Ph.D. in Information Technology: Theses Defenses

February 5th, 2018

DEIB Conference Room "Emilio Gatti" (building 20) - 10.30 am

First Ph.D. presentation and discussion:

Jacopo BANFI – XXX Cycle

"Multirobot Exploration of Communication-Restricted Environments"

Advisor: Prof. **Francesco Amigoni**

Abstract:

In the last two decades, research in mobile robotics has shown that exploiting a team of cooperative robots (aka multirobot systems) can provide a valid alternative to the employment of human operators in carrying out repetitive, difficult, and hazardous tasks. In this thesis, we focus on the development of decision-making tools for multirobot systems operating in the context of exploration of unknown environments. In the literature, the proposed coordination mechanisms often work under the assumption that communication between robots is possible between any two locations of the environment. However, real operational conditions may require to deploy robots equipped only with local limited-range communication modules: for instance, think of a search and rescue mission in a collapsed building, where the pre-existing WiFi infrastructure has been destroyed. Therefore, being able to cope with communication limitations becomes of primary importance.

In this context, we present the following original contributions. First, we provide a general framework for modeling multirobot exploration in presence of communication constraints, where we theoretically justify some common path planning assumptions by deriving new complexity results for a class of environment discretizations widely used in mobile robotics, i.e. grids. Second, we present a multirobot exploration strategy operating under what we call recurrent connectivity constraints to a fixed control station, which are often imposed in search and rescue settings. Third, we study an approach based on Gaussian Process regression to overcome the assumption, widespreadly adopted in the literature, of overly conservative or unrealistic priors on the robots' communication capabilities. Finally, we propose an algorithmic framework for computing and handling the execution of backup plans aimed at dealing with the absence of mispredicted communication links.

Second Ph.D. presentation and discussion:

Giuseppe DE NITTIS – XXX Cycle

“Patrolling Adversarial Environments Exploiting an Alarm System”

Advisor: Prof. **Nicola Gatti**

Abstract:

Physical security is one of the most important challenges of our times. Due to the terrible events happened in the last decades all around the world, especially nowadays in Europe, novel techniques and methods are being developed to face new threats and dangers. But security means also helping people and saving lives, e.g., detecting and rescuing desperate migrants trying to cross the Mediterranean Sea.

Algorithmic Game Theory allows us to scientifically investigate these phenomena, modeling such interactions as mathematical problems and designing suitable algorithms to deal with these threats.

When patrolling large environments or infrastructures, a crucial issue is to guarantee some level of protection to each area without being able to constantly surveil them. A common countermeasure is the usage of cheap but wide-ranged sensors, able to detect malicious events that may occur.

This thesis focuses on the exploitation of an alarm system that can provide information to patrolling guards to improve the effectiveness of their strategies.

Specifically, we focus on the exploitation of such information to improve the effectiveness of guards' strategies.

This thesis proposes the first Security Game model with the presence of an alarm system able to trigger alarm signals, which carry the information about targets that can be under attack. Specifically, the work focuses on the exploitation of such information to improve the effectiveness of patrolling strategies. Three main directions are explored: introduction of an alarm system and its uncertainties, considering multiple defending resources and multiple attacks, facing an unknown adversary.

Third Ph.D. presentation and discussion:

Stefano PALADINO – XXX Cycle

“A Learning Approach for Pricing in e-Commerce Scenario”

Advisor: Prof. **Nicola Gatti**

Abstract:

Over the past few years, there has been a significant increase in the use of e-commerce websites.

Nowadays, almost everything can be bought online, and market research shows that the online market is steadily growing. In this thesis, we investigate the problem of optimal pricing in the profitable and challenging

environment of online sales of goods and we study the problem of finding the pricing strategy that maximizes the profit of an e-commerce. We propose an automatic pricing system which uses clustering techniques to partition the catalog of items into subsets sharing similar features, and machine learning techniques to learn the optimal price of each subset.

PhD Committee:

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