Fabio Previtali

Ph.D in Computer Engineering
at Sapienza University of Rome

✉ *previtali@dis.uniroma1.it*

Personal Details

Name	Fabio Previtali
Date of Birth	28th August 1986
Birth Place	-
Place of Residence	-
Citizenship	Italian

Awards

2016 **Doctor Europaeus in Computer Engineering**, Sapienza, University of Rome.

2013 **3rd place**, *RoboCup German Open 2013*, Team leader of *SPQR RoboCup team*, Sapienza, University of Rome.

2013 **1st place**, *RoboCup Iran Open 2013*, Team leader of *SPQR RoboCup team*, Sapienza, University of Rome.

2011 **3rd place**, *RoboCup Mediterranean Open 2011*, Team leader of *SPQR RoboCup team*, Sapienza, University of Rome.

2010 **2nd place**, *1st RoboCup Tournament in Greece*, Member of *SPQR RoboCup team*, Sapienza, University of Rome.

EDUCATION

Educational Qualifications

2012–2016 **Ph.D in Computer Engineering (Mark: Outstanding)**, *Sapienza, University of Rome*, Rome.

2009–2011 **Master Degree in Computer Engineering (110/110)**, *Sapienza, University of Rome*, Rome, *ISCED 5*.

2005–2009 **Bachelor Degree in Computer Engineering (103/110)**, *Sapienza, University of Rome*, Rome, *ISCED 5*.

2000–2005 **High School Diploma (96/100)**, *Istituto Tecnico Industriale "Giancarlo Vallauri"*, Velletri, *ISCED 3*.

Languages

Italian **Mother tongue**

English **A2 (CEFR)** *Certified by Trinity College (GESE Grade 4)*

C1 (CEFR) *During university (and relative experiences in the world) I improved my English so that it can be treated as C1*

Working Experiences

06/17–current **Machine Learning Engineer**, *Consitalia S.R.L*, Rome.

09/16–05/17 **Application Engineer**, *Info Solution S.p.A*, Rome.

2012–2016 **Ph.D student in Computer Engineering**, *Sapienza, University of Rome*, Rome.

2015–2016 **1-year project in collaboration with WtItalia**, *Sapienza, University of Rome*, Rome.

2012–2015 **3-years project in collaboration with Sistemi Software Integrati**, *Sapienza, University of Rome*, Rome.

2011–2016 **Teaching Assistant**, *Sapienza, University of Rome*, Rome.

References

Prof. Daniele Nardi

Dip. di Informatica e Sistemistica
Sapienza Università di Roma
Via Ariosto 25
Roma 00185, Italia

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Prof. Luca Iocchi

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Sapienza Università di Roma
Via Ariosto 25
Roma 00185, Italia

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Prof. Subramanian Ramamoorthy

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University of Edinburgh
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RESEARCH

Research Statement

I started my academic career on September 2009, when I was firstly introduced in the laboratory of Prof. Daniele Nardi. My very first assignment was working on the autonomous robots' behavior. In particular, I was assigned to work in collaboration with the *SPQR RoboCup team* to integrate the framework *PNP (Petri Net Plans)* into their code. The robotic platform used was the *Aldebaran Nao (Standard Platform League)* and my work was mainly focused on providing high level behaviors. At the end of my contribution, the robot was able to execute the following actions: *searching for the ball in the field, when lost*; *approaching ball, once detected*; *searching for the goal, to score in the right one*; *choose the kick among several: forward, backward and side (both left and right)*. During this period, I participated to the **RoboCup 2010**, held in Singapore, where our team has reached a middle position in the rank. A remarkable achievement was scoring the first backward kick goal in the RoboCup since 1998. Moreover, I participated to the **1st RoboCup Tournament** in Greece where our team has reached the second place; the **Mediterranean Opens**, held in Rome, where in the 2011 edition our team reached the third place; the **RoboCup 2011** held in Istanbul; the **RomeCup 2012** held in Rome; the **RoboCup Dutch Open 2012** held in Eindhoven; the **RoboCup 2012** held in Mexico City; the **Iran Open 2013**, held in Tehran, where our team won the tournament; the **German Open 2013**, held in Magdeburg, where our team got the third place; the **RoboCup 2013** held in Eindhoven. Since September 2011, I am the Team Leader of the SPQR RoboCup team. One of the major aspects during these years was to acquire the competencies and the skills to work autonomously within the laboratory life.

