Federico Zaccaria

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Personal Information

- Born in Faenza (Italy), June 23rd, 1995
- **Research Topics**: Industrial Robotics, with a focus on Continuum Parallel Robots and their Mechanical Design.
  - Geometrico-Static Modelling of Continuum Parallel Robots.
  - Workspace analysis and computation of Continuum Parallel Robots.
  - Singularity and Equilibrium Stability analysis of Continuum Parallel Robots.
  - Performance Evaluation of Continuum Parallel Robots
  - Mechanical Design of Continuum Parallel Robots
- **Short Bio**: Federico received both his B.Sc. and M.Sc. degrees in Mechanical Engineering at the University of Bologna in 2017 and 2020, respectively, with a specialization curriculum in Mechanics of Automation and Robotics. He was a research fellow at CIRI-MAM, Advanced Application in Mechanical Engineering and Materials Technology, where he collaborated on the development of a robotic manipulation system for the COORSA project. Federico collaborates with the Laboratoire des Sciences du Numérique de Nantes, where he is enrolled at the SIS Ph.D program of the Ecole Centrale de Nantes. Its research topics, as a Ph.D. student of Mechanics and Advanced Engineering Science degree, are connected to industrial robotics and continuum parallel robot robots, with a focus on design, modelling, workspace analysis, and performance evaluation of flexible parallel manipulators.

Employment History

2020 – 23 **École Centrale De Nantes**, Ph.D. Student, Laboratoroire des Sciences du Numérique de Nantes. Ph.D Project *Design, Modelling, and Control of Continuum Parallel Robots*

Alma Mater Studioum - Univerisity of Bologna, Ph.D. Student, Department of Industrial Engineering. Ph.D Project *Design, Modelling, and Control of Continuum Parallel Robots*

2020 **Alma Mater Studioum - Univerisity of Bologna**, Research Fellow, Interdipartimental Center for Industrial .Research. *Development of a robotic manipulation system for the COORSA project.*

Education

2017 – 2020 **M.Sc. University of Bologna**, Bologna, Italy, in Mechanical Engineering, 110/110 with honors
Thesis title: *Geometrico-Static Modelling of Continuum Parallel Robots*, developed in collaboration with the Laboratoire des Sciences du Numérique de Nantes.

Education (continued)

2014 – 2017 **B.Sc. University of Bologna**, Bologna, Italy, in Mechanical Engineering, 110/110 with honors
Thesis title: *Studio dell'influenza del riciclo delle polveri su componenti in AISI316L prodotti tramite SLS.* (in Italian), developed in collaboration with the departement of Industrial engineering, Univerisity of Bologna.

2009 – 2014 **High School Diploma**, ITIS L.Bucci, Faenza, Italy, Technical School, Mechanics, 92/100.

Experience Abroad

2021 **École Centrale De Nantes**, Laboratoroire des Sciences du Numérique de Nantes
1-year period abroad for the development of co-tutorship Ph.D programm. Project: *Design and performance evaluation of continuum parallel robots.*

2019 **École Centrale De Nantes**, Laboratoroire des Sciences du Numérique de Nantes
6-months period abroad for the development of the M.Sc degree master thesis. Project: *Geometrico-static modelling of continuum parallel robots*

Conferences, Workshops, Summer Schools

November 5-10th, 2023 **IFToMM World Congress 2023**, Tokyo, Japan: Article: *Singularity Conditions of Concentric Tube Robots*

July 4-8th, 2022 **Summer school on the topic of deformation in robotics**, Lille, France, Extended Abstract: *Design of a Planar Continuum Parallel Robot with Large Workspace Capabilities*

May 27th, 2022 **New Frontiers in Parallel Robotics (Second Edition)**, Philadelphia, PA, USA. Workshop at the ICRA2022 Conference. Extended Abstract: *Workspace Computation Algorithms for Continuum Parallel Robots: state-of-the-art and perspectives.*

May 23-27th, 2022 **International Conference on Robotics and Automation (ICRA)** , Philadelphia, PA, USA. Presented the RA-L paper *Workspace Computation of Planar Continuum Parallel Robots*

June 4th, 2021 **Parallel Robots or not parallel robots? New frontiers in parallel robotics**, ONLINE, Workshop at the ICRA2021 Conference. Extended Abstract: *Challenges on Workspace Evaluation of Continuum Parallel Robots.*

Sept. 20-24th, 2020 **23rd CISM IFToMM Symposium on Robot Design, Dynamics and Control 2020 (ROMANSY)**, Sapporo, Japan (ONLINE), Article: *An analytical formulation of the geometrico-static problem of planar continuum parallel robots*

Teaching

2022-2023 — **Teaching assistant** at the course Mechanics of Motor Drives, M.Sc. in Mechanical Engineering, University of Bologna.

