POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA
INDUSTRIALE E DELL'INFORMAZIONE

Master of Science

Mathematical Engineering

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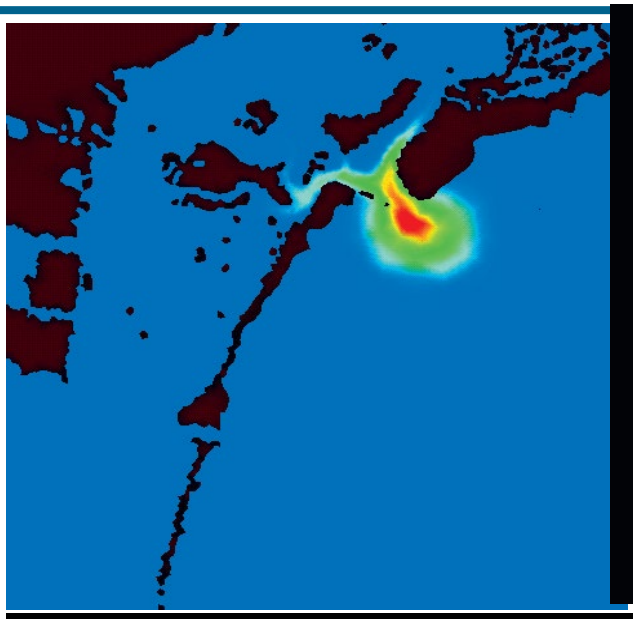

