Davide Costanzi

Curriculum vitae

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"Fatti non foste a viver come bruti, ma per seguir virtute e canoscenza" – Ulisse, Divina Commedia, Canto XXVI Inferno, Dante Alighieri

Research Interests

The research field of Davide Costanzi is assistive wearable robotics. His main interests include design, software development and human-machine interface of these robotic devices. He aims at developing effective *intention-based* control strategies for arm exoskeletons to assist physically impaired people in activities of daily living. His current research focuses on both experimental and theoretical aspects of *myoelectric control*. Since 2015, he is a collaborator of the advanced robotics laboratory ALTAIR, Dep. of Engineering for Innovation Medicine, University of Verona, Verona (Italy), where he conducts his research activity within the wearable robotics team. His expertise areas include:

- Signal Processing & Sensor Fusion;
- Bioelectric Signals (surface Electromyography – sEMG)
- Human-Machine Interfaces (HMIs)
- Assistive Wearable Robotics (Arm Exoskeletons)
- Control Systems

Experience

Oct 2015 ongoing — **Collaborator**, *Research activities with the wearable robotics team at the advanced robotics laboratory ALTAIR, Dep. of Engineering for Innovation Medicine*, University of Verona, Verona – Italy
Scientific coordinator: Prof. Andrea Calanca, PhD

Aug 2024 Dec 2024 — **Research Fellow**, *Progettazione meccanica di un esoscheletro con compensazione di gravità e mobilità di spalla-gomito*, University of Verona, Verona – Italy
Mechanical design of an upper limb assistive exoskeleton with gravity compensation and shoulder-elbow mobility
- **Supervisor**: Prof. Andrea Calanca, PhD

Jul 2022 Jun 2023 — **Research Fellow**, *Investigazione su controllo mioelettrico per esoscheletri assistivi all'arto superiore*, University of Verona, Verona – Italy
Development of control systems for upper limb assistive exoskeleton based on myoelectric signals
- **Supervisor**: Prof. Andrea Calanca, PhD

Jan 2020 Dec 2020 — **Research Fellow**, *Sviluppo di algoritmi di fusione sensoriale e controllo dell'interazione tra uomo e robot sfruttando componenti a basso costo*, University of Verona, Verona – Italy
Development of algorithms and methodologies to exploit low-cost hardware for human-robot interaction, including advanced sensor fusion algorithms for EMG signals analysis
- **Supervisor**: Prof. Paolo Fiorini, PhD

Oct 2017 Jun 2018 — **Student's Tutor**, *Programming I*, Prof. Nicola Bombieri, PhD, University of Verona
Evaluation of C programming exercises through e-learning platform

Oct 2016 – Jun 2017 **Student's Tutor**, *Programming II*, Prof. Nicola Fausto Spoto, PhD, University of Verona
Provide help to the students with the JAVA programming laboratory

Oct 2015 – Oct 2021 **PhD Student**, *Supervisors: Prof. Andrea Calanca, PhD, Prof. Paolo Fiorini, PhD*, Dep. of Computer Science – University of Verona, Verona – Italy
- **Thesis title**: *Myoelectric Control Architectures to Drive Upper Limb Exoskeletons*
- **Teaching** (student's tutor): Programming I, Programming II
- **Representative** of XXXI Cycle Computer Science PhD Students, Doctoral School of Natural Science and Engineering

Oct 2014 – Jun 2015 **Student's Tutor**, *Physics I*, Prof.ssa Pasquina Marzola, PhD, University of Verona
Provide help to the students with the exercises of the course

Oct 2012 – Feb 2013 **Stage**, *ESD Laboratory*, Verona - Italy
Development of tool HIF2IPXACT for EDALab s.r.l.
- **Academic Tutor**: Prof. Graziano Pravadelli, PhD
- **Company Tutor**: Prof. Sara Vinco, PhD

Education

2015–2021 **PhD in Computer Science – *XXXI Cycle***, *Dep. of Computer Science – University of Verona*, Verona – Italy, *Graduated on October 26th, 2021*
- **Thesis title**: *Myoelectric Control Architectures to Drive Upper Limb Exoskeletons*
- **Supervisor**: Prof. Andrea Calanca, PhD
- **co-Supervisor**: Prof. Paolo Fiorini, PhD
- **url**: `http://hdl.handle.net/11562/1061781`

