University Academic Curriculum Vitae

Personal information Name: Marco Frego
Nationality: Italian
E-Mail: marco.frego@unibz.it

Orcid: 0000-0003-2855-9052
Scopus: 56066384600
Google Scholar: Scholar profile

Education since leaving school

- 2008, Bachelor of Science in Mathematics, Univ. of Trento; Thesis: Key Schedule and Symmetric Cryptography (in Italian), rel. prof. A. Caranti.
- 2010, Master of Science in Mathematics, Univ. of Trento;Thesis: Decoding error probability and related bounds (in Italian), rel. prof. M. Sala.
- 2014, PhD in Mechatronics from the School of Civil, Environmental and Mechanical Engineering, Dept. Industrial Engineering, Univ. of Trento; Thesis: Numerical Methods for Optimal Control Problems with Applications to Autonomous Vehicles, rel. prof. E. Bertolazzi and F. Biral.
- 2023, Abilitazione Scientifica Nazionale 09/G1 - ING-INF 04 (Italian National Academic Qualification) as Associate Professor in 09/G1 Automatica.
- h-index on Scopus is currently 13 with approximately 500 citations; on Scholar it is 14 with approximately 700 citations.

I attended the Liceo Classico Sperimentale “G. Carducci”, which educated me in both humanities and science. I graduated in Mathematics in 2008 from the University of Trento and completed my Master's degree in General Mathematics with honours in 2010. After my PhD in Mechatronics at the University of Trento (2014), I spent a period as a post-doc at the Hamburg-Harburg University of Technology (TUHH) in Hamburg, Germany, where I worked on numerical methods for big data with application to engineering. In autumn 2015, I joined the Dep. of Information Engineering and Computer Science and the Dep. of Industrial Engineering at the University of Trento for 5 years as a post-doc in the field of automation and robotics.

I have been working at the Free University of Bozen-Bolzano since 2020, initially at the Faculty of Science and Technology, which was recently transformed into the new Faculty of Engineering, at the Human-centered Technologies and Machine Intelligence Lab (HCT Lab).

My expertise lies in the field of optimization and motion planning, more precisely in path planning with clothoids, where I have achieved significant results both from a theoretical and computational point of view and in their application in Human-Robot Interaction (HRI), e.g., comfort in rollators for the elderly, for which I have collaborated with the General Hospital of Trento and of Madrid. I have combined methods of optimization with those of Machine Learning. My research has been published in the most renowned journals for control engineering, computer science and mathematics. Further, his research is applied to

prototypes for intelligent vehicles and ADAS by Ferrari, Maserati, Fiat/Stellantis and automated warehouses with UPS as well as in Jung Heinrich's AGVs, in the auto pilot of ships by SeaRebbel. The software is integrated with various interfaces and is made freely available to the research and industrial community also via a Matlab toolbox.

I have active academic collaborations with:

- Departments of Industrial Engineering (DII) and Information Engineering and Computer Science (DISI) at University of Trento;
- Department of Electrical, Electronic, and Information Engineering "Guglielmo Marconi" of the University of Bologna;
- Big Data & Data Science Unit of Eurecat (Barcelona);
- Oracle (Zurich);
- School of Computing and the Motion Planning Lab at Clemson University (USA);
- School of Electrical Engineering of the Vellore Institute of Technology (India);
- Department of Cybernetics and Robotics, Wroclaw University of Science and Technology, Wroclaw, Poland;
- Joint Research Centre (JRC) of the European Union (Ispra, Italy).

I am also involved in third mission activities for the university, such as collaborating in the organization of open days, meetings with local companies and high schools for orientation purposes. I coordinate didactic projects with high schools to promote hands-on robotic experiences.

Present appointment

Professore Associato – Associate Professor
Since 01/06/2025 within the SSD ING-INF 04 Automatica.

Previous appointment

Ricercatore a Tempo Determinato A – Fixed Term Researcher
01/09/2023-31/05/2025 within the SSD ING-INF 04 Automatica.

I joined the research group of prof. A. Peer in robotics and automation at the Human-centered Technologies and Machine Intelligence Lab (HCT Lab).

