2022 ELEDIA@ICAM PhD Summer Schools

Global Optimization Methods

Theory, Techniques, and Advanced Engineering Applications

Optimization techniques are generally classified into deterministic/local and stochastic/global methods. Although effective in terms of convergence speed, the former methods generally require a 'domain knowledge' since in the case of non-linear and multi-minima functionals the initial trial solution must lie in the so-called 'attraction basin' of the global solution to avoid the convergence solution being trapped into local minima of the functional (i.e., wrong solutions of the problem at hand). In contrast, global optimization methods are potentially able to find the global optimum of the functional whatever the initial point/s of the search.

The course will review fundamentals and main issues of optimization problems then focusing on classical/state-of-the-art and recently introduced global optimization approaches. Applicative examples including exercises covering advanced engineering applications will corroborate the theoretical concepts.

Course Topics

- Fundamentals of global optimization, "no-free-lunch" theorem for optimization;
- Deterministic optimization: Steepest Descent (SD) and Conjugate-Gradient (CG) Methods;
- Stochastic 'nature-inspired' optimization algorithms;
- "Competitive" methods: Genetic Algorithm (GA), Differential Evolution (DE);
- "Cooperative" methods: Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO).
- Application of global optimization methods to advanced engineering synthesis and design problems;
- Recent advances within the System-by-Design (SbD) framework for the computationally-efficient solution of complex engineering problems;
- Applicative examples including exercises regarding specific engineering applications of global optimization methodologies.

Lecturers

- Prof. MASSA Andrea (https://www.eledia.org/eledia-unitn/people/massa-andrea/)
- Dr. POLI Lorenzo (https://www.eledia.org/eledia-unitn/people/poli-lorenzo/)
- Prof. ROCCA Paolo (https://www.eledia.org/eledia-unitn/people/rocca-paolo/)

References

[1] D. H. Wolpert and W. G. Macready, "No free lunch theorems for optimization," IEEE Trans. Evol. Comput., vol. 1, no. 1, pp. 67-82, Apr. 1997.

[2] P. Rocca, M. Benedetti, M. Donelli, D. Franceschini, and A. Massa, "Evolutionary optimization as applied to inverse problems," Inverse Problems, vol. 25, pp. 1-41, Dec. 2009.

[3] P. Rocca, G. Oliveri, and A. Massa, "Differential evolution as applied to electromagnetics, "IEEE Antennas Propag. Mag., vol. 53, no. 1, pp. 38-49, Feb. 2011.

[4] A. Massa and M. Salucci, "On the design of complex EM devices and systems through the system-by-design paradigm - A framework for dealing with the computational complexity," IEEE Trans. Antennas Propag., in press.

Dates: June 20-24, 2022

Location

- *In presence*: Polo di Mesiano, Via Mesiano 77, 38123 Trento, Italy
- *Online*: Zoom Platform (video registrations will be available for 2 weeks after the event)

Lessons

- 32 h total (including exam – not mandatory)
- 12 h hands-on (in Matlab)

Prerequisites: Basics of Maths

ECTS: 4

Registration Fees (*)

- Free for UniTN Students
- 200 Euro - online attendance
- 400 Euro - in presence attendance

Registration is mandatory

Course Coordination

- Prof. Andrea Massa
- Prof. Paolo Rocca

Further Information

- summer-schools@eledia.org

(*) The fees include the course teaching and the slides/material

Register at: https://edu.eledia.org/courses/phd-school-2022-global-optimization

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