

Curriculum Vitae of Lorenzo Grazi

December 1, 2022



Lorenzo Grazi

38, Via Bachelet, Cascina (PI), 56021, Italy

Birth date and place: October 17, 1987, Pisa, Italy

Contacts

Phone (office): 050 88 3475

Mobile: 346 7497225

Email: lorenzo.grazi@santannapisa.it, lorenzo.grazi87@gmail.com

Skype: lorenzo.grazi

Google Scholar web page: <https://scholar.google.com/citations?user=553wvv8AAAAJ&hl=it>

ResearchGate web page: <https://www.researchgate.net/profile/Lorenzo-Grazi>

Current position

Post-doctoral researcher at The BioRobotics Institute, Scuola Superiore Sant'Anna, Pisa, Italy

Affiliations

- Wearable Robotics Laboratory
The BioRobotics Institute, Scuola Superiore Sant'Anna
Viale Rinaldo Piaggio 34, 56025, Pontedera (PI), Italy
- Department of Excellence in Robotics and AI
The BioRobotics Institute, Scuola Superiore Sant'Anna
Viale Rinaldo Piaggio 34, 56025, Pontedera (PI), Italy

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Education

Undergraduate and graduate

- May 15, 2020: Doctor of Philosophy (PhD) degree in Biorobotics (*cum laude*), Scuola Superiore Sant'Anna, Pisa, Italy.
 - Dissertation title:* "Wearable robotics for the industry: control and assessment of exoskeletons with the human in the loop"
 - Duration:* October 2016 – May 2020
 - Dissertation supervisors:* Prof. Nicola Vitiello (Scuola Superiore Sant'Anna), Dr. Simona Crea (Scuola Superiore Sant'Anna)

- December 2, 2014: Master of Science (MSc) degree in Biomedical Engineering, curriculum "Industriale" (107/110), School of Engineering, Università di Pisa, Pisa, Italy.
 - Dissertation title:* "Gastrocnemius myoelectric control of a robotic hip exoskeleton"
 - Duration:* December 2011 – December 2014
 - Dissertation supervisors:* Prof. Cecilia Laschi, Prof. Silvestro Micera, Dr. Nicola Vitiello

- December 6, 2011: Bachelor of Science (BSc) degree in Biomedical Engineering, curriculum "Industriale" (94/110), School of Engineering, Università di Pisa, Pisa, Italy.
 - Dissertation title:* "Confronto di modelli per la valutazione del cross-shear nell'usura di protesi d'anca"
 - Duration:* September 2006 – December 2011
 - Dissertation supervisors:* Dr. Francesca Di Puccio (Università di Pisa), Dr. Lorenza Mattei (Università di Pisa)

- July 2006: High-school degree (94/100), Liceo Classico "G. Galilei", Pisa, Italy.
 - Duration:* September 2001 – July 2006

Other educational activities

- September 26-29, 2016: XXXV Scuola Annuale di Bioingegneria "La Bioingegneria per il benessere e l'invecchiamento attivo", Casa della Gioventù dell'Università di Padova, Bressanone, Bolzano, Italy, organized by Gruppo Nazionale di Bioingegneria.

Work Experience

- May 2020 – present: Post-doctoral researcher, Wearable Robotics Laboratory, The BioRobotics Institute, Scuola Superiore Sant'Anna
 - Main Activities and Responsibilities:
 - main research activity in the field of occupational exoskeletons;
 - work on European projects;
 - supervision of Master students;
 - writing of scientific publications and technical documentation;
 - management of non-disclosure agreements (NDA);

