Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2023-24)

Course title	Optimisation via Extremum Seeking
Scientific Discipline Sector	ING-INF/04
Hours of instruction	10 hours
CFU	1 CFU
Semester, period	June-July 2024
Goal	This course aims at providing PhD students with the fundamentals of an optimisation technique called Extremum Seeking (ES). In the framework of "optimisation without knowledge of the gradient" and under mild assumptions on some of the cost function properties, the ES algorithms steer the optimisation variable close to the optimiser while guaranteeing semi-global and practical stability properties. Classic approaches are reviewed, and recent research results are presented. Each lesson consists of lectures, numerical examples, simulation and analysis of case studies.
Syllabus	Unconstraint Non-Convex Optimisation Problems, High-Pass Filters, Lyapunov Stability, Averaging, Comparison Functions, Fourier Series.
Bibliography	Recommended books: Ariyur, Kartik B., and Miroslav Krstic. Real-time optimization by extremum-seeking control. John Wiley & Sons, 2003. Sanders, Jan A., Ferdinand Verhulst, and James Murdock. Averaging methods in nonlinear dynamical systems. Vol. 59. New York: Springer, 2007. Isidori, Alberto. Nonlinear control systems II. Springer London, 2013. Recommended Papers: Teel, Andrew R., Luc Moreau, and Dragan Nesic. "A unified framework for input-to-state stability in systems with two time scales." IEEE Transactions on Automatic Control 48.9 (2003): 1526-1544. Lecture notes from the lecturer.
Examination method	End-course examination based on a project work.