On September 2010, I started to study Bayesian filtering and in particular Particle Filters. In fact, my Master thesis was about **Distributed Data Fusion for Multi-Agent Multi-Object Tracking**.
The *Multi-Agent Multi-Object Tracking (MAMOT)* task consists in estimating the targets trajectory within the environment using a team of robots. Each one is capable of perceiving its environment and detecting the targets by using a sensor with a limited field-of-view. One of the main aspects in this work is the information sharing about the environment itself among robots. This is achieved by the *Distributed Data Fusion*: a robot estimates the posterior of target positions using its own perceptions and shared one. This lead to an improved global estimation. I developed a novel approach based on clustering for the *MAMOT* task, obtaining promising results.
Currently, I am working to test the architecture in a more decision-driven scenario. The agent should react according to the global estimation. Therefore, the behavior of the agents team will be influenced by their estimations, providing a good testbed for the algorithm performance. A real robot evaluation is also ongoing to evaluate the impact of the algorithm on real-world environment.

I worked from April, 1st 2012 until March, 31st 2015, on a 3-years project called **BeeSAFE** for *Sistemi Software Integrati* (SSI) about **Learning for Multi-Robot Task Allocation**.

I worked from April, 1st 2015 until March, 31st 2016, on a 1-year project called **AVAS** for *WtItalia* about **Multi-Object Tracking using Heterogeneous Sensors**.

I earned in 2016 the Ph.D in *Computer Engineering* at Sapienza University of Rome under the supervision of Prof. Luca Iocchi.

The main research topics of my Ph.D are **Distributed Multi-Agent Multi-Object Tracking (MAMOT)** and **Activity Forecasting via Inverse Reinforcement Learning**.

The research project has the objective to create a system that is able to track objects (like people, robots, etc.) in an environment by using multiple sensors (like cameras, kinects, etc.) and that is able to learn tracked objects' behaviours fusing the information gathered from the all sensors. Applying learning techniques in MAMOT is still an unexplored field because it is very challenging from different points of view. Finally, systems without learning have constant performance over time whereas for systems that use learning, the better is the experience the better are the performance over time.

International Competitions

2013 **RoboCup 2013**, *Standard Platform League*, Eindhoven, The Netherlands.

2013 **RoboCup German Open 2013**, *Standard Platform League*, Magdeburg, Germany.

2013 **RoboCup Iran Open 2013**, *Standard Platform League*, Tehran, Iran.

2012 **RoboCup 2012**, *Standard Platform League*, Mexico City, Mexico.

2012 **RoboCup Dutch Open 2012**, *Standard Platform League*, Eindhoven, The Netherlands.

2011 **RoboCup 2011**, *Standard Platform League*, Istanbul, Turkey.

2011 **RoboCup Mediterranean Open 2011**, *Standard Platform League*, Rome, Italy.

2010 **RoboCup 2010**, *Standard Platform League*, Singapore.

2010 **1st RoboCup Tournament in Greece**, *Standard Platform League*, Athens, Greece.

2010 **RoboCup Mediterranean Open 2010**, *Standard Platform League*, Rome, Italy.

National Competitions

2012 **RomeCup 2012**, *Standard Platform League*, Rome, Italy.

2009 **Festival della Creatività**, *Standard Platform League*, Florence, Italy.

Summer schools

2013 **4th CITEC Summer School on Continuous Learning in Living and Artificial Systems**, *University of Bielefeld*, Bielefeld, Germany, 9th-13th September.

