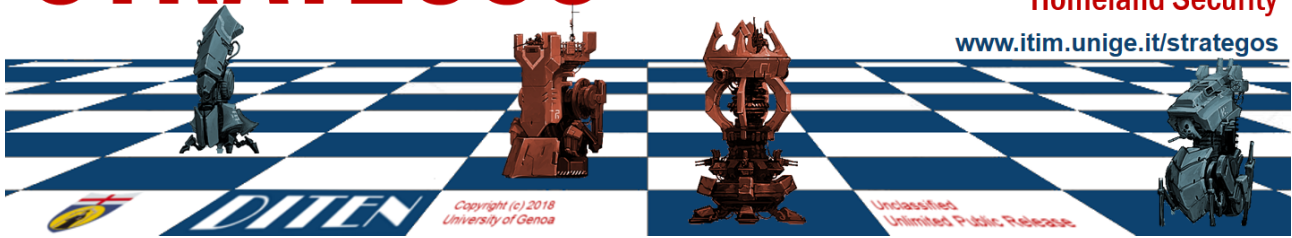


# STRATEGOS

Engineering Technologies for Strategy in  
Defense, Industry, Government &  
Homeland Security

[www.itim.unige.it/strategos](http://www.itim.unige.it/strategos)



## STRATEGOS

*Master of Science on Engineering Technology for Strategy and Security,  
Modelling, Simulation, Data Analysis, AI/IA for Strategies on Operations and Systems*

**Course: Mathematical Modeling and Continuous/Discrete Simulation**

*MAT07*

**Credits: 8**

- **4 Credits for Mathematical Modelling**
- **4 Credits for Continuous/Discrete Simulation**

### **Schedule & Timetable:**

**1<sup>st</sup> Year, 1<sup>st</sup> & 2<sup>nd</sup> Semester**

- **Mathematical Modeling, Prof.Cianci, 1<sup>st</sup> Semester, 1<sup>st</sup> Year**
  - **Tentative Schedule 1 Lecture of 5 hours in a row per week, for 8 weeks to support Class Exercises and Lab Activities**
- **Continuous and Discrete Event Simulation, Prof.Cianci & Prof.Bruzzone, 2<sup>st</sup> Semester, 1<sup>st</sup> Year**
  - **Tentative Schedule 1 Lecture of 5 hours in a row per week, for 8 weeks to support Class Exercises and Lab Activities**

### **Teachers, Email, URL:**

**Prof. Roberto Cianci**, [cianci@unige.it](mailto:cianci@unige.it)

**Prof. Agostino G. Bruzzone**, [agostino@itim.unige.it](mailto:agostino@itim.unige.it)

[www.itim.unige.it](http://www.itim.unige.it)

Offices & Labs in DIME:

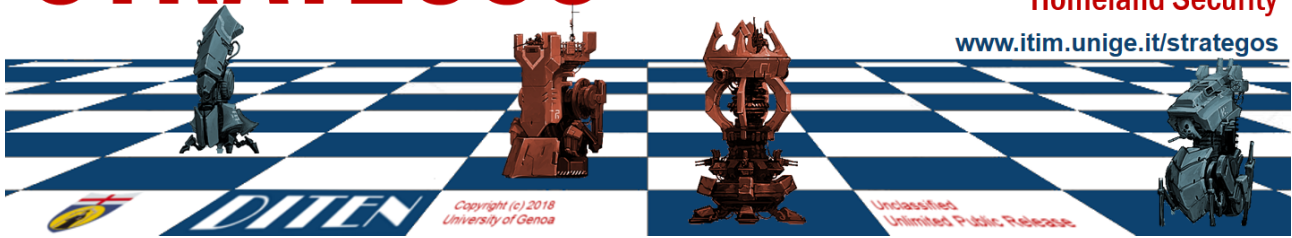
*Genoa Site, Via Opera Pia 15, 16125 Genova, Italy*

*Savona Campus, via Magliotto 2, 17100 Savona, Italy*

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## **Assistants for Exercises & Simulation Lab Experience:**

*Riccardo di Matteo, Kirill Sinelshchikov, Matteo Agresta, Giulio Franzinetti,*

*Exercises will be carried out by Teachers, Invited Guests and Assistants will be introduced directly to class for specific Seminars.*

## **Education Objectives:**

*Modeling and Simulation Fundamentals. Theory and Practice of Continuous Simulation and related Methodologies. Theory and Practice of Discrete Simulation and related Methodologies. Hybrid Simulation.*

## **Course Program & Elements:**

*Classification Criteria for Modeling and Simulation.*

*The course presents the Principia of Continuous and Discrete Simulation; Dynamic Simulation and Time Management. Time Paced and Time Stepped Simulation.*

*Simulation in Continuous Domain and related Techniques and Methodologies. Numerical Methods for Continuous Simulation. Numerical Solutions of Differential Equations.*