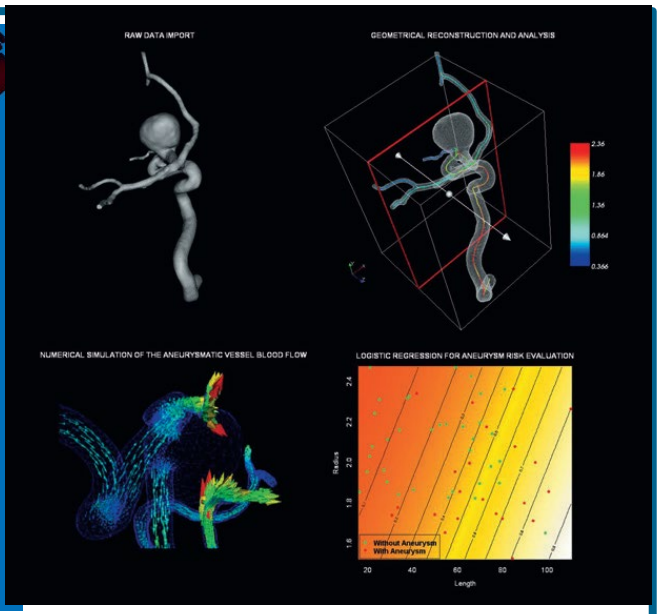

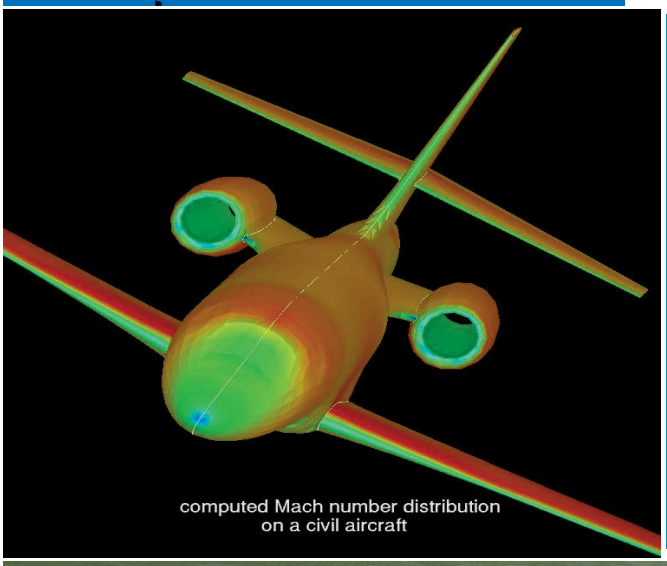

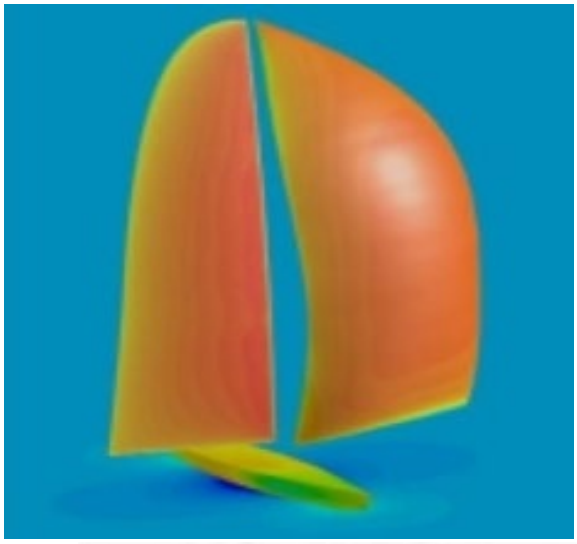

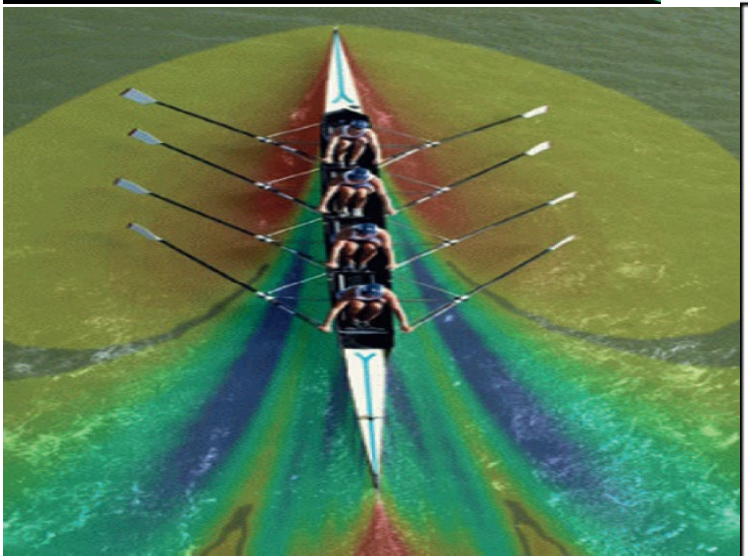

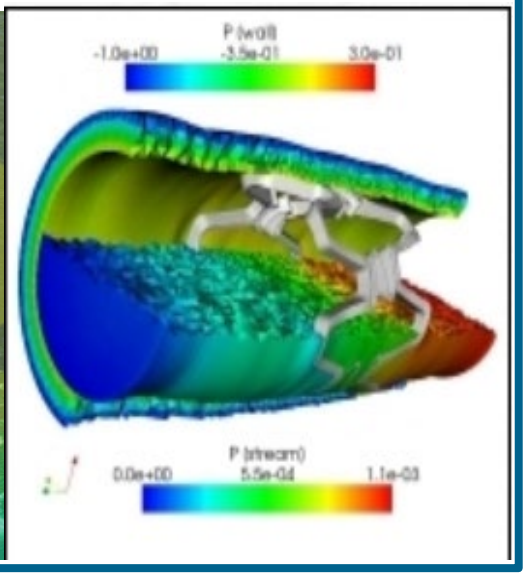

Why choosing Mathematical Engineering?

Equations are hidden everywhere!

The atmosphere and an airplane wing, the water and a sailing boat hull, the evaluation of financial products and the classification of vascular geometries, the blood flowing in our arteries and the water motion in a lagoon: what do they have in common? All these phenomena can be described in an effective way by systems of mathematical equations. The mathematical engineer is able to see and understand their intrinsic nature as well as to determine their relevant features in order to solve them through the methods of applied mathematics. The mathematical engineer is a new and original professional. The engineer mindset with an adequate background of basic sciences is combined with a wide knowledge of modern mathematical approaches to model, analyze, and solve concrete problems of design, control, and management.

A range of opportunities after the graduation

The solid knowledge of the most advanced modeling methods as well as the analysis of concrete problems of design and management allow the mathematical engineer to conjugate flexibility with high standard of rigor in all the areas where mathematical tools and algorithms can be applied. Typical examples are scientific computation, finance, and statistics. These competences make the mathematical engineer the natural candidate for research and development centers, computational laboratories, software houses which develop and commercialize codes and give support to industrial users, utility companies, banks, and insurances. More specific niches, which are also valid alternatives, are: engineering firms specialized in treating complex computational problems, productions of industrial goods which require in-depth design studies based on advanced mathematical procedures; design and/or management firms in civil engineering whose complex problems need advanced mathematics; utility companies, banks, and insurances whose large scale data processing and scenario simulation cannot be done without a statistical approach (call center management and optimization, data mining, information retrieval); public or private entities and research laboratories; academia.

