Axel Furlan

PhD candidate in Robotics and Computer Vision

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Research interests

Indoor scene reconstruction from moving observer
Autonomous navigation
Multiple object detection and tracking
Learning in graphical models
Vision for robot-world interaction

Education

Sep 2012 - Nov 2012	Visiting Scholar at Prof. Silvio Savarese's Vision Lab. University of Michigan, Ann Arbor, MI, USA
May 2012 - Aug 2012	Visiting Scholar at Prof. FeiFei Li's Stanford Vision Lab. Stanford University, Stanford, CA, USA
Sep 2011 - Apr 2012	Visiting Scholar at Prof. Silvio Savarese's Vision Lab. University of Michigan, Ann Arbor, MI, USA
Jan 2010 - now	PhD candidate in Computer Vision I am a 4th year Ph.D. candidate in the Informatics Doctorate Program at the Università degli Studi di Milano Bicocca, Milan, Italy Topic: Scene reconstruction for autonomous navigation. Adviser: Prof. Domenico G. Sorrenti. Co-Adviser: Prof. Silvio Savarese. Tutor: Prof. Giancarlo Mauri.
Oct 2005 - Mar 2009	Masters Degree Thesis title: "Object detection and robust tracking system in a multi-hypothesis probabilistic framework" Advisor: Prof. Domenico G. Sorrenti, IRALab, Università degli Studi di Milano Bicocca, Milan, Italy
Sep 2002 - Sep 2005	Bachelor Degree in Informatics (audio video systems and nets) Thesis title: "Using UMTS technology for the remote control of a mobile robot" Advisor: Dott. Ing. Francesco Fabris, Universit degli studi di Trieste, Trieste, Italy
Sep 1997 - Jul 2002	Experimental Scientific program (mathematics, physics and informatics) Scientific Lyceum with Slovenian teaching language F. Prešeren, Trieste, Italy

Publications

A. Furlan, S. D. Miller, D. G. Sorrenti, L. Fei-Fei, S. Savarese
Free your Camera: 3D Indoor Scene Understanding from Arbitrary Camera Motion
24th British Machine Vision Conference (BMVC), 2013 - Accepted

A. L. Ballardini, A. Furlan, A. Galbiati, M. Matteucci, F. Sacchi, D. G. Sorrenti

An effective 6DoF motion model for 3D-6DoF Monte Carlo Localization
4th Workshop on Planning, Perception and Navigation for Intelligent Vehicles, IROS, 2012

A. Furlan, D. Marzorati and D. G. Sorrenti
On the normality of the projection parameters
Mathematics of Filtering and its Applications (MFA), 2011

A. Furlan, D. Marzorati and D. G. Sorrenti
Scale-independent Object Detection with an Implicit Shape Model
Third International Conference on Imaging for Crime Detection and Prevention' (ICDP), 2009

Deliverable 5.2 of the RAWSEEDS Project (www.rawseeds.org), 2009

Demos

May 2013	Autonomous car driving live demo at Wired Next Fest. For this demo we had our autonomous car driving people around for 3 days in an offroad, heavily crowded environment at the city park of Porta Venezia in Milano.
March 2013	Autonomous car driving demo, interview and photo session for "Quattro Ruote" (automobile magazine). In this demo we showed the ability of our autonomous car to drive inside an indoor parking lot.
January 2013	Indoor autonomous robot navigation demo with Geo Scienza, RAI 3 (national television).
January 2011	Outdoor autonomous car driving demo with RAI 3 (national television). In this demo we recoded for RAI 3 some sequences of autonomous driving within the University of Milano - Bicocca campus.
November 2010	Indoor autonomous car driving demo at the Electrical Intelligent Vehicles Fair 2010 (EIV2010). In this demo we had our autonomous car driving people between stands of the fair for 4 days, moving through small spaces and in a highly crowded environment.

Grant proposal

2013 HTC Mobile Computing Academic Research Program	Together with professors Silvio Savarese and FeiFei Li, I wrote a grant proposal for the 2013 HTC Mobile Computing Academic Research Program, which was recently accepted. This is a three year grant which, quoting the call for participation document, "aims to establish multi-institute, multi-year research works to develop cutting-edge technologies for improving user experiences with their mobile devices".

Research Activities

Reviewer	Reviewer for CVPR, ICCV, Robocup
Industrial projects	I am currently working at the ROAMFREE project in cunjuction with InfoSolution and the Politecnico of Milano.
Teaching assistant	Teaching assistant for the courses of Computer Vision, Robotics, Industrial Informatics (microcontrollers) and Computer Architecture

Thesis co-advisor	I have been the thesis co-advisor of 7 students in Robotics and Computer Vision projects since September 2009.