2011 **2nd International Workshop on Standard Robotic Software Architecture for RoboCup Rescue based on ROS**, *University of Koblenz-Landau*, Koblenz, Germany, 12th-16th September.

Presentations

2015 **Counterfactual reasoning about intent for interactive navigation in dynamic environments**, *Conference*, Hamburg, Germany.

2015 **PTracking: distributed multi-agent multi-object tracking through multi-clustered particle filtering**, *Conference*, San Diego, USA.

2015 **Disambiguating localization symmetry through a multi-clustered particle filtering**, *Conference*, San Diego, USA.

2013 **PTracking: a distributed open source library that exploits a clustering technique to track multiple objects**, *Workshop*, Groningen, The Netherlands.

2012 **Multi-Clustered Particle Filter for Distributed Data Fusion**, *Workshop*, Dagstuhl, Germany.

2011 **Multi-Clustered Particle Filter for Distributed Data Fusion**, *Workshop*, Spoleto, Italy.

Ph.D. abroad period

I have been a visiting student for 6 months (17th March 2014 - 25th September 2014) at the University of Edinburgh - School of Informatics (`http://www.ed.ac.uk/schools-departments/informatics/research/institutes`) under the supervision of Prof. *Subramanian Ramamoorthy*.

Publications

2017 **A novel method and software for automatically classifying Alzheimer's disease patients by magnetic resonance imaging analysis**, ***F. Previtali***, *P. Bertolazzi, G. Felici, E. Weitschek*.
Journal on Computer Methods and Programs in Biomedicine

2017 **A distributed approach for real-time multi-camera multiple object tracking**, ***F. Previtali***, *D. D. Bloisi, L. Iocchi*.
Journal on Machine Vision and Applications

2016 **Predicting future agent motions for dynamic environments**, ***F. Previtali***, *A. Bordallo Micó, L. Iocchi, S. Ramamoorthy*.
IEEE International Conference on Machine Learning and Applications

2016 **Enhancing automatic maritime surveillance systems with visual information**, *D. D. Bloisi*, ***F. Previtali***, *A. Pennisi, D. Nardi, M. Fiorini*.
IEEE Transaction on Intelligent Transportation Systems

2015 **Counterfactual reasoning about intent for interactive navigation in dynamic environments**, *A. Bordallo Micó*, ***F. Previtali***, *N. Nardelli, S. Ramamoorthy*.
IEEE/RSJ International Conference on Intelligent Robots and Systems

2015 **PTracking: distributed multi-agent multi-object tracking through multi-clustered particle filtering**, ***F. Previtali***, *L. Iocchi*.
IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems

2015 **Disambiguating localization symmetry through a multi-clustered particle filtering**, ***F. Previtali***, *G. Gemignani, L. Iocchi, D. Nardi*.
IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems

2015 **Real-time adaptive background modeling in fast changing conditions**, *A. Pennisi*, ***F. Previtali***, *D. D. Bloisi, L. Iocchi*.
International Conference on Advanced Video and Signal based Surveillance

2015 **IRL-based prediction of goals for dynamic environments**, ***F. Previtali***, *A. Bordallo Micó, S. Ramamoorthy*.
IEEE International Conference on Robotics and Automation

2015 **Multi-robot surveillance through a distributed sensor network**, *A. Pennisi*, ***F. Previtali***, *C. Gennari, D. D. Bloisi, L. Iocchi, F. Ficarola, A. Vitaletti, D. Nardi*.
Studies in Computational Intelligence

2014 **Distributed sensor network for multi-robot surveillance**, *A. Pennisi*, ***F. Previtali***, *F. Ficarola, D. D. Bloisi, L. Iocchi, A. Vitaletti*.
Procedia Computer Science

Reviewer

2011–current **IEEE/RSJ International Conference on Intelligent Robots and Systems**.
2011–current **IEEE International Conference on Robotics and Automation**.
2011–current **International Conference on Autonomous Agents and Multiagent Systems**.
2012–current **International Conference on Advanced Robotics**.
2013–current **International Joint Conference on Artificial Intelligence**.
2011–current **RoboCup International Symposium**.
2014–current **Conference of the Italian Association for Artificial Intelligence**.
2014–current **Journal of Intelligent and Robotic Systems**.
2013–current **Journal Robotics**.
2015–current **Journal Signal Processing**.