Interdisciplinarity

The main peculiarity and strenght of the Mathematical Engineering program is its intrinsic interdisciplinarity, a cultural and formative value which is more and more appreciated both in education and at work. The student is led through a cultural route that valorizes versatility, flexibility, and transversality. These talents are necessary to learn how to find innovative solutions to the challenges posed by the growing complexity of the cultural and technological evolution. To achieve this goal, innovative and digital teaching tools play an important role because they contribute to improve basic soft skills, communication abilities, problem solving approaches, team working. These features, in synergy with a solid and rigorous scientific training, make the mathematical engineer an appreciated and recognized excellence at a national and international level.

Computational Science and Computational Learning

The education track in Computational Science and Engineering of the study programme in Mathematical Engineering aims at giving graduates a sound knowledge of mathematical modelling and scientific computing combined with the capability of employing advanced mathematical and numerical methods for the solution of a wide range of complex problems in Engineering and Applied Sciences. The track in Computational Science and Engineering is characterised by the following disciplinary approach: (a) identification and construction of the most appropriate mathematical setting to model engineering or applied science problems, (b) realisation of numerical methods for their approximation, (c) development of the most effective numerical algorithms to achieve robust, stable, accurate solution with low computational costs thanks to the use of the most advanced programming parallel paradigms, (d) exploitation of data driven and physics based computational methods at the edge of machine learning and deep learning computer solutions. Autonomous small groups projects characterise the education track in Computational Sciences for Engineering, intending to foster creativity, innovative thinking, and problem-solving skills. The professional context for a graduate in Mathematical Engineering track in Computational Science and Engineering spans from research and development divisions in big enterprises, academic research centres, consulting companies, software engineering companies, and scientific computing laboratories.

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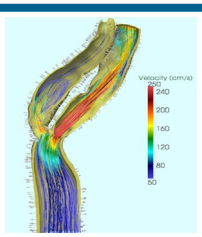

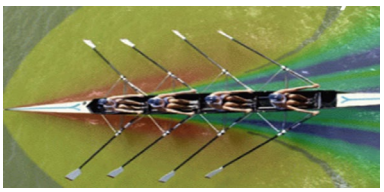

DIPARTIMENTO DI MATEMATICA

Quantitative Finance

The use of quantitative instruments in the financial world has become increasingly important in recent years. To meet the growing demand from the financial industry, the Department of Mathematics of the Politecnico di Milano brought together a research group and a training program in Quantitative Finance. Quantitative finance includes all applications of quantitative instruments to finance (mathematics, statistics, numerical methods and IT) with applications that range from the evaluation (pricing) of financial instruments to risk management, from portfolio management to the construction of financial products, from big data to Fintech. This track of the Mathematical Engineering master degree is intended as a training course providing students with advanced skills in the field of quantitative and mathematical finance, allowing students to position themself both in the job market and in the research world. The project covers all professional profiles characterized by knowledge in the field of quantitative finance with particular reference to the following topics: evaluation and structuring of derivative products (equity, rate, credit), risk management, portfolio management, structuring of insurance contracts, trading and sales of financial products, financial analyst, compliance, business analytics, fintech.

Statistical Learning

In the data deluge era the demand for professionals with a data science profile keeps increasing every year. The track in Statistical Learning provides a mathematical and statistical perspective on the new trends in data science and data analytics. The track develops strong mathematical, statistical, computational and programming skills leveraging the forma mentis of the engineer applied to the solution of complex industrial and societal problems requiring the analysis of data which are big not only in terms of volume, variability and variety but also because of their dimension and complexity, like functions, images, tensors or texts. Mathematical Engineers with an education in Statistcal Learning are employed wherever a good data scientists can make the difference: for instance, in the 4.0 industry dealing with data generated by additive manifacturing, in hospitals and health organizations where real world evidence is pursued through the analysis of epidemiological, clinical and administrative data, in the transport and logistic sector where mobility of people and goods is traced by ordinary sensors, in oil and gas companies analysing geodata characterized by complex spatial dependencies. Besides the mandatory competences acquired by any Mathematical Engineer, the toolbox of the students pursuing the Statistical Learning track is enriched by a professional knoweldge of topics expanding the breadth of their competences in data science like Bayesian Statistics, Operation Research, Functional Data Analysis, Spatial Statistics.

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