Teaching
I teach the course *Systems and Control Lab* (60h - 6 credits) in the Bachelor's degree programme in Industrial and Mechanical Engineering, for which I also prepare the teaching material consisting of slides, notes and projects with robots. In the AY 2023/2024 I also taught 30h of the lab part of *Modern Control* for the Bachelor's degree programme in Electronics and Cyberphysical Systems and 20 hours in *Probability Theory and Statistics* course for the Bachelor's degree programme in Computer Science. Furthermore, I held for the Studium Generale of UniBZ the course *Game theory explained with microcontrollers.*

Research
My current research focuses on bridging approaches coming from Machine Learning with classic motion planning methods. In particular, planning methods designed for autonomous vehicles taking into account non-holonomic constraints and being the result of an optimal

control problem are widely used and adopted in various fields and scenarios because of the quality of their properties, but have the drawback of being computationally demanding. Although certain planning methods represent, in principle, solved problems, being them subroutines of a high-level planner (e.g. the Non Euclidean Travelling Salesperson Problem), they need to be called a large number of times: therefore, their efficiency is crucial. With my studies, I try to avoid the selection by trial and error (brute force enumeration) of the many candidate solutions by learning the solution space with ML techniques. This is possible only after the generation of a dataset that captures all possible configurations, but elements like positions in the plane potentially span an infinite space of dimension two. To overcome this problem, I developed a method to map these variables, without loss of generality, in a compact set, which could then be sampled up to the desired accuracy. To further reduce the size of the dataset, I exploited the symmetries of the problem by proposing a new formulation.
These problems naturally yield a rich and interdisciplinary environment across control, automation, robotics, computer science and mathematics. Indeed, the trajectories are often the result of nonlinear optimal control problems and are modelled using special mathematical functions like clothoids, Dubins or Reeds-Shepp curves. Their implementation requires knowledge of programming different languages, like Matlab and Maple for the design of prototypes and for research, but also C++ with parallel architectures on GPUs like Cuda, for deploying the software on a robot or on an autonomous vehicle.
My multidisciplinary background provides the necessary tools to approach these problems from various angles while my collaborators support me in different fields. From an academic perspective, my findings on some of these topics represent the state of the art and are simultaneously being adopted by major companies in the automotive, aerospace, marine, automated warehouse and AGV sectors.

In prof. Peer's group at uniBZ, I contribute on the topics mentioned above as well as on other themes for the aspects related to optimization. One of these is the wood cutting problem, which plays an important role in our Alpine Province due to the presence of many sawmills. The question of how to optimally cut lumber from a given set of logs is not only of interest in production, but also contributes to reducing waste and increase the sustainability of the process. The problem leads to a non-convex and nonlinear optimization with integer and continuous variables, a MINLP. Due to the complexity in solving the original problem, many methods and techniques are used to address or approximate it. Our contributions relate to both the theoretical aspects as well as the proposal of effective heuristic solutions.
Another project that I am working on, in collaboration with a local branch of a multinational company, concerns the optimization of a shopfloor. The problem related to the project considers several aspects of the production line, ranging from the behavior of the personnel, their skill levels and their cooperation with a gamified system of reward points and costs. It takes into account the prediction of the tasks to be carried out, the availability of the machinery necessary for the production, possible faults and interruptions. Therefore, the problem combines deterministic and stochastic terms, Markov models, decisions and the feedback part for the workers.

More on my research, below.

Third mission
I am also involved in several initiatives for technological transfer to companies and schools. For several years our group has been organizing educational courses for companies in the context of Industry 4.0, which are sponsored by the European Social Fund (ESF). Another activity connected to this is presenting the activities of the Human-

centered Technologies and Machine Intelligence Lab to visiting companies, where during the visit I present several of the projects carried out, ranging from control and planning of robots and manipulators, motion capturing, to the estimation and recognition of emotions via physiological signals.
During the school year, the Lab hosts school visits from the province's high schools for university orientation and hands-on experience with laboratory custom tailored projects. The "Sense the motion" projects with the Mocap system and the projects for robot motion planning proved to be particularly successful. I recently participate to the STEM week.

Institutional activities
I was a member of the PhD collegium of Advanced System Engineering, of the Course and Faculty Councils, but since RTDs are no longer legally allowed to be member, I can currently just follow the works of the collegium.
For several years, I have been a Tutor for students in the Bachelor's programme in Electronics and Cyberphysical Systems. I recently became a vice-president of the admissions test commission for the Faculty of Engineering.

