

## Personal information

Surname(s) / First name(s)

Telephone(s)

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Nationality(-ies)

Date of birth

Website

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## Activity

Research and Development on high-end interaction systems between humans and robots in Augmented and Virtual Environments. Expertise in the underlying software infrastructure involving networking, system-level optimization and data analysis using computer vision and machine learning.

## Work Experience

Dates

Occupation or position held

Name and address of employer

Research Topics

Main activities and responsibilities

May 2007 - May 2018

Assistant Professor

Scuola Superiore Sant'Anna, Pisa, Italy - PERCRO laboratory

Computer Vision (2014-); Human-Centered Robotics (2012-) Wearable Systems for Ergonomics (2011-); Machine Learning for industrial environment and robotics (2010-); Virtual Environments for Human Training (2006-); Virtual and Augmented Reality: software, systems and interaction (2003-); Haptic Rendering (2002-2010);

- Team manager as leader of the "Sensing, Modeling and Learning Group" at SSSA comprising 3 PhDs, 1 postdoc and 1 engineer as of July 2017
- Software development and system design for research and industrial projects
- Principal Investigator of research grants with financial responsibility: currently 1 European projects, 1 national, 1 industrial one (300k€/ year in average)
- Effort estimation, break down and coordination of activities
- Grant writing at European, national and industrial level, both as PI or as contributor
- Scientific service to community: review for conference and journals, Co-Chair of IEEE Technical Committee on Haptics. Organization of international events (IEEE Program Chair, workshop organization)
- Tutoring of PhD and master students (9 PhDs and 20 master)
- Lecturing at PhD and master level

Research Results

Publications in the areas of virtual reality, haptic rendering, haptic devices, human training in virtual environments, wearable sensing: 24 ISI Journal papers, 90 peer-reviewed conference papers (54 IEEE/ACM), 10 book chapters, 29 posters and workshops, 9 invited talks, 2 patents. H-Index: 15 ([Scholar](#)), 12 (Scopus), Erdos number 5. Best poster award at MMVR14. Visual listing of publications available [here](#)

Dates	July 2006 - April 2007
Occupation or position held	Research Fellow
Name and address of employer	Scuola Superiore Sant'Anna, Pisa, Italy - PERCRO laboratory
Main activities and responsibilities	Contribution to the definition of the system architecture of a haptic simulation of interaction of textiles ( <b>HAPTEX</b> ). Development of a framework in C++/OpenGL/Chai3D for the design of haptic-enabled games and applications under supervision of Prof. Frisoli.
Dates	August 2005 - June 2006
Occupation or position held	Visiting Student
Name and address of employer	Stanford University, BioRobotics Laboratory
Main activities and responsibilities	Research activity funded by grant AO 04-G66 "Virtual Reality Planning In Reconstructive Trauma Surgery" of MD. Sabine Girod, under the tutoring of Prof. Ken Salisbury and Federico Barbagli. Research on haptic collision detection for supporting the operation planning ?? ??.
Dates	June 2003 - August 2003
Occupation or position held	Visiting Scholar
Name and address of employer	University College of London, Computer Science Department
Main activities and responsibilities	Research period on evaluation of haptic experiments and CAVE

## Education and training

Dates	January 2003 - June 2006
Title of qualification	PhD
Principal subjects	PhD in Perceptual Robotics at PERCRO Laboratory with a Thesis entitled "Multirate and Perceptual Techniques for Haptic Rendering in Virtual Environments", tutor Prof. Massimo Bergamasco. Defended with Honors on 6th June 2006
Organization	Scuola Superiore Sant'Anna, Pisa, Italy
Dates	October 1997 - September 2003
Title of qualification	Diploma
Principal subjects	Five year grant with tight selection in parallel to Master studies. Thesis on "Haptic Scripting for setup of experiments". Defended with Honors on 10th September 2003.
Organization	Scuola Superiore Sant'Anna, Pisa, Italy
Dates	October 1997 - October 2002
Title of qualification	Master
Principal subjects	Master in Computer Engineering with a Thesis on "Integration of Database and interactivity in a visualization system based on the Information Landscape approach". Completed with Honors on 8th October 2002.
Organization	Università di Pisa, Italy

## Research Topics

Dates	2017-2018
Activity	Research on Human Activity based on Cameras and Deep Learning
Details	Multiscale modeling of people behavior from body motion to patterns across timescale. Research carried out in then INAIL project.
Dates	2015-2018
Activity	Research on Intention Recognition for Autonomous Driving
Details	As part of an industrial project for an automotive company aimed at estimating the behavior of vehicles in highway. Research on methods for modeling intention prediction using probabilistic graphical models and deep learning using sensor fusion data.