2013–2015 **Master's degree in Computer Science and Engineering *Embedded Systems curriculum***, *University of Verona*, Verona – Italy, *Graduated on October 21st, 2015* with degree *110/110 cum laude with special mention for the curriculum*
- **Thesis title**: *Analysis of a Single Actuator Exoskeleton*
- **Supervisor**: Prof. Paolo Fiorini, PhD
- **co-Supervisor**: Prof. Andrea Calanca, PhD

2010–2013 **Bachelor degree in Computer Science**, *University of Verona*, Verona – Italy, *Graduated on July 15th, 2013* with degree *110/110 cum laude with mention*
- **Thesis title**: *Automatic Generation of IP-XACT models*
- **Supervisor**: Prof. Graziano Pravadelli, PhD

2005–2010 **Scientific High School Diploma**, *Liceo Scientifico Statale G.Galilei*, Verona – Italy, *Graduated in July 2010* with degree *100/100*

Projects

Jan 2022 – Jul 2024 **Collaborator**, *Nello sguardo è il tuo futuro: Diagnosi precoce di autismo e movimenti oculari*, University of Verona, Verona – Italy
Long-term project founded by the Brain Research Foundation Verona Onlus (BRFVr) to sistematically analyse eye movements and cinematics in a large infants population, with the aim of verifing these measures viability as early diagnosis indexes of an Autistic Spectrum Disorder (ASD).
- **Supervisors**: Prof. Paola Cesari, PhD, Prof. Chiara Della Libera, PhD, and Prof. Leonardo Zoccante, MD
- **Role**: IT support, management of experimental data collection and development of analysis software.
- **Setup**: BabyLab was equipped with 4 IR-cameras optical MOCAP system (Vicon), retinal eyetracker (SMI), monitor with adjustable mount, and PC workstations.

Phd

Oct 2018 – Sep 2019 **Collaborator**, *Progettazione di un'ortesi robotica per l'arto superiore con controllo mioelettrico e indirizzata a soggetti con debolezza muscolare*, University of Verona, Verona – Italy

EU/FSE project founded by regional administration (Regione del Veneto) for developing an innovative upper arm orthesis with myoelectric interface for subject suffering from muscular weakness.

- **Supervisors**: Andrea Calanca, PhD, and prof. Paolo Fiorini, PhD
- **Role**: Participation in project writing, collaboration to the definition of orthesis requirements, development of myoelectric control architecture.

Master's degree (course projects)

Second year II semester **Robotics**, *Prof. Riccardo Muradore, PhD*

- **Topic**: Tele-operation algorithms, Orocos
- **Description**: Implementation in a real scenario (not simulation) of a state-of-the-art force/velocity tele-operation algorithm; code developed using the real-time control framework Orocos.

Second year I semester **Data Intensive Computing Systems**, *Prof. Damiano Carra, PhD, with Katia Maschi*

- **Topic**: Giraph, Hadoop, Subgraph Isomorphism
- **Description**: Porting and testing of a Giraph (an Hadoop cluster-based computing model designed for working with large-scale graphs) program to solve the Subgraph Isomorphism Problem.

Second year I semester **Software for Embedded Systems**, *Prof. Graziano Pravadelli, PhD*

- **Topic**: Fault injection, Hardware simulation, OVP (Open Virtual Platform)
- **Description**: Development of a tool for simulated CPU-level fault injection into an OVP model, in order to evaluate software robustness at running on faulty CPUs.

Second year I semester **Natural Computing Models**, *Prof. Giuditta Franco, PhD, with Luca Piccolboni*

- **Topic**: Compressed Suffix Array, FM-Indexes, dictionary-based DNA analysis
- **Description**: Development of an efficient algorithm to build fixed word size dictionaries from compressed Suffix Arrays of DNA strings, in the form of *FM-Indexes* (developed by prof.s Ferragina and Manzini)

First year II semester **Non-Visual Interaction**, *Prof. Paolo Fiorini, PhD, with Nicolò Dalla Riva*

- **Topic**: Path planning, ROS (Robot Operating System)
- **Description**: Benchmarking of path planning algorithms, using OMPL (Open Motion Planning Library), a library implementing sample-based planning algorithms, ROS and V-rep to simulate their behaviour.