- experimental trial manager of the Wearable Robotics Laboratory for both clinical and non-clinical experimental studies.
- February 2016 – September 2016: Research assistant (Assegnista di ricerca) on “Design, development and experimental validation of control system and human-robot interfaces for wearable robotic devices” (“Progettazione, sviluppo e validazione sperimentale di sistemi di controllo ed interfacce uomo-macchina per sistemi robotici indossabili”), Wearable Robotics Laboratory, The BioRobotics Institute, Scuola Superiore Sant’Anna
- Main Activities and Responsibilities:
 - design, development and experimental validation of control system and human-robot interfaces for wearable robotic devices (both lower-limb and upper-limb exoskeletons, i.e. active pelvis orthosis, knee-ankle-foot orthosis, elbow and shoulder-elbow exoskeletons);
 - research activity focused on the development of interfaces exploiting electromyographic signals both for controlling exoskeletons and assessing the motor functions of human limbs;
 - development of control strategies to provide hip movement assistance during walking with an active pelvis orthosis;
 - research activity on the assessment and evaluation of motor functions in activity of daily living and rehabilitation scenarios with an upper-limb exoskeleton;
 - experience on carrying out several experimental sessions (on healthy subjects), both with lower-limb and upper-limb exoskeletons.
- January 2015 – January 2016: Post-degree scholarship (Borsista di ricerca) on “Adaptive control strategies for wearable robotic devices for motor assistance and rehabilitation” (“Strategie di controllo adattive per sistemi robotici indossabili per l’assistenza e la riabilitazione motoria”), Wearable Robotics Laboratory, The BioRobotics Institute, Scuola Superiore Sant’Anna
- Main Activities and Responsibilities:
 - design and development of adaptive control strategies for wearable robotic devices for motor assistance and rehabilitation, with a special focus on the study of electromyographic interfaces for the development of myoelectric-based control algorithms and strategies especially for lower-limb exoskeletons;
 - study of electromyography theory;
 - development of an experimental setup for the real-time acquisition of electromyographic signals from several subjects;
 - implementation, development and experimental evaluation of the assistive control strategies with the human in the loop;
 - real-time and post-processing analysis of EMG signals, both for controlling the exoskeletons and for assessing the effect of the assistive strategies on human muscular system;
 - experiences of collaborations with people (clinicians, physiotherapists) coming from the clinical center Fondazione Don Carlo Gnocchi, in Florence, in the frame of the Movement Assistance and Rehabilitation Laboratory (MARE Lab);
 - implementation of a preliminary myoelectric controller for two different hand exoskeletons.

Personal and Professional Skills

Languages

- Italian: mother tongue
- English: good knowledge
- French: beginner

Software Skills

- Microsoft Office™ tools (Word, Excel, PowerPoint, Visio): proficient
- MATLAB® (data analysis, signal analysis, statistical analysis): proficient
- LabVIEW core and LabVIEW Real-Time module: proficient
- LabVIEW StateChart Module: good knowledge
- LabVIEW FPGA module: basic knowledge
- C++ programming language: basic knowledge
- Mathcad to model biomechanics of human body: basic knowledge
- Comsol Multiphysics (fluid dynamics): basic knowledge
- Adobe Premiere for video editing: good knowledge

Technical Skills

- Electromyographic interfaces
- Robotic devices
- Design of experimental protocols
- Design of experimental setup for the real-time acquisition of EMG signals
- Design of myoelectric real-time control strategy
- Data analysis and simulation
- Writing of scientific papers, presentations and technical documents and project reports and deliverables
- Writing of documentation for conduction of experimental activities with exoskeletons for Ethics Committee

Other Skills

- Team work
- Problem solving
- Conduction of experimental activities
- Team work organization
- Management of non-disclosure agreements
- Management of clinical and non-clinical experimental trials