Dates	2018-2020
Activity	Research on Virtual and Mixed Reality for supporting physical pre-operative planning
Details	Mixed Reality and Human Computer Interaction. Research carried out in then Health Ministry 3D Virtual Baby Hearth project.
Dates	2012-2018
Activity	<b>Ergonomic Assessment using Wearable Systems</b> - <a href="#">website</a>
Details	Research, development and management of a system ( <a href="#">project page</a> ) for the real-time assessment of workload based on a wearable system capable of precision reconstruction of arm motion and EMG workload. Reconstruction algorithm core development based on UKF in C++/Eigen, co-development and optimization of the firmware STM32 in C. Experiment design and component selection. ?? ?? ?? ??
Dates	2015-2017
Activity	Research on Diagnostician User Interface for Haptic Remote Medicine
Details	Research and Development on a new Augmented Reality interface for interacting with a remote USG and palpation robot based on encountered haptic paradigm. Leading research on the interaction, component selection, core development in C++/OpenGL leading a new component framework for Mixed Reality interaction (CoCo). Papers: ??, ??.
Dates	November 2013 to December 2015
Activity	Human-Robot Interaction and Augmented Reality
Details	Research on a Baxter robot based system for the transfer of human abilities through robotics. Multi-camera sensor fusion, trajectory learning and AR feedback. ?? ??
Dates	March 2014 to November 2014
Activity	Pano-stereoscopic system for tele-presence
Details	System definition, component selection, core development (C++/OpenGL) and optimization for a system based on 5 pairs of cameras for real-time tele-presence and HMD. See ??
Dates	October 2006 to December 2011
Activity	<b>Platform for Sport Training in Virtual Environments</b>
Details	Research, development and team coordination on a system for training Rowing in Virtual Environments ( <a href="#">SPRINT</a> ) based on a multimodal platform. The system employed audio feedback, vibrotactile feedback, motion capture, integration of sensors such as VO2. Architecture design, interaction design, definition of feedback, 3D graphics development. Supervision of a PhD during the period and coordination of the team involving multiple partners for the development of the platform and execution of experiments. ??.
Dates	March 2009-2016
Activity	<b>Mobile Haptic Platform for Rehabilitation</b>
Details	Research and development of the MOTORE mobile rehabilitation device, currently being commercialized. Software platform design and development in C++/Qt, contribution to the design of the haptic rendering, co-development and optimization of the firmware in Simulink and C, communication protocol, project management. Papers: ??, ??, ??,??.
Dates	2011-2015
Activity	Machine Learning Anomaly Detection for Industry
Details	Research and team management for the creation of new algorithms, development and plant integration of systems for the identification of anomalies in data. Applied in a C++ software for the Italian electric utility.
Dates	January 2010-March 2011
Activity	Haptic Rendering and Interaction for Virtual Textiles

Details	Development of an interaction system for the haptic interaction with virtual textiles simulated using a FEM model. Algorithm and interaction design, development in C++ and OpenCL ??.
Dates	January 2008-September 2008
Activity	Haptic Virtual Laboratory
Details	Design and development of a system for the execution of multi user experiments involving haptic rendering and physics based simulation. Implemented in C++, OpenGL and XVR. ??.
Dates	2002-2010
Activity	Information Landscape Visualization System
Details	Research and development of a system for immersive data visualization. The system has been developed in C++/ OpenGL and designed to work in different types of Virtual Environments, from CAVE to HMDs. ??.

## Research Grants

This section presents the research grants of which I have been Principal Investigator or Fund Manager. Total raised funding 1.4M€.

Dates	2018-2020 (3 years)
Name	3D Virtual Baby Hearth GR-2016-02365072
Sponsor	Ministry of Health (Finalizzata 2016)
Grant Size	351k€ for the 2-partners project, 53k€ as SSSA
Details	Principal Investigator for SSSA of the Ministry of Health funded project on Human-Computer Interaction with 3D printed baby hearths using Virtual and Mixed Reality.
Dates	2017-2019 (2 years)
Name	SailPORT
Sponsor	INAIL BRIC 2016 ID 24
Grant Size	528k€ for the 10-partners project, 200k€ direct
Details	Scientific Coordinator of a project funded by the Italian National Institute for Insurance against Accidents at Work (INAIL) on safety of workers in sea ports. Dealing with deep-learning based computer vision for people flow and accident analysis, biomechanical analysis for safety at work using Wearable sensors. SSSA coordinates other 9 local health entities (ASL).
Dates	2015-2018 (3 years)
Name	MMRISK
Sponsor	Industrial
Grant Size	240k€
Details	PI of an Industrial research project on providing autonomous cars understanding of external vehicle and obstacle behavior. This activity is associated to the interest in general, probabilistic based, modeling of behavior.
Dates	2015-2018 (3.5 years)
Name	RAMCIP <a href="http://www.ramcip-project.eu/">http://www.ramcip-project.eu/</a>
Sponsor	EU H2020
Grant Size	335k€, 8 partners
Details	PI and Task Leader in an European Research project coordinated by CHERTH (GR) on Robotic Assisted Living for MCI people. Research on (1) estimation of biomechanical state of the user from the point of view of the robot, (2) quantification of user's skills and their progress along time, (3) human-robot interaction based on innovative AR.
Dates	2014-2017 (3 years)
Name	PELARS <a href="http://www.pelars.eu">http://www.pelars.eu</a>
Sponsor	EU FP7 Technology Enhanced Learning

