

# Emanuele Ruffaldi

PhD. Eng. - Senior IEEE

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## Areas of Expertise

Software Development

Virtual and Augmented Reality

Sensor Fusion

Robotics

Haptics

Machine and Deep Learning

Research Team Management

Agile Project Management

## Experience

**Sr. Software Developer, MMI SpA** - <http://www.mmimicro.com/>

April 2018 to Present, Pisa, Italy

Embedded software development for the Microsurgical Robot device by MMI in the R&D department. The activity deals with architecture optimization, Master sensins and anomaly detection, validation and verification for IEC 62304 compliance.

**Assistant Professor, PERCRO, Scuola Superiore Sant'Anna** - <https://www.santannapisa.it/en/>

June 2007 to April 2018, Pisa, Italy

Research and development, team management and tutoring, multi partner research management, research project financial responsibility (300k€/year), EU grant writing. Lecturing (Computer Vision, Interaction in Virtual Environments and haptics related classes). Principal Investigator (PI) of one European and one national project.

### > Leader of Sensing, Modeling and Learning for Humans Group

2010-2018

Engineering team management spanning several research projects. The group currently comprises 1 PhD students, 3 Post-doc and 2 master students. In the past tutored 9 PhDs and supervised 20 master theses.

### > PI on Ergonomic Assessment using Wearable Systems

Since 2012 to 2018, ministry of health project, industrial collaboration and INAIL project (2 years)

Research, development and management of a system 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.

### > PI Research on Intention Recognition for Autonomous Driving

2015-2018

Industrial project for an automotive company aimed at estimating the behavior of vehicles in highway. Development of a C++ software framework based on probabilistic graphical models.

### > Research on Diagnostician User Interface for Haptic Remote Medicine

December 2013 to 2016

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 guiding a new component framework for Mixed Reality interaction (DiagUI).

### > Transfer of Human Abilities to Robot

November 2013 to December 2015, regional project – Research on a Baxter robot based system for the transfer of human abilities through robotics. Multi-camera sensor fusion, trajectory learning, AR feedback

### > Pano stereoscopic system for tele-presence

March 2014 to November 2014, industrial collaboration - 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.

### > Platform for Sport Training in Virtual Environments

October 2006 to December 2011

Research, development and team coordination on a system for training Rowing in Virtual Environments (SPRINT) 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.

### > **Mobile Haptic Platform for Rehabilitation**

March 2009 to 2018, industrial collaboration and regional/European funding

Research and development of the MOTORE mobile rehabilitation device, currently being commercialized. Software platform design and development in C++/Qt (32kLOC), contribution to the design of the haptic rendering, co-development and optimization of the firmware in Simulink and C, communication protocol, project management.

### > **Machine Learning Anomaly Detection for Industry**

January 2011 to 2015

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.

### > **Haptic Rendering and Interaction for Virtual Textiles**

January 2010 – March 2011

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.

### > **Haptic Virtual Laboratory**

January 2008 to September 2008

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.

### > **Information Landscape Visualization System**

Since 2002 to 2010

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 Fellow, PERCRO, Scuola Superiore Sant'Anna**

June 2006 to May 2007, Pisa, Italy

Contribution to the definition of the system architecture of a haptic simulation of interaction of textiles (HAPTEX). Development of a framework in C++/OpenGL/Chai3D for the design of haptic-enabled games and applications

## **Education**

### **Visiting Researcher, Stanford CS Department, BioRobotics Lab**

September 2005 to June 2006, Stanford CA

### **Ph.D. CS & Robotics, Scuola Superiore Sant'Anna**

January 2003 to June 2006, Pisa, Italy – on Haptic Rendering, with Honors

### **Diploma of Engineering, Scuola Superiore Sant'Anna**

October 1997 to October 2002, Pisa, Italy – on Immersive Visualization, with Honors

### **MS in CS Engineering, University of Pisa**

October 1997 to October 2002, Pisa, Italy

## **Technical Competences**

Public Code Repository: <https://github.com/eruffaldi> and code listing <https://goo.gl/tyXkCM>

Main language: C++ with cross-platform programming. Use of C++ since 1995 in networked, multi-threaded applications ranging from robotics (ROS), virtual reality and machine learning (Tensorflow). Library and tools development. Usage of several libraries such as Qt, Eigen, OpenCV, PCL and CHAI3D. Parallel and GPU

Technology Domains: Robotics (2006-), AI&ML (2006-) CVision (2014-), VR&AR (2003-), Haptics (2002-2018)

Additional languages: Python (2005-), Matlab/Simulink (1998-) and Labview CLD certified (2018-)

3D and Virtual Reality technologies: OpenGL, HMD/CAVE, Vicon Motion Capture

Platforms: Linux and macOS after long Windows experience

Open Source contributions: x264, OpenCV and minor projects

## **Research Products - <https://goo.gl/QHBvdz>**

Awarded National qualification for Associate professorship in Computer Engineering – July 2018/July 2024 and Applied Mechanics – Nov 2019/Nov 2024.

Patents: 1 granted, 2 applications

Publications: 26 ISI Journal papers, 96 peer-reviewed conference papers (58 IEEE/ACM), 10 book chapters, 29 posters and workshops, 9 invited talks. H-Index: 17 (Scholar), 14 (Scopus).