Research Activities

Publications

- [L. Grazi](#), E. Trigili, N. Caloi, G. Ramella, F. Giovacchini, N. Vitiello, S. Crea (2022). "Kinematics-based Adaptive Algorithm of a Semi-Passive Upper-Limb Exoskeleton for Workers in Static and Dynamic Tasks", *IEEE Rob. Auton. Lett.*, doi: 10.1109/LRA.2022.3188402.¹
- S. Crea, P. Beckerle, M. De Looze, K. De Pauw, [L. Grazi](#), T. Kermavnar, J. Masood, L. W. O'Sullivan, I. Pacifico, C. Rodriguez-Guerrero, N. Vitiello, D. Ristić-Durrant, J. Veneman (2021). "Occupational Exoskeletons: A Roadmap Towards Large-Scale Adoption. Methodology and challenges of bringing exoskeletons to workplaces", *Wearable Technologies*, doi: 10.1017/wtc.2021.11
- F. Lanotte, Z. McKinney, [L. Grazi](#), B. Chen, S. Crea, N. Vitiello (2021). "Adaptive Control Method for Dynamic Synchronization of Wearable Robotic Assistance to Discrete Movements: Validation for Use Case of Lifting Tasks", *IEEE Trans. Robotics*, doi: 10.1109/TRO.2021.3073836²
- F. Lanotte, A. Baldoni, F. Dell'Agnello, A. Scalamogna, N. Mansi, [L. Grazi](#), B. Chen, S. Crea, N. Vitiello (2020). "Design and characterization of a multi-joint underactuated low-back exoskeleton for lifting tasks", in *2020 8th IEEE RAS/EMBS International Conference for Biomedical Robotics and Biomechatronics (BioRob)*, pp. 1146-1151, doi: 10.1109/BioRob49111.2020.9224370.
- [L. Grazi](#), E. Trigili, G. Proface, F. Giovacchini, S. Crea, N. Vitiello (2020). "Design and experimental evaluation of a semi-passive upper-limb exoskeleton for workers with motorized tuning of assistance", *IEEE Trans. Neural Syst. & Rehabil. Eng.*, vol. 28(10), pp. 2276-2285, doi: 10.1109/TNSRE.2020.3014408.
- E. Trigili*, [L. Grazi*](#), S. Crea, A. Accogli, J. Carpaneto, S. Micera, N. Vitiello, A. Panarese (2019). "Detection of movement onset using EMG signals for upper-limb exoskeletons in reaching tasks", *J. Neuroeng. Rehabil.*, vol. 16, no. 1, p. 45, doi: 10.1186/s12984-019-0512-1. * equal contributors
- [L. Grazi](#), B. Chen, F. Lanotte, N. Vitiello, S. Crea (2019). "Towards methodology and metrics for assessing lumbar exoskeletons in industrial applications", in *2019 II Workshop on Metrology for Industry 4.0 and IoT (MetroInd4.0&IoT)*, pp. 400-404, doi: 10.1109/METRO14.2019.8792877
- B. Chen, F. Lanotte, [L. Grazi](#), N. Vitiello, S. Crea (2019). "Classification of Lifting Techniques for Application of A Robotic Hip Exoskeleton", *Sensors*, vol. 19, no. 4, doi: 10.3390/s19040963.
- F. Lanotte, [L. Grazi](#), B. Chen, N. Vitiello, S. Crea (2018). "A Low-Back Exoskeleton can Reduce the Erector Spinae Muscles Activity During Freestyle Symmetrical Load Lifting Tasks", in *2018 7th IEEE International Conference on Biomedical Robotics and Biomechatronics (Biorob)*, pp. 701-706, doi: 10.1109/BIOROB.2018.8488094.
- B. Chen, [L. Grazi](#), F. Lanotte, N. Vitiello, S. Crea (2019). "Lift Movement Detection with a QDA Classifier for an Active Hip Exoskeleton", in *Wearable Robotics: Challenges and Trends*, pp. 224-228, doi: 10.1007/978-3-030-01887-0_43.

¹ Article accepted for presentation at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) held in Kyoto (Japan) on October 23-28, 2022.

² Article accepted for presentation at the IEEE International Conference on Robotics and Automation (ICRA) held in Philadelphia (USA) on May 23-27, 2022.

