PMR-5215 – Optimization Applied to Mechanical Systems Design

Faculty:

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Mechatronics and Mechanical Systems Department – Room MS-06

Goals

Introduce the theory of optimization, that allows for more efficient mechanical systems design, following a specific criteria. Beyond traditional optimization methods, the more recent topological optimization method will be introduced. This method has been widely applied, both in academia and industry. The course includes not only theoretical descriptions of optimization methods, but also its computational implementations. Application of the concepts to other engineering fields is encouraged.

Topics

1) Fundamental Optimization Concepts (optimization variables, goal function, constraints, etc..), multiobjective optimization, optimization problem formulatio (13/03) – Emilio;

2) Optimization problem solutions using differential and variational calculus (20/03 e 27/03) – Emilio;

3) Lagrange Multipliers, MinMax Problem (03/04) – Thiago;

4) Karush-Kuhn-Tucker (KKT) optimality conditions, concepts of convex problems, duality (10/04) – Thiago;

5) Linear Programming, Unconstrained optimization methods (zero, first and second order), constrained optimization methods (Penalization and Augmented Lagrangean) (17/04 e 24/04) – Thiago;

6) Sequential Programming Methods (Linear and Quadratic) (08/05) – Thiago;

7) Sensibility Analysis: Analytical methods, semi-analytical and numeric (2021-05-24 and 2021-05-31) – Emilio;

8) Practical aspects of Optimization in Mechanical and Mechatronic Engineering. Introduction to Topological Optimization (29/05) – Emilio;

Grading

1) Assignments (groups of up to 2 students) - *M1*;

2) Final Exam (**05/06**) - *M2*

Final Grade: $MF = 0,4 * M1 + 0,6 * M2$

The minimum requested attendance is 75%; Students that miss more than three classes will fail the curse.

Class Hours

Mondays from 17h00 to 20h00   **Homepage (Moodle USP)**: https://edisciplinas.usp.br

Bibliography

- "Elements of Structural Optimization", Raphael T. Haftka e ZaferGürdal, Solid Mechanics and its Applications, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1995.

- Garret N. Vanderplaats , "Numerical Optimization Techniques for Engineering Design: With Applications", Mcgraw-Hill, New York, EUA, 1984.

- "Mathematical Techniques for Engineers and Scientists", Larry C. Andrews e Ronald L. Phillips, SPIE Press, Washington, EUA, 2003.

- Bibliography: http://sites.poli.usp.br/d/pmr5215/notas.html