I also hold editorial duties as Associate Editor for IEEE Robotics and Automation Letters (RA-L) and as Committee for the Italian National Conference of Automatica.it 2024.

Professional experience

Chronological list of all previous employments (each with job title, starting and finishing dates, level, employer, responsibilities)

From / to	Job title	Name of academic Institution	Academic level	responsibilities
2020/2023	RTD-A	UniBZ	Fixed Term Researcher	Research, teaching, projects,third mission activities
2019/2020	H2020 "Safestrip" Post-doc	UniTN	Researcher A/R	Scientific responsibility of traffic coordination for autonomous vehicles at intersections.
2018/2019	Eit-Digital "Award" and its follow up Post-doc	UniTN	Researcher A/R	Scientific responsibility optimization of AGVs in an automated warehouse
2017/2018	H2020 "Acanto" Post-doc	UniTN	Researcher A/R	Developer of path planning methods for assistive robots
2015/2017	"OptHySys" Post-doc	UniTN	Researcher A/R	Coordinator and Scientific responsibility for optimal control system for autonomous vehicles
2014/2015	Wiss. Mitarbeiter Post-doc	Hamburg Univ. of Technology TUHH	Wiss. Mitarbeiter	Assistant prof. for the course of Numerical Linear Algebra
Summer 2010	H2020 "Veritas"	UniTN	Researcher A/R	Scientific responsibility for a garment for stereovision
2009/2010	Internship	Integrated Device Technology IDT - Milan	Internship	Scientific responsibility for studying properties of error control codes inside solid state disk SSD.

2020-2023

Researcher with fixed term contract (RTD-A), Faculty of Engineering, Free University of Bozen-Bolzano, Italy, SSD ING-INF/04 (automatica).

Research in the area of robotics and automation, ref. prof. A. Peer.
Another branch of my research studies the combination of Machine Learning methods with classic path and motion planning techniques, like the Markov-Dubins, Reeds-Shepp, clothoids and other motion primitives.

Participation and research in the project ("Digital Shop Floor Management" - DSFM) in collaboration with the local branch of a multinational company (GKN) in the field of Machine Learning related to HCI in the industrial setting of a shop floor: research combined elements of optimisation (MDP and Optimal Control) with gamification, to steer human behaviour towards a more sustainable style by means of wearable smart devices.

Post-Doc, University of Trento - DII/DISI, Trento

2018-2020

Research in the area of robotics, EIT-Digital Project "Award", PI prof. L. Palopoli. Research in the area of autonomous vehicles with Human-Machine Interaction, H2020 EU Project "Safe Strip" http://safestrip.eu/, PI prof. F. Biral.
For the EIT-Digital "Award" project and its follow-up "Award II", I designed a traffic management system in collaboration with the shipping company UPS to support the coordination of human guided forklifts with AGVs. Field tests with a prototype forklift engineered within our research group were conducted in a UPS warehouse in the Netherlands. My contribution focused on traffic management and on the integration of the route map of the vehicles.
For the H2020 project SafeStrip, the goal was to develop an Advanced Driver Assistance System (ADAS) to help the driver stay on an optimal trajectory at road intersections as well as on a racing track (in collaboration with Ferrari). I applied my clothoid technology for the design of optimal control strategies in real-time.

Post-Doc, University of Trento - DISI, Trento

2017-2018

Research in the area of robotic walking assistants for elderly adults, H2020 EU Project Acanto, http://www.ict-acanto.eu, ref. prof. L. Palopoli. In the Acanto project, I designed an assistant and implemented it on an assistive walker (rollator) for elderly people to support them in daily mobility tasks. The user could interact with the walker to organize activities, resulting in a Chance Constrained Stochastic Programming. I developed a model for human walking based on the Headed Social Force Model to recognize and predict the movements of pedestrians who could possibly be in collision trajectories with the walker and designed a corresponding reactive planner for it. This resulted in a combination of clothoid trajectories that maximise human comfort, prediction and optimization. Several prototypes of the walker have been tested at the hospital of Madrid in Getafe and at the Muse museum in Trento.