- B. Chen, [L. Grazi](#), F. Lanotte, N. Vitiello, S. Crea (2018). "A Real-Time Lift Detection Strategy for a Hip Exoskeleton", *Front. Neurobot.*, vol. 12, p. 17, doi: 10.3389/fnbot.2018.00017.
- [L. Grazi](#), S. Crea, A. Parri, R. Molino Lova, S. Micera, N. Vitiello (2018). "Gastrocnemius Myoelectric Control of a Robotic Hip Exoskeleton Can Reduce the User's Lower-Limb Muscle Activities at Push Off", *Front. Neurosci.*, vol. 12, p. 71, doi: 10.3389/fnins.2018.00071.
- A. Accogli, [L. Grazi](#), S. Crea, J. Carpaneto, S. Micera, N. Vitiello N., A. Panarese (2016). "An efficient EMG-based algorithm for movement onset detection for shared control of an assistive upper-limb exoskeleton", in *Proceedings of the International Workshop on Assistive & Rehabilitation Technology (IWART)*, December 2016.
- A. Accogli, [L. Grazi](#), S. Crea, A. Panarese, J. Carpaneto, N. Vitiello, S. Micera (2016). "EMG-based detection of user intentions for human-machine shared control of an assistive upper-limb exoskeleton", in *International Conference on Neurorehabilitation (ICNR)*, Segovia, Spain, 18-21 October 2016, doi: 10.1007/978-3-319-46532-6_30.
- A. Parri, S. Crea, [L. Grazi](#), S. Manca, E. Martini, E. Trigili, N. Vitiello, M.C. Carrozza (2016). "Sfide ed orizzonti della robotica indossabile", in *La bioingegneria per il benessere e l'invecchiamento attivo*, Patron Editore, pp. 153-179.
- [L. Grazi](#), S. Crea, A. Parri, T. Yan, M. Cortese, F. Giovacchini, M. Cempini, G. Pasquini, S. Micera, N. Vitiello (2015). "Gastrocnemius Myoelectric Control of a Robotic Hip Exoskeleton", 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 3881-3884, doi: 10.1109/EMBC.2015.7319241.

Given Presentations

- Given oral presentation on "Kinematics-based Adaptive Algorithm of a Semi-Passive Upper-Limb Exoskeleton for Workers in Static and Dynamic Tasks" at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022), 23-28 October 2022, Kyoto (Japan)
- Given oral presentation on "Towards assessment metrics and methodology for assessing lumbar exoskeletons in industrial applications" at the international conference of the IEEE International Workshop on Metrology for Industry 4.0 and IoT, 4-6 June 2019, Naples, Italy
- Given oral presentation on Wearable Robotics entitled "*I robot che si indossano*" at "Festa della Robotica", 9 March 2018, Pomarance, Italy
- Given oral presentation on "*Gastrocnemius myoelectric control of a robotic hip exoskeleton*" at the international conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2015), 25-29 August 2015, Milan, Italy

Attended Conferences, Workshops, and Events

- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022), 23-28 October 2022, Kyoto (Japan)
- IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob 2020), 29 November-1 December 2020, online event
- IEEE International Workshop on Metrology for Industry 4.0 and IoT, 4-6 June 2019, Naples, Italy
- International Symposium on Wearable Robotics (WeRob 2018), 16-20 October 2018, Pisa, Italy
- International Conference on Neurorehabilitation (ICNR 2018), 16-20 October 2018, Pisa, Italy
- XXXV Scuola del Gruppo Nazionale di Bioingegneria, 27-30 September 2016, Bressanone, Bolzano, Italy

- IEEE Engineering in Medicine and Biology Society conference (EMBC 2015), 25-29 August 2015, Milan, Italy
- 7th International Workshop on Human Friendly Robotics (HFR 2014), 23-24 October 2014, Pontedera, Pisa, Italy

International committee

- Co-Chair of the "TuDT1 Exoskeletons and Prostheses - Upper Body" session at the IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob 2020)