Ph.D. Research Projects

Joint object detection and indoor scene reconstruction	I'm working on this project under the advisory of Prof. Silvio Savarese (Vision Lab, University of Michigan). In this project we are extending the existing indoor scene reconstruction framework (Furlan *et al.*, BMVC13) to jointly reason about objects and geometrical structure of the scene.
Indoor scene reconstruction from moving observer	I worked on this project under the advisory of Prof. Silvio Savarese (Vision Lab, University of Michigan) and Prof. FeiFei Li (Stanford Vision Lab, Stanford University). Within this project we developed a real-time approach capable of jointly exploit scene estimation techniques and SLAM approaches, in order to estimate the geometrical structure of indoor scenes by integrating different view point information from a video sequence. Camera movement does not need to be known, the observer can freely move with 6DoF and no Manhattan world assumption is made. This work was published at BMVC 2013.
Urban Shuttles Autonomously Driven (USAD)	With my research group I designed and developed an autonomous driving system for an electrical golf cart. Given the system's complexity, many groups of students were involved in developing its various parts. Along with the coordination of the students, I contributed to the realization of the path-following function with velocity control, the trajectory planning algorithm and the development of a 6DoF extension (published at the IROS Workshop 2012) of the canonical 3DoF odometry model for AMCL self-localization (Probabilistic Robotics). We are now working on the inclusion of the camera-based object detection and tracking system. For this project an electric golf cart was used. We created the whole automation system, starting with mechanics and afterwards adding electronics and firmware. I personally designed and created the steering gearbox, the power and control boards and the firmware for controlling the steering angle. As a further step, I modified a partially working prototype of the encoder board and created both the electronic throttle control board and the emergency automatic-to-manual switching board. All these components were manufactured in our laboratory. Please refer to the "Demos" section for a list of public demonstrations of the results achieved within this project.
GA Project (indoor autonomous navigation and robot-tracking)	This project involves autonomous indoor navigation of a mobile robot and human-robot interaction. The robot is free to drive within our Department building, and is equipped with an artificial arm to open doors and use elevators. Its tasks will cover post delivery of any kind and guidance for visitors. Besides, the robot will be tracked by a fixed camera network; the output of the tracking system will be used both as emergency relocation for the robot's auto-localization system (in case of irrecoverably wrong pose estimation) and as visual feedback for visitors who have previously requested robot's guidance service.

Master Thesis

Scale-Independent Object Detection with an Implicit Shape Model

Research and development of an object detection and tracking system based on the Implicit Shape Model within a Model Selection Framework. The project was drawn from the work of Leibe et al. As an innovation, I proposed to modify the original approach in order to estimate the object's scale without the potentially noisy scale information generated by local descriptors like Shape Context or SIFT. One of the main advantages of this approach is that there is no need for scale-dependent training sets. This innovation was published at the ICDP conference in 2009.

Other Projects

2009

Occasional collaboration
Study and definition of a framework for people tracking, analysis of a multi-hypothesis approach, evaluation of the possible cases of failure of the imaging subsystem and documentation of the whole work. The project lasted 3 months.

2008

Occasional collaboration
Study and development of a system for people-tracking through fixed cameras in crowded environments. The project was developed in 3 months for Accenture S.p.A. together with the Politecnico of Milan. The work covered the study and testing of algorithms concerning several object recognition and tracking through fixed cameras. Finally a multicamera approach was developed for people-tracking on longer paths.

2007

Trinocular stereo vision system
In 2007 I worked at a vision system based on a trinocular stereo head. I developed this system with a colleague of mine within a project not bound to any specific course. The aim of our research was to explore new approaches for the data association problem among segments. In particular, by applying several domain transforms, we moved from the pixel space to reach a further parametric space of line sheaves. The preliminary results were encouraging, though the work was suspended because of lack of time.

2005

Stage for the Bachelor Degree
Research on the UMTS protocols applied to robotics. The project was developed at the AIBSLab Company in Trieste and lasted 4 months. The development of a system for the remote control of a mobile robot based on a 3Rd generation UMTS cell phone was the result of the project.

Personal Projects

2007

Image processing, adaptive background subtraction
During the 'Image processing 2' course I developed, together with a colleague, an algorithm for on-line background update in a video sequence. This technique allowed us to survey cars travelling through a crossroads while dealing with little camera movements and phenomena like waving trees. My participation in this project finished when we obtained the final results, but the same algorithm (with negligible modifications) was afterwards used by my colleague in a project of people-tracking in the London subway. Our approach was then verbally praised by the professors of Kingston University London where the tracking system was being developed.

Aug 2007 - Mar 2008

Robot building

I design and developed a mobile robot, Robocom 1st. The work was carried out in IRALab under the supervision of Prof. Domenico G. Sorrenti and Dr. Daniele Marzorati and included design and development of both mechanical and electronic components of the robot. The most precise mechanical pieces were ordered from a manufacturer, while the other mechanical and all the electronic components were made in our lab. In order to interact with the manufacturer I had to learn CAD software programming. Design and development of the electronic components were the result of a long period of study on techniques for the creation of electronic components. Robocom 1st was and still is employed in several projects, e.g. Rawseeds, also in collaboration with the Politecnico of Milan.