2021-2022 — **Teaching assistant** at the M1-Coro-Project, M.Sc. in Advanced Robots, École Centrale de Nantes.

Teaching assistant at the Laboratory of Robotics and Mechatronics, M.Sc. in Mechanical Engineering, University of Bologna.

2020– 23 — **Master Thesis Supervision**:

- 2022-23: Continuum Parallel Robots for Safe Interactions: contact modelling, École Centrale de Nantes;
- 2021-22: Design of a decoupled compliant parallel manipulator for bidimensional translations, in collaboration with TU-Delft, University of Bologna;
- 2021-22: Sviluppo di sistemi automatizzati e flessibili per il raggruppamento e lo scarico di prodotti per la cura personale (in Italian), University of Bologna;
- 2020-21; Sviluppo di una cella di assemblaggio automatico per un motore elettrico automobilistico (in Italian), University of Bologna;
- 2020-21: A Gazebo Simulator for Continuum Parallel Robot, École Centrale de Nantes;
- 2019-20: Analisi ed ottimizzazione del meccanismo di prelevamento di etichette in una macchina di confezionamento, (in Italian), University of Bologna;

2020–23 — **Bachelor Thesis Supervision**:

- 2022-23: Sviluppo di un sistema di misura della forza trasmessa durante un contatto accidentale, (in Italian), University of Bologna;

Talks

November 10th, 2023 — **Singularity Conditions of Concentric Tube Robots**, Tokyo, Japan, IFToMM World Congress 2023.

November 07th, 2023 — **Total Least Square In-Field Identification for MEMS Based Triaxial Accelerometers**, Tokyo, Japan, IFToMM World Congress.

November 17th, 2022 — **Design and Experimental Workspace Validation of a Planar Continuum Parallel Robot**, La Lechére, France, ANR Cosseroot assembly.

June 22nd, 2022 — **Workspace Evaluation of CPRs**, St-Brevin-les-pins, France, Armen team seminars.

June 9th, 2022 — **An overview on Workspace Evaluation of Continuum Parallel Robots: State-of-the-art and new Algorithms**, Nantes, France, Journée des doctorants du site nantais de l'école doctorale MASTIC.

May 27th, 2022 — **Workspace Computation Algorithms for Continuum Parallel Robots: state-of-the-art and perspectives**, Philadelphia, PA, USA, at the *New Frontiers in Parallel Robotics* workshop.

Talks (continued)

May 25th, 2022 — **Workspace Computation of Planar Continuum Parallel Robots**, Philadelphia, PA, USA, at the *ICRA 22* conference.

May 13th, 2022 — **Design of a Planar Continuum Parallel Robot with Large Workspace Capabilities**, (ONLINE) ANR Cosseroot assembly.

February 25th, 2022 — **Soluzioni innovative per la manipolazione mobile e la depallettizzazione: design e controllo**, (ONLINE, in Italian), Webinar COORSA Project.

December 14th, 2021 — **Workspace Evaluation of Continuum Parallel Robots**, École Centrale de Nantes, Armen team seminars.

November 10th, 2021 — **Workspace Evaluation of Continuum Parallel Robots**, Azay-le-rideau, France, ANR Cosseroot assembly.

June 04th, 2021 — **Challenges on Workspace Evaluation of Continuum Parallel Robots**, (ONLINE) at the *Parallel Robots or not parallel robots? New frontiers in parallel robotics* workshop.

March 21st, 2021 — **Dynamic Modelling of Flexible beams**, École Centrale de Nantes (Online), lectures of the working group on underactuated robotics.

September 24th, 2020 — **An Analytical Formulation for the geometrico-static problem of continuum parallel robots**, 23rd CISM IFToMM Symposium on Robot Design, Dynamics and Control 2020 (ROMANSY, ONLINE).

Skills

Coding — Strong experience with Matlab coding, basic knownledge of C language (STM Microcontroller coding), and knowledge of Arduino

Compute Aided Design — Knowledge of PTC Creo, Basic knowledge of Solidkworks

Mechanical Design — Experience in mechanical design, charged of the mechanical design supervision of the IRMA lab in 2022 and 2023.

Mechanical Machining — Basic knowledge of mechanical machining (milling, lathe), and mechanical assembly.

3D printing — Strong Experience in 3D printing and design for 3D printing, charged of the 3D printers management of the IRMA lab in 2022 and 2023.

Academic Writing — Experience in academic writing, and strong knowledge of Latex writing

Office Package — Strong Experience in powerpoint presentations, word document typesetting, and knowledge of excel.