Grant Size	370k€, 12 partners
Details	PI,WP Leaderm Technology Manager and Scientific Board member in an European project coordinated by CIID (DK) on Learning Analytics in Projectual-based learning. Research on (1) activity recognition based on vision (2) Learning Analytics methods for student profiling.
Dates	2015 (1 year)
Name	SMOOTI - <a href="#">press</a>
Sponsor	Industrial funded by Telecom Italia
Grant Size	35k€
Details	PI in an Industrial research project on prototyping a wearable system for real-time ergonomics during work activity. This activity continues and consolidates the previous ERGANE project.
Dates	2012-2015 (3 years)
Name	ERGANE
Sponsor	Italian CCM Ministry of Health - <a href="#">final workshop</a>
Grant Size	105k€
Details	PI in a Research project aimed at designing a wearable system based on inertial and EMG sensors for the ergonomic assessment in selected working activity. Leading the design on the motion reconstruction algorithms
Dates	2011-2013,2014,2016
Name	Anomaly Detection in Industrial Plants
Sponsor	Italian Electric Utility
Grant Size	110k€
Details	PI on two research projects funded by the Italian electric utility on the identification of anomalies in power plants.The most recent is related to the anomaly detection on a coal miller based on Machine Learning applied to large amount of historical data.The older was based on leakage detection based on the data recorded in an array of microphones.
Dates	2015-2016 (15 months)
Name	Future Challenges <a href="#">website</a>
Sponsor	H2020 CSA
Grant Size	25k€, 3 partners
Details	PI in an European project for selection of research Inducement Prizes coordinated by NESTA (UK). Consulting on the selection of the technologies to be investigated for the preparation of the challenges.

## Personal skills and competences

Mother tongue(s)

Other language(s)

*Self-assessment  
European level<sup>(\*)</sup>*

**English**

## Italian

Understanding		Speaking		Writing
Listening	Reading	Spoken interaction	Spoken production	
C1	C1	C1	C1	C1

<sup>(\*)</sup> Common European Framework of Reference (CEF) level

## Management skills and competences

- Activity coordination in the team, and at the level of consortium as Workpackage leader
- Presentation of results at Review meeting
- Effort estimation, break down, reporting
- Financial accounting rules for projects funded by national or European calls

## Technical skills and competences

Listing of Open Source contributions: [here](#)

- Main Programming Language: C++ and cross-platform programming. Use of C++ since 1995 in networked, multi-threaded applications ranging from robotics, virtual reality and machine learning. Library and tools development.
- Component-based, concurrent and soft real-time programming
- Secondary Languages: Python and Matlab used for tooling and data analysis. Talk at EuroPython ?? ??
- Languages used in the past: x86 assembler, PHP, Java, C#, Delphi
- C++ Libraries: Qt, Eigen, boost, OpenCV, Aruco, PCL
- Parallel and GPU computing: OpenMP (paper ??) and CUDA
- Programming Tools: cmake, Doxygen, graphviz
- Unit Testing tools: catch
- Version control systems: git, previously subversion and mercurial
- Software Management Tools: Jenkins, rhodecode
- Use of Web technologies (HTML5, REST and Javascript) mainly for exposing software functionalities
- Daily usage of LaTeX for reporting and documentation, automatic report generation
- Architecture Tools: interest in SysML (paper ??)

## 3D and Virtual Reality Technologies

- Display with Oculus HMD and HTC Vive, experience in CAVE
- Motion Capture with Vicon and Xsens
- Application development with custom framework (XVR, CoCo) and Unity
- OpenGL API: 2.x and 3.3, WebGL
- Research and development experience with haptic interfaces: worked with Phantom, custom Exoskeleton, custom desktop devices
- Disciplined approach in Transformation Graphs for telepresence systems

## Data Processing

- Deep learning using Python frameworks
- Mainly Matlab/Simulink with C++ adaptation, machine learning methods with interest in probabilistic graphical models for static and dynamic models.
- Sensor fusion based on non-linear Kalman filtering
- Interest in data management software with provenance for traceable research

## Platforms

- Operating Systems: OSX (main), Linux (development) and in the past Windows (low level), with some exposure to OpenVMS
- Multiplatform and cross-platform development with C++
- Knowledge of internal structure of operating systems (Windows and Linux) and the system stack
- Use of Virtualization technologies for improving software development: Vagrant and Docker
- Embedded systems: some experience with ARM solutions in particular STM32, and in the past use of TI C2000
- Network programming at various levels
- Robotic development using ROS - [github](#) - papers ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ?? ??

Torre del Lago Puccini, February 22, 2018

Emanuele Ruffaldi