2007 - now

Printed Circuit Boards (PCBs) development
After carrying out the Robocom 1st project, I designed and developed PCBs for several mobile robots, exploiting protocols such as USB, SPI, ECAN, I2C for communication among different peripherals (accelerometers, photo-sensors, LCD displays, servos or motors, etc.) and micro-controllers at 8 and 16 bit.

2005

Computerized melody transcription
While attending the 'Signal processing' course in 2005, our team project (6 persons) also developed a software program which analyses a sound track containing a melody recorded by a real instrument and at the same time transcribes it in a MIDI file. Most of the efforts were dedicated to the definition of heuristics for the interpolation of melody pitches based on the coefficients of the Fourier transform over a variable time window.

2002 - 2005

Acoustics, psychoacoustics and sound analysis
During the 3 years of the bachelor degree - from - I attended several courses on acoustic physics which were partly held by teachers from the G. Tartini Conservatory in Trieste. Within these courses I had the opportunity for different kinds of laboratory experience and I developed both individual and team projects. These projects covered the knowledge and development of software tools for the study of perception phenomena like beats and 'Tartini's Third Sound'. Experiments were carried out both with physical devices (vibrating tightened strings, instrument tuning sessions) and with informatics tools exploiting functionalities offered by the software Mathematica.

Summer Schools

2011

2^{nd} PLUS School
In 2011 I participated in the 2nd PLUS School, held in Genoa at the Italian Institute of Technology. The school covered computer vision topics like scene understanding, object detection and tracking, probabilistic graphical models etc.

2010

Ageing Society and Technology: Systems, Theories, Practices
In 2010 I participated in the 'Ageing Society and Technology: Systems, Theories, Practices' Summer School in Ascoli Piceno, Italy. The school covered topics like robotics for the ageing society and vision systems for social-aid applications.

2010

2^{nd} International Computer Vision Summer School
In 2010 I participated in the 2nd International Computer Vision Summer School organized by the University of Catania. The school covered a large number of computer vision topics.

2006

Computer Science Robots intelligently interacting with people
In 2006, while still a master student, I was admitted to a cycle of lectures in Computer Science on 'Computer Science Robots intelligently interacting with people' that was organized as a Ph.D. summer school. This course was held on Crete and the lecturers were the major world wide exponents in Robotics and Computer Vision.

Teaching

2009 - now	Teaching assistant in Computer Vision, Robotics, Industrial Informatics and Computer Architecture Teaching assistant (expert and senior student). Since 2009 I have been active as teaching assistant in the courses of Computer Architecture, Industrial Informatics and, informally, for Robotics and Computer Vision.
2009 - now	Thesis co-advisor I have been the thesis co-advisor of 7 students in Robotics and Computer Vision projects since September 2009.
2006 - now	Support for students in laboratory for computer vision and robotics Since 2006 I have supervised and aided students in their projects at the IRALab. Such projects vary from design and development of PCBs and electro-mechanical devices to computer vision and robotics algorithm developing and code writing.
2006 - now	Laboratory and e-learning tutor Since 2006 I have been active as a tutor for the course on Computer Architecture. My task includes helping students prepare for examinations, monitoring their on-line practice and preparing interactive material for their studies and self-grading tests.

Languages

Besides native Italian and Slovenian, I speak, read and write fluent English and I understand, speak and read German adequately.

Skills

Quick adaptation skills even in multi-cultural environments (my native town, Trieste, is historically multi-ethnic and can boast a very good inter-cultural integration).

Good teaching and expository skills in managing groups of students in research tasks.

Good team leading skills matured in more than 15 years (since I was 14) of voluntary service (see below, Other Activities and Interests).

Informatics skills (coding, algorithms developing and analysis, DB, systems, etc.).

Skilled in the following languages/tools: C/C++, C#, Java, VB, PHP, Microchip C, HTML, AJAX, Mathematica, Matlab, CAD, Eagle, graphics interfaces with MFC and Glade (gtk).

Other Activities and Interests

Since 2006 I have been a Certified Executive Ambulance Rescuer: qualified operator for DAE (semi-automated defibrillator), maxi-emergency and ECG with GPRS rescuer/headquarter interface.

Since 2006 I have worked in contexts of strong juvenile uneasiness, supporting educators and psychologists (UVI and CtiF, Milan).

I studied piano at the conservatory for 15 years, maturing experience in public exhibitions as soloist, piano accompanist, member of chamber groups, orchestras and choirs.

Sports: Baseball, Volleyball, Ski, Swimming, Sailing.

Martial arts: Karate (Shoto-Kai), Aikido.

From 1995 to 2005 I was an active boy-scout and from 2008 I have worked with scout groups during summer camps.