Involvement in International and National Research Projects

International Research Projects

- December 2020 – present: *H2020 Mari4_YARD* (User-centric solutions for a flexible and modular manufacturing in small and medium-sized shipyards), Grant Agreement N. 101006798
 - Main activities and responsibilities:
 - reference person for the technical aspects related to the control of the exoskeleton developed in the project;
 - reference person for the periodic management meeting with the consortium partners;
 - writing of deliverables and technical documentation;
 - reference person for all the experimental activities related to occupational exoskeletons in the Wearable Robotics Laboratory, which are ancillary activities of the project.
- October 2020 – present: *H2020 CONBOTS* (CONnected through roBOTS: physically coupling humans to boost handwriting and music learning), Grant Agreement N. 871803
 - Main activities and responsibilities:
 - reference person for the technical aspects related to the development and control of the exoskeleton developed in the project;
 - reference person for the periodic management meeting with the consortium partners;
 - writing of deliverables and technical documentation.
- October 2016 – September 2019: *H2020 HUMAN* (HUMAN MANUFACTURING), Grant Agreement N. 723737
 - Main activities and responsibilities:
 - reference person for the technical aspects related to the development and control of the exoskeletons developed in the project;
 - reference person for the validation activities along the project, with several days spent in factories' shopfloors;
 - reference person for the periodic management meeting with the consortium partners;
 - writing of deliverables and technical documentation.

National Research Projects

- April 2016 – April 2018: *CENTAURO* (Colavoro, Efficienza, prevenZione nell'industria dei motoveicoli mediante Tecnologie di AUTomazione e Robotica), Bando Regione Toscana FAR FAS 2014)
 - Main activities and responsibilities:
 - contribution to the design, development, and test t of the exoskeleton developed in the project;
 - writing of deliverables and technical documentation.

Participation to International Projects Meetings

- November 7-8, 2022: Review Meeting of the H2020 CONBOTS Project, Imperial College London, London, Great Britain †
- October 11-12, 2022: M18 Plenary Meeting of the H2020 Mari4_YARD Project, Inesc Tec, Oporto, Portugal †
- September 9, 2021: M6 Plenary Meeting of the H2020 Mari4_YARD Project, online †
- July 1, 2021: First Review Meeting of the H2020 CONBOTS Project, online †
- May 18, 2021: M15 Plenary Meeting of the H2020 CONBOTS Project, online †
- January 26, 2021: M12 Plenary Meeting of the H2020 CONBOTS Project, online †
- January 11, 2021: Technical Meeting of the H2020 CONBOTS Project, online †
- December 16-17, 2020: Kick-Off Meeting of the H2020 Mari4_YARD Project, online
- October 6, 2020: M9 Plenary Meeting of the H2020 CONBOTS Project, online †
- July 30, 2020: Technical Meeting of the H2020 CONBOTS Project, online †
- July 6, 2020: M6 Plenary Meeting of the H2020 CONBOTS Project, online †
- November 13-14, Final Review Meeting of the H2020 HUMAN Project, Brussels, Belgium †
- May 7-8, 2019: M31 Plenary Meeting of the H2020 HUMAN Project, Comau, Torino, Italy †
- January 22-23, 2019: M28 Plenary Meeting of the H2020 HUMAN Project, Holonix, Milano, Italy †
- June 26-27, 2018: Technical Meeting of the H2020 HUMAN Project, Sintef, Oslo, Norway
- May 11-12, 2018: First Review Meeting of the H2020 HUMAN Project, The BioRobotics Institute, Scuola Superiore Sant'Anna, Pontedera, Italy †
- April 11-12, 2018: M18 Plenary Meeting of the H2020 HUMAN Project, Aidimme, Valencia, Spain †
- October 11-12, 2017: M12 Plenary Meeting of the H2020 HUMAN Project, University College of London, London, Great Britain †
- March 28-29, 2017: M6 Plenary Meeting of the H2020 HUMAN Project, Airbus, Seville, Spain †
- April 19-20, 2017: Technical Meeting of the H2020 HUMAN Project, Royo, Valencia, Spain
- February 20-21, 2017: Technical Meeting of the H2020 HUMAN Project, The BioRobotics Institute, Scuola Superiore Sant'Anna, Pontedera, Italy †

† Given presentation

Reviewer of Scientific Papers

International Scientific Journals

- Scientific Reports: 1 paper
- IEEE Transactions on Robotics: 1 paper
- IEEE Transactions on Medical Robotics and Bionics: 1 paper
- IEEE Transactions on Mechatronics: 14 papers
- IEEE Transactions on Cybernetics: 1 paper
- IEEE Transactions on Biomedical Engineering: 4 papers
- IEEE Transactions on Neural Systems & Rehabilitation Engineering: 3 papers
- IEEE Robotics and Automation Letters: 4 papers
- IEEE Transactions on Automation Science and Engineering: 1 paper
- IEEE Journal of Translational Engineering in Health and Medicine: 1 paper
- Robotics and Autonomous Systems: 2 papers
- Wearable Technologies: 4 papers