First year II semester **Networked Embedded Systems**, *Prof. Davide Quaglia, PhD*

- **Topic**: Formation control, simulation
- **Description**: Development using SystemC and SCNSL (SystemC Network Simulation Library) of a simulation environment for network-aware formation control algorithms evaluation.

First year II semester **Advanced Architectures**, *Prof. Nicola Bombieri, PhD*

- **Topic**: CUDA C++ programming
- **Description**: Development of a GP-GPU version of the algorithm to solve Maximum Flow Problem.

Scientific Publications

Peer-reviewed Journals

Zandonà C, Roberti A, ***Costanzi D***, Gül B, Akbulut Ö, Fiorini P, Calanca A. *A Comparison between Kinematic Models for Robotic Needle Insertion with Application into Transperineal Prostate Biopsy.* MDPI Technologies. 2024 Mar;12(3):33. doi: 10.3390/technologies12030033. Epub 2024 Mar 1.

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Feola E, Refai MIM, ***Costanzi D***, Sartori M, Calanca A. *A Neuromechanical Model-Based Strategy to Estimate the Operator's Payload in Industrial Lifting Tasks.* IEEE Trans Neural Syst Rehabil Eng. 2023;31:4644–4652. doi: 10.1109/TNSRE.2023.3334993. Epub 2023 Nov 20. PMID: 37983149.

Calanca A, Toxiri S, ***Costanzi D***, Sartori E, Vicario R, Poliero T, Natali CD, Caldwell DG, Fiorini P, Ortiz J. *Actuation Selection for Assistive Exoskeletons: Matching Capabilities to Task Requirements.* IEEE Trans Neural Syst Rehabil Eng. 2020 Sep;28(9):2053–2062. doi: 10.1109/TNSRE.2020.3010829. Epub 2020 Jul 21. PMID: 32746325.

Conference Proceedings

Costanzi D, Gandolla M, Calanca A. *Towards Personalized Myoelectric Control Strategies.* 2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE 2023). Oct 2023, pp. 858–863, doi: 10.1109/MetroXRAINE58569.2023.10405566.

Calanca A, Dimo E, Palazzi E, Luzi L, Ferro R, Sartori E, Vicario R, Murr N, Meneghetti M, ***Costanzi D***, Vertechy R, Fiorini P. *Toward Personal Affordable Exoskeletons With Force Control Capabilities.* The 14th PErvasive Technologies Related to Assistive Environments Conference (PETRA 2021). Jun 2021. pp. 156–159. doi: 10.1145/3453892.3454005.

Calanca A, Palazzi E, Vertechy R, ***Costanzi D***, Sartori E, Dimo E, Murr N, Zanni G, Fiorini P. *Enabling Force Controllability by Mechanics in Exoskeleton Design.* First Italian Conference on Robotics and Intelligent Machines (I-RIM Conference 2019). 2019. pp. 1–2.

Languages

Italian	Mother tongue	
English	PET Certification (level B1) in March 2009	*certified by the Cambridge ESOL at the branch of Verona*

Computer Experience

Programming (general)	C, C++, Python, CMake, Java, HTML, PostgreSQL
Programming (specific)	ROS (Robot Operating System), CUDA, Hadoop
Operating Systems	Windows, Linux-Ubuntu (command line, development environment, system programming)
Software	Microsoft Office, OpenOffice, Microsoft Visual Studio, NetBeans IDE, Eclipse IDE, QtCreator, LaTeX, MatLab

According to the Italian law D. Lgs. 196/2003 (art. 13) and to the European Parliament Regulation GDPR 679/2016 (art. 13), I hereby express my consent to process and use my data provided in this CV for this application.

Verona, January 9, 2025

Davide Costanzi