach enables a better understanding of mechanisms in healthcare and biopharmaceuticals that are still only partially understood. The group's research thus helps to address societal challenges such as process quality and safety, reducing the energy and environmental footprint, food sovereignty and public health. This expertise translates into a comprehensive range of advanced engineering services for businesses, organised around four main areas: process modelling and numerical simulation; estimation and software sensors; advanced control and optimisation; and digital twins.

SECO has participated in numerous competitive projects, including the PAI DYSCO network of excellence funded by Belspo, the European iConcensus project under the IMI2 (Innovative Medicines Initiative), as well as ERDF projects such as Win4Excellence, BioWin, Win2Wal and Beware, which have enabled the forging of lasting partnerships with Walloon industry and international academic institutions.

Digital twins

Current research topics include the development of digital twins for industrial processes, state estimation using Moving Horizon Estimation coupled with PINNs as computational surrogates, Extremum Seeking control for the real-time optimisation of bioprocesses, and the coordination of multi-drone systems with robustness guarantees.

Building on this work, SECO anticipates several major research challenges. The first concerns the reliability and interpretability of hybrid models – a central issue for applications in healthcare or food safety. A second challenge is to develop robust software sensors capable of operating in real time in constrained environments with performance guarantees.

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Process sustainability

In the context of the energy transition and process sustainability, the aim is also to simultaneously optimise productivity, energy consumption and the environmental footprint within a multi-objective framework and under conditions of uncertainty. Finally, the rise of cyber-physical systems and autonomous robots – including swarm-operating drones – raises new questions regarding distributed observability, decentralised control and operational safety in dynamic and partially unknown environments.

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Systems, Estimation, Control and Optimisation Unit (SECO)

UMONS

Bâtiment Dolez

31, Boulevard Dolez

B-7000 Mons

Tel.: +32(0)65 374138

Email : alain.vandewouwer@umons.ac.be

<https://web.umons.ac.be/seco/>