Post-Doc, University of Trento - DISI, Trento

2015-2017

Research in the area of Hybrid Control System (HCS), steering a robotic autonomous car on a known track (ref. prof. Palopoli, prof. Zaccarian). In this project I developed the core of the clothoid algorithms for autonomous vehicles, decoupling the motion planning problem in path planning and speed profile generation. The latter is an Optimal Control Problem for which I could find a semi-analytical solution that allowed to run the overall problem in real-time and on embedded systems. Another problem we solved was the smoothing of sensors/GPS sampled data affected by noise. We designed a filter to smooth data collected by wearable devices like smartphones and smart watches to produce a clean sequence of data, suitable for post-processing. The filter works in 2D or 3D and is based on the Tychonov

regularisation method and Cross-Validation techniques.

2014-2015 **Post-Doc, Technische Universität Hamburg-Harburg (Hamburg-Harburg University of Technology - TUHH), Hamburg, Germany**
I studied Hierarchical Matrices, Scientific Parallel Computing with prof. S. LeBorne. During this stay abroad, I worked on algorithms for high performance computing related to linear algebra for big data problems stemming from the processing of medical data and AI. I was a teaching assistant for the course of "Numerical Linear Algebra" (40h) for the common courses of all the engineering BSc courses of the Hamburg-Harburg University of Technology – TUHH.

2010-2014 **PhD at University of Trento - DII, Trento (ING-INF/04, ING-IND/13, MAT/08)**
Title of the thesis: Numerical methods for optimal control problems with application to autonomous vehicles. During my PhD and collaboration with Ferrari with prof. Biral, the problem of describing trajectories and roads for autonomous vehicles emerged. After studying the respective literature and considering the needs of the company, clothoids were found to be the most suitable curves. However, there were no available tools for handling them, so it was my responsibility to start a new project in this regard. After more than 10 years from the initial development, the clothoid library that I developed with my supervisor prof. Bertolazzi is considered the state of the art on the subject for both the theoretical algorithmic study and the implementation. It is used for the most various applications from famous companies and other universities (see attached endorsement letters). Other examples of applications are (apart from the traditional vehicle or robotics-related): models of blood vessel, of rat whiskers, railway alignments, reconstruction of hand-written strokes, trajectories of walking humans, paths for map generation, assistive robotics like wheelchairs and rollators, sport engineering.

2010-2011 **Developer, Laboratory of Mechatronics of University of Trento, Trento**
Design and speed-up optimization of a human garment for 3D body reconstruction for rehabilitation purposes with implementation of Error Correcting Codes. The project's outcome was adopted in the General Hospital Santa Chiara, Trento, for physical therapy and rehabilitation. My contribution was patented as part of the EU Project Veritas http://veritas-project.eu/ ref. prof. M. De Cecco.

2010 **Consultancy agreement, Lab. of Industrial Mathematics and Cryptography, University of Trento**
With prof. M. Sala, on the security of a system of electronic payment for a third party.

2009 **Internship, Integrated Device Technology IDT, Milan**
On the decoding performances of cyclic codes of very long length (16000 bits) applied in solid state disk SSD.

Experience in academic teaching at UniTN

My teaching experience began in 2010 after my MS graduation, with prof. Sala allowing me to practice some lecture hours of his course *Coding Theory* (MAT/02). Then, during my PhD at the Dep. of Industrial Engineering at UniTN, I was an instructor for the 20h exercises for the course of *Computational methods for Mechatronics* (ING-INF/04, ref. prof. Bertolazzi) for the MS in Mechatronics. I taught those exercises from 2010 to 2020 with exception for the period of time I spent in Hamburg, Germany for

my abroad post-doc. The evaluation of my teaching in my last year at UniTN received a rating of 100% for overall class satisfaction from approximately 70 students. I gave my lectures writing my notes on a tablet instead of a traditional blackboard, so that students could receive my handwritten notes after the lectures, which is something they appeared to greatly appreciate. I share these notes on cloud Google Classroom, together with the slides and the LaTeX course notes (an exercise book which is still used).
From 2012 to 2014 I was an instructor for the course of *Mathematics and Statistics I* (MAT/06, 20h) at the Centro Integrato per la Biologia (CIBIO) for the BSc in Biotechnologies at the University of Trento. My lecture notes were appreciated by the classes of about 80 students and my rating was in the range of "definitely yes" (highest). My notes also continued to be used after I left for Germany, until the professor retired (ref. prof. Iannelli).

Experience in academic teaching at TUHH

During my post-doc in Germany at the TUHH, I taught *Numerical Linear Algebra* (40h) for all the cohorts of engineering students (classes of about 1400 students), where I had also the responsibility to participate in the exam correction process for various courses offered by the university, ref. prof. LeBorne.

