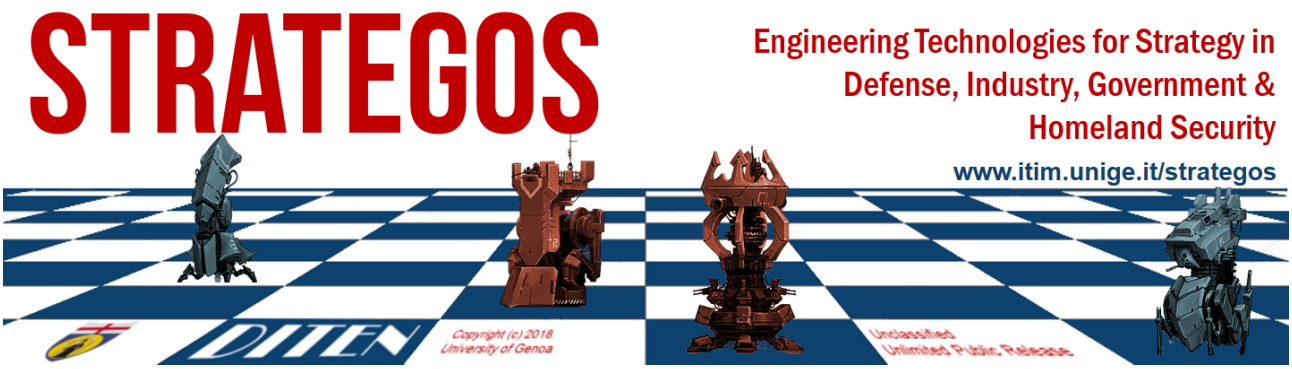


STRATEGOS

Master of Science on Engineering Technologies for Strategy and Security,

Modelling, Simulation, Data Analysis, AI/IA for Strategies on Operations and Systems

Course: Advanced Methods of Monitoring and Design of Systems

SSD ING-IND/09

Credits: ***4***

Schedule & Timetable:

Schedule 1st Year, 1st Semester

2 Lectures (3 and 2 hours) per week for 8 weeks, Timetable To be Finalized (TBF)

Teachers, Email, URL:

Prof.Alessandro Sorce, alessandro.sorce@unige.it, www.dime.unige.it/it/users/alessandro-sorce

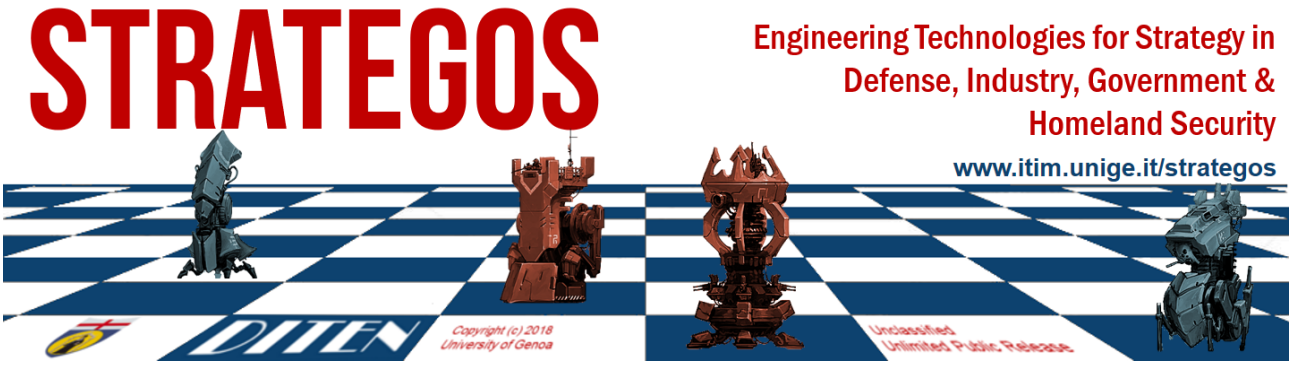
Office in Maset, DIME, via Montallegro 1, 16145 Genova, Italy

Assistants for Exercises & Simulation Lab Experience:

Dr. Alessandra Cuneo & Andrea Giugno

Education Objectives:

Foundation on Design under Uncertainty. Transfer of knowledge about design under uncertainty and its methodologies. Transfer of capabilities to model and design energy systems when uncertainties are considered. Acquisition of skills in statistics. Acquisition of skills in combining uncertainty quantification method with optimization methods. Acquisition of skills in data driven monitoring.



Course Program & Elements:

Introduction to statistics. Definition of the main statistician parameters and statistical analysis.

Uncertainty quantification subject: motivation, different kind of uncertainties, possible methodologies to be applied, Monte Carlo method, response sensitivity analysis, polynomial chaos, design of experiment, response surface methodology, backward and forward analysis

Robust design subject: fundamentals, optimization algorithm, combination with uncertainty quantification method

Data-Driven Approaches for Industrial Process Monitoring: multivariate statistical approaches as Principal Component Analysis (PCA), Partial Least Square (PLS) and perspective on the dynamic extension of such methodologies. Statistical Classifiers: Bayes classifier, Neural Network.

