



Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2022-23)

Course title	Duality-based decentralized and distributed optimization
Scientific Discipline Sector	ING-INF/04
Hours of instruction	10 hours
CFU	1 CFU
Semester, period	June-July 2023
Goal	<p>This course aims at providing PhD students with modeling and methodological tools for formulating and solving large-scale optimization problems using the duality theory. During the course several optimization problems will be formalized, particularly referred to relevant issues within management and industrial engineering. Problem definition and resolution will be also implemented in simulation and engineering software (Matlab). The final goal is to provide PhD students with the necessary background for starting research in the field of duality-based decentralized and distributed optimization techniques to be applied to large-scale systems.</p> <p>Each lesson consists in lectures, numerical examples, simulation and analysis of case studies.</p>
Syllabus	<p>Systems schemes and architectures: centralized and non-centralized approach. Preliminaries on unconstrained and set constrained optimization and basics on convex optimization.</p> <p>Duality (Lagrange multipliers theory) and duality based algorithms: waterfilling, dual ascent method (DAM), Augmented Lagrangian Method (ALM), Alternating Direction Method of Multipliers (ADMM).</p> <p>Decentralized optimization problem set up and duality-based methods: DA, ALM, and ADMM for separable convex programming.</p> <p>Distributed optimization problem set up and duality-based methods: DA and ADMM for separable convex programming, distributed waterfilling for coupled convex programming. Motivating examples and case studies.</p>
Bibliography	<p>Recommended books:</p> <p>Bertsekas, D. P., & Tsitsiklis, J. N. (1989). <i>Parallel and distributed computation: numerical methods</i> (Vol. 23). Englewood Cliffs, NJ: Prentice Hall</p> <p>Boyd S. & Vandenberghe L., <i>Convex Optimization</i>, Cambridge University Press, UK, 2004.</p> <p>Slides and supporting material from lecturer.</p>
Examination method	End-course examination based on a project work.