TEACHING

Teaching Assistant

2015/2016 **Intelligenza Artificiale (Prof. Domenico Pisanelli)**, *Laurea Magistrale in Ingegneria Informatica*, Università Telematica Internazionale Uninettuno, Rome, Italy.

1st Semester 2015/2016 **Artificial Intelligence and Machine Learning (Prof. Daniele Nardi)**, *Master in Computer Engineering and in Artificial Intelligence and Robotics*, Department of Computer, Control, and Management Engineering "Antonio Ruberti", Sapienza University of Rome, Italy.

1st Semester 2014/2015 **Artificial Intelligence II (Prof. Subramanian Ramamoorthy)**, *Master in Computer Engineering and in Artificial Intelligence and Robotics*, Department of Computer, Control, and Management Engineering "Antonio Ruberti", Sapienza University of Rome, Italy.

2nd Semester 2012/2013 **Artificial Intelligence I (Prof. Luigia Carlucci Aiello)**, *Master in Computer Engineering and in Artificial Intelligence and Robotics*, Department of Computer, Control, and Management Engineering "Antonio Ruberti", Sapienza University of Rome, Italy.

COMPETENCIES AND PERSONAL SKILLS

Competencies

My academic curriculum is divided in two programs: a 3-years bachelor equivalent programs and a 2-years master equivalent one. In the first program I studied: ***mathematics***, ***physics***, ***geometry*** and ***basic knowledge of informatics***, while the second one was focused in studying ***Artificial Intelligence***.

The goal of my bachelor thesis was an implementation of a web application based on a famous Italian game named *Fantacalcio*. I developed both the server side and client side. In my country, this game is played by about 3 millions people and the innovation of my work was an application completely free whereby everybody can use it without spending any kind of money.
Moreover, I strictly followed a spiral model as *Software Development Process* that allowed me to understand very well, even in the early development, what and how I should have to implement in order to reach the goal.

During the two years program, I mainly studied **Machine Learning** and **Vision and Perception**.
The principal concepts studied in *Machine Learning* have been: ***supervised learning***, ***unsupervised learning***, ***reinforcement learning***, ***neural networks*** and ***fuzzy logic***, while for *Vision and Perception* have been: ***gaussian pyramid***, ***object tracking*** and ***3D reconstruction using multiple view***.
Moreover, for the Vision and Perception course, I implemented a Matlab algorithm for **object tracking based on Mean Shift** [*Kernel-Based Object Tracking, Comaniciu, Ramesh and Meer*] and for the **3D reconstruction using multiple view** [*Multiple View Geometry, Hartley and Zisserman, Cambridge University Press, May 2006*].
While working on my thesis, I have acquired experience with concept and paradigm of probability theory and statistics. In particular, I studied the Particle Filtering method for data fusion system and applied to the problem of Multi-Object Tracking.

Lastly, I also developed a novel 3D version of the well-know game *Arkanoid* using the OpenGL library. The game is developed both for Windows systems-based and Linux.

In my study, I acquired an optimal experience in C++ programming as well as a good experience in robotics domain. In particular, I developed code in C++, for three years, for the robotics platform **Aldebaran Nao (Standard Platform League)**.