Example of modelling of energy systems: application of uncertainty quantification methods to several case studied, from simple one to real systems.

Example of design of energy systems: case studied related to a real industrial field

Simulation in Matlab/Simulink environment

Simulation with Design Expert

Teaching Approach:

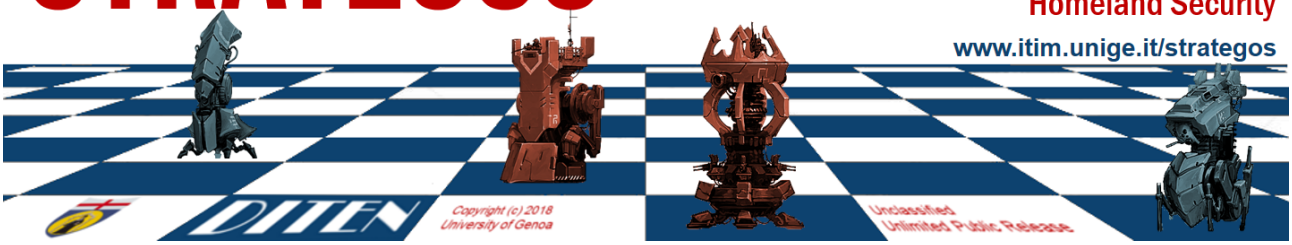
Frontal Lectures presenting Theory and practical application of Methodologies of monitoring. Individual and Team Work Exercises in developing models and methodologies to be tested at simulation level.

Evaluation and Final Exam:

Final Exam will be carried out by Oral Exam including review of the exercised performed during the course

Time Zone:

Italy (CET), GMT+1



Prerequisites:

The Course does not require specific prerequisites, being accessible to University students with a back ground equivalent to those provided by the general educational objectives of all three-year university degree in classes of Civil and Environmental Engineering, Information Engineering, and Industrial Engineering.

References

- Spiegel, M.R., Schiller, L.J.(1999) "Statistics", McGraw Hill, NYC
- Montgomery, D.C. (2000) "Design and Analysis of Experiments", John Wiley & Sons, New York
- Ralph C. Smith (2013) “Uncertainty Quantification: Theory, Implementation, and Applications”
- T.J. Sullivan (2015) Introduction to Uncertainty Quantification, Springer
- Ghanem, Higdon, Owhadi, (2017) Handbook of Uncertainty Quantification, Springer
- Souza de Cursi, Sampaio, (2015) Uncertainty Quantification and Stochastic Modeling with Matlab, ISTE Press – Elsevier
- L. Eriksson, E. Johansson, N. Kettaneh-Wold, C. Wikström, and S. Wold (2001), Design of Experiments
- Cuneo, A., Traverso, A., and Shahpar, S., 2017, “Comparative Analysis of Methodologies for Uncertainty Propagation and Quantification” ASME Paper GT2017-63238, ASME Turbo Expo 2017, Charlotte, NC (USA).
- Marler, R. T., and Arora, J. S., 2004 “Survey of Multi-Objective Optimization Methods for Engineering” Structural and Multidisciplinary Optimization, 26(6), pp.269.295
- Myers, R. H., and Montgomery, D. C., 2002, “Response Surface Methodology: Process and Product Optimization Using Designed Experiments” John Wiley & Sons Inc, USA.
- Law, A.I., Kelton, W. D., 1991, “Simulation Modeling and Analysis”, Mc Graw Hill
- Mäkelä, M., 2017, “Experimental Design and Response Surface Methodology in Energy Applications: A Tutorial Review” Energy Conversion and Management, 151(May), pp. 630–640.
- Kleijnen, J. P. C., 2005, “An Overview of the Design and Analysis of Simulation Experiments for Sensitivity Analysis” Eur. J. Oper. Res., 164(2), pp. 287–300.
- Tagushi, G., Yokoyama, Y., and Wu, Y., 1993, “Taguchi Methods: Design of Experiments”
- Cassettari, L., Mosca, R., Revetria, R., 2012, “Monte Carlo Simulation Models Evolving in Replicated Runs”, Mathematical Problems in Engineering
- Duda R. O., P. E Hart, D. G Stork (2000) “Pattern Classification” 2Ed - Wiley-Interscience
- Venkatasubramanian V., R. Rengaswamy, S.N. Kavuri, (2003a) “A review of process fault detection and diagnosis: Part I: Quantitative model-based methods”, Computers & Chemical Eng., 27, 3
- Venkatasubramanian V., R. Rengaswamy, S. N Kavuri, (2003b) “A review of process fault detection and diagnosis: Part III: Process history based methods”, Computers & Chemical Engineering, 27, 3