- MDPI Sensors: 5 papers
- MDPI Designs: 1 paper
- HINDAWI Applied Bionics and Biomechanics: 2 papers
- Frontiers in Robotics & AI: 2 papers
- Recent Patents on Engineering: 1 paper
- Mechanism and Machine Theory: 1 paper
- Part C: Journal of Mechanical Engineering Science: 1 paper
- Soft Robotics: 2 papers

International Conferences

- IEEE International Conference on Rehabilitation Robotics (ICORR): 1 paper
- IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob): 1 paper
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS): 1 paper
- International Symposium on Wearable Robotics (WeRob): 2 papers

Co-Tutoring of Master Students

- November 2021 – present: *Michele Fiore*, M.Sc. Student in Bionics Engineering at the Università di Pisa and Scuola Superiore Sant’Anna. Scientific supervisors: Prof. Nicola Vitiello, Dr. Simona Crea.
- April 2020 – October 2020: *Giulia Ramella*, M.Sc. Student in Mechatronic Engineering at the Università Politecnico di Torino, dissertation title: “Development and experimental testing of a control strategy for adaptive assistance delivered by a semi-passive upper-limb exoskeleton”. Scientific supervisors: Prof. Nicola Vitiello, Dr. Simona Crea.
- March 2019 – February 2020: *Noemi Caloi*, M.Sc. Student in Bionics Engineering at the Università di Pisa and Scuola Superiore Sant’Anna, dissertation title: “Development and experimental testing of a control strategy to provide adaptive assistance to subjects wearing a semi-passive upper-limb exoskeleton”. Scientific supervisors: Prof. Nicola Vitiello, Dr. Simona Crea.
- October 2018 - December 2018: *Matteo Arena*, M.Sc. Student in Biomedical Engineering at the Università di Pisa, dissertation title: “Assessment of physiological parameters in static and dynamic overhead tasks with an upper-limb exoskeleton”. Scientific supervisors: Prof. Nicola Vitiello, Dr. Simona Crea.
- January 2017 – October 2017: *Francesco Lanotte*, M.Sc. Student in Bionics Engineering at the Università di Pisa and Scuola Superiore Sant’Anna, dissertation title: “Design, development and experimental validation of a control strategy for an active pelvis orthosis for assisting workers in load lifting tasks”. Scientific supervisors: Prof. Nicola Vitiello, Dr. Simona Crea.

Scientific Societies Memberships

- February 2022 – present: IEEE Robotics and Automation Society
- March 2020 – present: IEEE Membership (Member, member N. 93651184)
- January 2016 – December 2018: IEEE Membership
- January 2016 – December 2018: IEEE Engineering in Medicine and Biology Society Membership
- January 2016 – December 2017: IEEE Young Professionals

Editorial Activity

- May 31, 2022 – present: Guest Editor for the Special Issue “Recent Advances Towards Frontier Research in Wearable Robotics”, MDPI Sensors journal. Co-Guest Editors: Dr. Rahim Mutlu, Prof. Arturo Forner-Cordero.
- May 2020 – present: Member of the Topical Advisory Panel for the MDPI Sensors journal.

Qualifications

- October 1, 2015: Professional qualifying examination (Abilitazione alla professione di ingegnere), sector “Ingegneria Industriale (Sezione A)”, Università di Pisa, Pisa, Italy.

I give my permission to consider my personal data in agreement with D.lgs 196/2003 and art. 13 GDPR 679/16.

Under regulations reported in art. 46 and ss. of D.P.R. 445/2000, I declare that all data above reported are truthful.

Cascina, 01/12/2022

A handwritten signature in blue ink that reads "Lorenzo Grazi". The signature is written in a cursive, flowing style.