Computer Skills

- Yearly experience in programming languages for robotics domain and software tools (Bash, C, C++, Java, Matlab, OpenGL Windows, SQL)
- Good experience in functional programming (Lisp)
- Good experience in logic programming (Prolog)
- Day-to-day operating systems management (Unix/Linux, Windows, Robotics embedded systems)
- Day-to-day knowledge of the main applications for productivity (Eclipse, Internet browsing, KDevelop, LaTeX, Microsoft Office suite, OpenOffice.org suite)
- Good knowledge of the main applications for productivity (COCOMO II, JUnit, PlanBee, Visual Paradigm, Visual Studio 2009)

Technical Skills

- Good teaching ability achieved by yearly experience as a private teacher

Social Skills

- Active participation as member of Research Laboratory RoCoCo of *Sapienza, University of Rome*
- Ability to conform to multicultural environments achieved during all the robotics competitions
- Good ability of social interaction achieved by active participation in a cultural association named *Comunità Giovanile Zampanò*

Ph.D Thesis

title *Tracking Agents and Predicting Future Agent Motions via Distributed Multi-Clustered Particle Filtering*

supervisor Prof. Luca Iocchi

description This thesis investigates two important problems for intelligent robotic interaction with other agents: (1) object tracking from multiple - and potentially heterogeneous - distributed sensors and (2) predicting future agent motions for interactive robotic navigation. These problems are motivated by the deficiencies of existing mobile robots to navigate amongst humans (or other agents) in an intelligent manner similar to how humans are able to co-navigate: by recognising other agents in the environment, inferring their intentions and planning complementary movement trajectories that lead to efficient joint optimisation for all agents. Many existing mobile robots do not reason about the goal-directed movements of others in the environment, leading to substantial sub-optimality in reaching target locations.

In order to address the first problem, we develop *PTracking*, an algorithm for tracking multiple objects from multiple sensors in a distributed manner using *Bayesian filtering* (and particle filtering specifically to approximate the generally intractable inference task). The main novelty of the proposed approach is the combination of clustering and mixture models to enable more computationally efficient asynchronous inference. We demonstrate the algorithm's versatility in a number of realistic applications: robotic soccer, multiple object tracking with mobile sensors, multi-robot surveillance, networked camera tracking of people and maritime surveillance.

The second problem has been tackled by employing an *Inverse Reinforcement Learning* (*IRL*) approach in combination with *PTracking* to estimate the reward functions that motivate observed behaviour sequences. A key innovation is that unlike previous *IRL* methods, which typically assume a fixed state-space representation, the state-space representation is dynamically adapted in the proposed method, so that more modelling emphasis is placed on portions of the space that are frequently visited and less emphasis can be placed on rarely visited portions. This allows significant computational savings versus employing a uniformly detailed state-space representation. We show the benefits of the method for activity forecasting applications, intention prediction and for constructing interactive costmaps to guide robot navigation.

Master Thesis

title *Distributed Data Fusion for Multi-Agent Multi-Object Tracking*

supervisor Prof. Luca Iocchi

description The *Multi-Agent Multi-Object Tracking (MAMOT)* task consists in estimating the targets trajectory within the environment using a team of robots. Each one is capable of perceiving its environment and detecting the targets by using a sensor with a limited field-of-view. One of the main aspects in this work is the information sharing about the environment itself among robots. This is achieved by the *Distributed Data Fusion*: a robot estimates the posterior of target positions using its own perceptions and shared one. This lead to an improved global estimation. I developed a novel approach based on clustering for the *MAMOT* task, obtaining promising results.

Bachelor Thesis

title *Fantacalcio Online*

supervisor Prof. Paolo Liberatore

description The goal of my thesis was an implementation of a web application based on a famous Italian game named *Fantacalcio*. I developed both the server side and client side. In my country, this game is played by about 3 millions of people and the innovation of my work was an application completely free whereby everybody can use it without spending any kind of money.
Moreover, I strictly followed a spiral model as *Software Development Process* that allowed me to understand very well, even in the early development, what and how I should have to implement in order to reach the goal.

Rome, October 18, 2017

Fabio Previtali

Autorizzo al trattamento dei dati personali ai sensi del Decreto Legislativo 30 giugno 2003 n. 196 "Codice in materia di protezione dei dati personali".