Optimization methods - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Optimization methods
Kod przedmiotu	11.9-WE-AutD-OptimMeth-Er
Wydział	Wydział Informatyki, Elektrotechniki i Automatyki
Kierunek	Automatyka i robotyka / Komputerowe Systemy Automatyki
Profil	ogólnoakademicki
Rodzaj studiów	Program Erasmus drugiego stopnia
Semestr rozpoczęcia	semestr zimowy 2022/2023

Informacje o przedmiocie

Semestr	1
Liczba punktów ECTS do zdobycia	5
Typ przedmiotu	obowiązkowy
Język nauczania	angielski
Sylabus opracował	• prof. dr hab. inż. Andrzej Obuchowicz

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Laboratorium	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

- to familiarize students with the basic techniques of linear and nonlinear programming
- to develop students' skills in the specification of optimization tasks in engineering design tasks and to solve them using numerical packages

Wymagania wstępne

Mathematical analysis, Linear algebra with analytical geometry, Numerical methods

Zakres tematyczny

Linear programming tasks . Classic, standard, and canonical linear programming characters. The geometric method, base solutions, and simplex algorithm. Quotient programming. Transport and allocation problems.

Nonlinear programming tasks - conditions for optimality. Convex sets and functions. Necessary and sufficient conditions for the existence of an extreme function without restrictions. Lagrange multipliers method. Extrema of functions in the presence of equality and inequality constraints. Karush-Kuhn-Tucker conditions (KKT). The regularity of restrictions. Conditions for the existence of a saddle point. Square programming.

Computational methods for solving non-linear programming tasks. Methods of searching the minimum towards Fibonacci methods, the golden ratio, Kiefer, Powell, and Davidon methods. Simple search methods: Hooke-Jeeves and Nelder-Mead methods. Continuous and discrete gradient algorithm. Newton's method. Gauss-Newton and Levenberg-Marquardt methods. Basic methods of improvement directions: Gauss-Seidel methods, fastest decrease, Fletcher-Reeves conjugate gradients, variable Davidon-Fletcher-Powell metrics. Searching for the minimum under restrictive conditions: methods of internal, external and mixed punishment, gradient projection method, sequential square programming method, methods of acceptable directions.

Basics of discrete and mixed optimization. Integer programming. Problems of shortest routes and maximum flow. Elements of dynamic programming.

Global Optimization. Stochastic optimization. Adaptive random search. Metaheuristic methods: simulated annealing algorithm, evolutionary algorithms, particle swarm optimization.

Multi-criteria optimization and adaptation in non-stationary environments. Pareto-optimality. Types of non-stationary environments, classification of adaptive problems.

Practical issues. Simplification and elimination of restrictions. Elimination of discontinuities. Scaling the task. Numeric zooming of the gradient. Use of library procedures. Review of selected libraries of optimization procedures. Discussion of the methods implemented in popular numerical and symbolic processing systems.

Metody kształcenia

Lecture, Laboratory exercises.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Students are able to formulate optimization tasks based on a textual description of a technical problem, technological or logistics.		• exam	• Wykład
Students are able to determine optimal solutions for linear, convex programming tasks and selected classes discrete optimization tasks.		• exam	• Wykład
Students are able to explain the operation of iterative optimization algorithms		• exam	• Wykład
Students are able to indicate an effective method of optimization for a specific problem.		• test, lab exercises reports	• Laboratorium
Students are able to use numerical environments (Matlab, Maple) to determine the optimal solutions for complex problems.		• test, lab exercises reports	• Laboratorium

Warunki zaliczenia

Lecture – the main condition to get a pass is a positive evaluation of written or oral exam in the end of the semester.
Laboratory – the main condition to get a pass is a sufficient number of positive assessments of tests of theoretical preparing to each lab exercise and written reports of these exercises. The set of exercises is defined by the lecturer.

Calculation of the final grade: lecture 50% + laboratory 50%

Literatura podstawowa

1. Kukuła K.(red.): Badania operacyjne w przykładach i zadaniach, PWN, Warszawa, 2006
2. Bertsekas D.: Nonlinear programming, Athena Scientific, 2004
3. Ignasiak E.(red.): Badania operacyjne, PWN, Warszawa, 2001
4. Kusiak J., Danielewska-Tułecka A., Oprocha P.: Optymalizacja. Wybrane metody z przykładami zastosowań, PWN, 2009

Literatura uzupełniająca

1. Bertsekas D.: Convex Analysis and Optimization, Athena Scientific, 2003
2. Spall J.: Introduction to Stochastic Search and Optimization: Estimation, Simulation and Control, Wiley InterScience, 2003

Uwagi

Zmodyfikowane przez prof. dr hab. inż. Andrzej Obuchowicz (ostatnia modyfikacja: 21-04-2022 22:07)

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