Languages — **English C1**, IELTS test 7.0/9.0, **French B2**, DELF B2 82.5/100

Formations

2022 — Data Driven methods in Engineering (ONLINE) (10 hours);

Formations (continued)

2021
- Advance modelling of Robots, École Centrale de Nantes (12 hours);
- French Course at Advanced Level (FLE), Maison des Chercheurs étranges, Nantes (24 hours);
- Scientific Formations Cosseroots, IMT-Atlantique, Nantes (13 hours);
- Banche dati per l'ingegneria IEEE Explore, Almastart, Open Access in action, nuovi scenari nuove prospettive, nuovi servizi, (In Italian) University of Bologna (5 hours);
- Software per la gestione di bibliografie: Endnote, Banche dati citazionali: Web of Science e Scopus, (In Italian) University of Bologna (5 hours);

2020
- Academic English Course at Advanced level (AcES) at the CLA, University of Bologna (24 hours);
- Mechatronics systems modelling and Control, University of Bologna (63 hours);
- How to give a scientific presentation, University of Bologna (2 hours);
- A gentle introduction to Continuous and Mixed-Integer Conic Programming (ONLINE) (3 hours);
- Architetture e programmazione dei sistemi elettronici (in Italian) University of Bologna (60 hours);

Awards

September 24th,2021
- selected as **best student paper award** at the IFToMM World Congress 2023, with the paper *Total Least Square In-Field Identification for MEMS Based Triaxial Accelerometers*

September 24th,2020
- selected as **finalist for the best research paper award** at the 23rd CISM IFToMM Symposium on Robot Design, Dynamics and Control 2020 (ROMANSY), with the paper *An analytical formulation of the geometrico-static problem of planar continuum parallel robots*

Reviews

- IEEE Transaction on Robotics;
- IEEE Robotics and Automation Letters;
- IEEE Access;
- ASME Journal of Mechanics and Robotics;
- Frontiers on Robotics and AI;
- MDPI Machines;
- The Fourth international conference of IFToMM Italy

Research Publications

Journal Articles

1. F. "Zaccaria, E. Idá, and S. Briot, "Design and experimental equilibrium stability assessment of a rfrfr continuum parallel robot," *Mechatronics*, vol. 95, p. 103 064, 2023.
2. F. Zaccaria, E. Ida', and S. Briot, "A Boundary Computation Algorithm for the Workspace Evaluation of Continuum Parallel Robots," *Journal of Mechanisms and Robotics*, vol. 16, no. 4, p. 041 010, 2023.

3. F. Zaccaria, E. Idá, S. Briot, and M. Carricato, "Workspace computation of planar continuum parallel robots," *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 2700–2707, 2022.
4. F. Zaccaria, E. Quarta, S. Badini, and M. Carricato, "Optimal design for vibration mitigation of a planar parallel mechanism for a fast automatic machine," *Machines*, vol. 10, no. 9, p. 770, 2022.
5. J. Aleotti, A. Baldassarri, M. Bonfè, *et al.*, "Toward future automatic warehouses: An autonomous depalletizing system based on mobile manipulation and 3d perception," *Applied Sciences*, vol. 11, no. 13, p. 5959, 2021.
6. F. Zaccaria, A. Baldassarri, G. Palli, and M. Carricato, "A mobile robotized system for depalletizing applications: Design and experimentation," *IEEE Access*, vol. 9, pp. 96 682–96 691, 2021.

Books and Chapters

1. M. Duchi, F. Zaccaria, S. Briot, and E. Ida', "Total least squares in-field identification for mems-based triaxial accelerometers," in *Advances in Mechanism and Machine Science*, M. Okada, Ed., Cham: Springer Nature Switzerland, 2023, pp. 570–579.
2. F. Zaccaria, E. Idá, and S. Briot, "Singularity conditions of concentric tube robots," in *Advances in Mechanism and Machine Science*, M. Okada, Ed., Cham: Springer Nature Switzerland, 2023, pp. 376–385.
3. A. Gotelli, F. Zaccaria, O. Kermorgant, and S. Briot, "A gazebo simulator for continuum parallel robots," in *Altuzarra, O., Kecskeméthy, A. (eds) Advances in Robot Kinematics 2022. ARK 2022. Springer Proceedings in Advanced Robotics*, vol. 24, Springer, Cham, 2022, pp. 248–256.
4. F. Zaccaria, S. Briot, M. T. Chikhaoui, E. Idà, and M. Carricato, "An analytical formulation for the geometrico-static problem of continuum planar parallel robots," in *Venture, G., Solis, J., Takeda, Y., Konno, A. (eds) ROMANSY 23 - Robot Design, Dynamics and Control. ROMANSY 2020. CISM International Centre for Mechanical Sciences*, vol. 601, 2021, pp. 512–520.

References

Available on Request