Convex Optimization and Game Theory (online)

Dates and time

17-05; 31-05; 07-06; 14-06 2021
from 13.45-16.00

Course location

Online course

ECTS

3 ECTS if the homework is completed successfully.
For online courses it is not possible to get credits for auditing

Lecturers

Dr. ing. S. Grammatico, Delft University of Technology
Dr. P. Mohajerin Esfahani, Delft University of Technology

Objective

The aim of the course is to introduce the mathematical tools for analyzing and designing (distributed) algorithms for solving (multi-agent) convex optimization problems and game equilibrium problems. The selected mathematical tools are within linear algebra, system theory, fixed point and monotone operator theory.

Contents

Lecture 1: Convex analysis
Convex sets, (strictly, strongly) convex functions, indicator functions. Set-valued mappings, normal cone operator and tangent cone operator. Subdifferential mapping. Projection operator, proximal operator.
Reference material: textbooks [3, 1].

Lecture 2: Monotone operator theory
Elements of operator theory: fixed points, zeros, contraction, averaged and nonexpansive mappings. Fixed point algorithms: Picard-Banach iteration, Krasnoselskij-Mann iteration. Zero-finding algorithms: monotone operator splitting, forward-backward algorithm.
Reference material: textbook [1], survey [4].

Lecture 3: Convex optimization
Lagrangian duality, KKT system, KKT inclusion. First-order, second-order and accelerated, algorithms. Distributed optimization algorithms. Alternating direction method of multipliers (ADMM).
Reference material: textbooks [2], [3, 1], survey [4].

Lecture 4: Monotone game theory
Nash equilibrium problem, best response mapping, variational inequality. Generalized Nash equilibrium problem, preconditioned forward-backward equilibrium seeking, forward-reflected-

backward equilibrium seeking.
Reference material: textbooks [3, 1].

Course materials

[1] H. H. Bauschke and P. L. Combettes. Convex analysis and monotone operator theory in Hilbert spaces. Springer, 2010.
[2] S. Boyd and L. Vandenberghe. Convex Optimization. Cambridge University Press, 2009.
[3] R.T. Rockafellar and R.J.B. Wets. Variational Analysis. Springer, 1998.
[4] E. K. Ryu and S. Boyd. A primer on monotone operator methods. Appl. Compt. Math., 15(1), 2016.

Prerequisites

The prerequisite knowledge consists of linear algebra, calculus and optimization at a graduate level.

Homework assignments

Graded take-home exam: mathematical proofs and numerical simulations.