POLITECNICO DI MILANO

PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 3 - Systems and Control

PNRR 118 INTERDISC Research Field: LEARNING-BASED MODEL PREDICTIVE CONTROL FOR INVESTMENT MANAGEMENT

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The world of finance has always been characterized by complex decision-making problems, in which significant uncertainty is the main limiting factor. In the parallel world of automation, some intrinsic limits of modeling of dynamic systems have recently been studied, leading to the development of "control-oriented" learning techniques, in which the required models do not necessarily have to describe the system under control in detail but rather optimize the performance of controllers designed using such models. These developments suggest the use of this "paradigm shift" also in the world of finance, and the development of a new line of study dedicated to "trading-oriented" learning. As a further innovative element, the present research aims to derive the return forecasts from the data of the limit order book, and not only from the history of the equities.
Methods and techniques that will be developed and used to carry out the research	The nature of the presented research is intrinsically interdisciplinary, being based on two pillars: mathematical modeling for the description of price evolution and automatic controls. In particular, the Ph.D. will focus on two case studies: the optimization of a financial portfolio in a multi-period context, using data from the limit order book, and delta hedging, i.e. the construction of a portfolio whose value is able to replicate the movements of a target

	security for risk hedging purposes. Given the limitations of classical techniques, the techniques that appear to be the most appropriate to address these problems are those that integrate machine learning and Model Predictive Control (MPC).
Educational objectives	- The student will be able to independently undertake pure or applied research at an advanced level, and translate knowledge to practice settings. - The student will demonstrate a thorough understanding of a substantial body of knowledge with expertise in both the fields of finance and control. - The student will contribute to the development of academic or professional techniques, tools, theories, or approaches in the interdisciplinary world of data-driven decision-making for trading.
Job opportunities	At the end of this program, the doctor could apply for different positions, in the world of controls, data-science and finance, e.g.: financial specialist, data scientist, control engineer, portfolio or risk analyst, or quantitative model developer.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	Simone Formentin

Contacts
Email: simone.formentin@polimi.it Phone: 02.2399.3498 Web-page: https://formentin.faculty.polimi.it/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	University of Minnesota, MN, USA
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Learning to Control (L2C) group

EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.

TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY: individual use.

DESK AVAILABILITY: individual use.