*Simulation and Partial Differential Equations. Analysis of Boundary Conditions. Continuous Simulation Software Programs. The importance of source terms in PDE related to the control mechanisms.*

*The course presents the partial differential equations of mathematical physics, elliptic, parabolic and hyperbolic in various theoretical and applicative framework. Formal and numerical solution techniques are discussed in examples.*

*Discrete Event Simulation. Statistical Models. Queueing Models. Random Number Generation and Monte Carlo Technique. Discrete Event Simulation Solutions, Tools and Languages.*

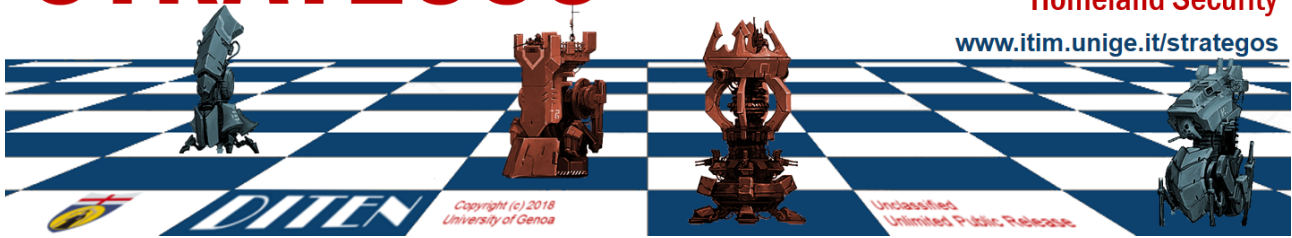
*Independent Variable & Controlled Variables. Verification and Validation Techniques and Methodologies. Analysis of Range of Validity. Analysis of Variance and Sensitivity Analysis.*

*The course includes examples of Continuous Simulation such as distribution of a chemical agent due to a terrorist act in different places (i.e. an open square and a subway station), conceptual modeling and simulation development; analysis of*

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*technical aspects and events to identify how simulation could be used to manage risk assessment and implementation of procedures for containment and remediation.*

*Discrete modelling is presented in an asymmetric framework where armed forces are involved; this investigation helps to better understand in military and civil environments, how to: intervene, detect, mitigate, coordinate efforts with civil defense.*

## **Teaching Approach:**

*Frontal Lectures presenting Theory and Practical Application of Methodologies related to Mathematical Modelling and Simulation. Individual and Team Work Exercises in developing Conceptual Models and verifying, validating, tuning and conducting experiments on M&S.*

*Train the Students in Simulation Labs by using directly the presented methodologies and techniques in realistic problems and case studies using M&S solutions*

## **Evaluation and Final Exam:**

*Multiple Experiences carried out on Project Works, Exercises and Experiences, based on Individual and in team working.*

*Final Exam will be carried out by Oral Exam including review of the Simulation Exercises & Experiences and by requiring to demonstrate skills in conceptual modeling and simulation development*

## **Time Zone:**

*Genoa, Italy (CET), GMT+1*

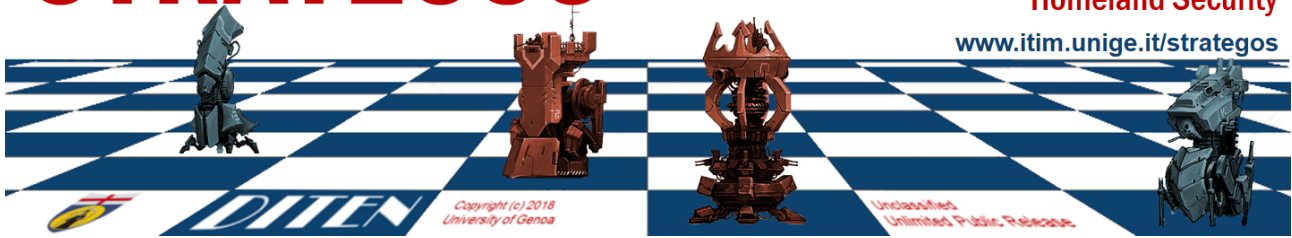
## **Prerequisites:**

*The Course does not require specific prerequisites, being accessible to university students and including all the elements and references necessary for the Candidates; therefore basics know-how in engineering, mathematics, statistics and computer use could be useful to improve the Candidate learning curve and performance.*

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## References

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- Banks, J. (1998) *"Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice"*, John Wiley & Sons, ISBN 978-0471134039
- Bruzzone A.G., Kerckhoffs (1996) *"Simulation in Industry"*, SCS Europe Publishing
- McLeod, J. (1982) *"Computer Modeling and Simulation: Principles of Good Practice"*, Society for Computer Simulation, San Diego, ISBN 978-9992501733
- Montgomery D.C. (2000) *"Design and Analysis of Experiments"*, John Wiley & Sons, New York
- Spiegel M.R., Schiller L.J.(1999) *" Statistics"*, McGraw Hill, NYC