Experience in academic teaching at UniTN

In autumn 2015, I returned to the University of Trento, where I remained until 2020 for a 5 years post-doc period between the Departments of Industrial Engineering (DII) and Information Engineering and Computer Science (DISI), ref. prof. Bertolazzi, prof. Biral, prof. Zaccarian and prof. Palopoli.
In the AY 2016/2017 and 2017/2018 I taught as a contract professor (Docente con titolarità) the 60h course on *Foundations of Computer Science and Numerical Analysis* (*Fondamenti di Informatica e Calcolo Numerico*) (MAT/08, ING-INF/05) for the Bachelor of Industrial Engineering.

Experience in academic teaching at UniBZ

Since I started as RTD-A at the Free University of Bozen-Bolzano and its Faculty of Engineering (formerly Science and Technology) in autumn 2020, I have been teaching the 60h course *Systems and Control Lab* (ING-INF/04) for the BSc in Industrial and Mechanical Engineering. In this course, I provide both frontal teaching as well as practical lab experiences with the robots from prof. Peer's lab as well as the preparation of the notes, slides and lab projects.
In AY 2023/2024 I taught the lab part of *Modern Control* (ING-INF/04, 30h) and was an instructor for *Probability Theory and Statistics* (MAT/06, 20h). The overall rating of my teaching by the students (classes with an average of 10 students) over the last three years is 9.7/10, see attached screenshots.
Furthermore, I have also taught *Introduction to Matlab* (ING-INF/04, 18h) and *Game theory explained with microcontrollers* (ING-INF/04, 9h) for the University's Studium Generale.
As a member of the doctoral school in Advanced System Engineering, I have held an advanced seminar (6 hours) on the use of *LaTeX for scientific works*.
Finally, I held a number of invited lectures on *Robot Motion Planning* for the School of Computing of the Clemson University (USA), ref. prof. Karamouzas, and for the Vellore Institute of Technology (India), ref. prof. Kumar.

AY 2025 / 2026

In detail, by Academic Year (AY):
Lecturer/RTD for the course of *Systems and Control*, 60h in German, for the BS Industrial and Mechanical Engineering and BS

in Electronics and Information Engineering, UniBZ

Lecturer/RTD for the course of *Systems and Control Lab*, 60h in English, for the BS Industrial and Mechanical Engineering and BS in Electronics and Information Engineering, UniBZ

AY 2024 / 2025

Lecturer/RTD for the course of *Fundamentals of Systems and Control*, 24h in English, for the BS Electronics and Cyberphysical Systems, UniBZ

Lecturer/RTD for the course of *Systems and Control Lab*, 60h in English, for the BS Industrial and Mechanical Engineering, UniBZ

Lecturer/RTD for the exercise part of *Probability Theory and Statistics*, 20h in English, for the BS in Informatics and Management, UniBZ

AY 2023 / 2024

Lecturer/RTD for the course of *Systems and Control Lab*, in English, for the BS Industrial and Mechanical Engineering, UniBZ

Lecturer/RTD for the course of the lab part of *Modern Control*, in English, for the BS in Electronics and Cyberphysical Systems, UniBZ

Lecturer/RTD for the exercise part of *Probability Theory and Statistics*, in English, for the BS in Informatics and Management, UniBZ

Lecturer/RTD for the course of *Game theory explained with microcontrollers*, in Italian, for the Studium Generale, UniBZ

AY 2022 / 2023

Lecturer/RTD for the course of *Systems and Control Lab*, in English, for the BS Industrial and Mechanical Engineering, UniBZ

AY 2021 / 2022

Lecturer/RTD for the course of *Systems and Control Lab*, in English, for the BS Industrial and Mechanical Engineering, UniBZ

Extended seminar *LaTeX for scientific works* for the PhD School on Advanced Systems Engineering of UnibZ

AY 2020 / 2021

Lecturer/RTD for the course of *Systems and Control Lab*, in English, for the BS Industrial and Mechanical Engineering, UniBZ

AY 2019 / 2020

Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN

AY 2018 / 2019

Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN

AY 2017 / 2018

Docente con titolarità/contract professor for the course of Fondamenti di Informatica e Calcolo Numerico, in Italian, for the Laurea Triennale in Ingegneria Industriale, (BS in Industrial Engineering), UniTN

Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN

AY 2016 / 2017	Docente con titolarità/contract professor for the course of Fondamenti di Informatica e Calcolo Numerico, in Italian, for the Laurea Triennale in Ingegneria Industriale, (BS in Industrial Engineering), UniTN
AY 2015 / 2016	Lecturer/Assistant prof. for the course of *Fondamenti di Informatica e Programmazione*, in Italian, for the BS in Industrial Engineering, UniTN
AY 2014 / 2015	Lecturer for the course of *Numerical Linear Algebra*, in German and English, for the Bachelor Degree in Engineering at the Technical University of Hamburg (TUHH), Germany
AY 2013 / 2014	Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN Instructor for the course of *Mathematics and Statistics I*, in Italian, for the BS in Biotechnology, Cibio, UniTN
AY 2012 / 2013	Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN Instructor for the course of *Mathematics and Statistics I*, in Italian, for the BS in Biotechnology, Cibio, UniTN
AY 2011 / 2012	Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN
AY 2010 / 2011	Lecturer/Assistant prof. for the course of *Computational Methods for Mechatronics*, in English, for the Laurea Magistrale (Master degree) in Mechatronics, UniTN Instructor for the course of *Coding Theory*, in English, for the MS in Mathematics, UniTN

Other academic responsibilities

- PI of PRIN 2022 - 2022E954LL - Clothoids in 3d for engineering and biomechanical applications
- Local Organizing Committee of the national Italian conference of automatic control engineers Automatica.it 2024, where I serve also as Program Committee.
- CO-I of Euregio Mobility Fund Call and organizer of the Winter school EUSCOTHA: Euregio School on Control Theory and Applications (Trento, February 12-16 2024) with partners UniTN and the University of Innsbruck (Austria).
- Team member of Infrastructure Call for the User Study Lab of UniBZ.
- Team member in the project “Orfaro” in the field of emotion recognition in HRI, with prof. Peer and prof. Tschiesner for the RC 2022.
- Member of the Advanced Systems Engineering collegium of the PhD School of uniBZ.

- Tutor of the students of the BSc in Electronics and Cyberphysical Systems at UniBZ.
- Member of the Commission for Admission Tests for the Faculty of Engineering at UniBZ.
- Team member for the EU-EFRE/FESR project “Automation with PLCs” with prof. Peer at uniBZ
- CO-I in the EU-EFRE/FESR project “Smart Enterprise Qualification Program”
- I participated in degree commissions for the BSc in Industrial Engineering at UniTN in AA 2017/18 and 2018/19.
- Coordinator for the project OptHySys at UniTN funded by the Province of Trento.
- Session Chair several high-profile international conferences, such as the ECC, CDC and Codit on sessions of robotics.
- I co-supervised dr. Hoomaan MoradiMaryamnegari for his PhD at UniBZ (with prof. A. Peer), on reinforcement learning techniques applied to model predictive control.
  I supervised (unofficially) dr. Paolo Bevilacqua during his 3-y PhD in computer science and robotics at UniTN. He is a close co-author in many papers and colleague in several EU projects.
  I follow (unofficially) PhD Student Enrico Saccon since his Master, who has become a co-author in many scientific papers on the Markov-Dubins Problem.
  I co-supervised master students at the Dept. of Mathematics with prof. M. Sala, and at the Bachelor at the Dept. of Industrial Engineering of uniTN with prof. Bertolazzi and prof. Trivellato.
  I follow some BSc students at UniBZ as well.

Memberships

My current and past memberships include the IEEE (Institute of Electrical and Electronics Engineers) and SIAM (Society for Industrial and Applied Mathematics), IFAC (Internation Federation of Automatic Control). I participate to SIDRA (Società Italiana Docenti e Ricercatori in Automatica) and I-RIM (Istituto di Robotica e Macchine Intelligenti).

In addition, I am an Associate Editor of IEEE Robotics and Automation Letters (RA-L), a top-tier Q1 journal in the field of automation and I have been a reviewer for the following journals/conferences: Automatica, IEEE-LCSS, Control Engineering Practice, IEEE-TAC, JCAM, Mathematical Reviews, IEEE-RAL, IROS, ECC, Intelligent Vehicles, ICRA.

Research and scholarships

Given the nature and requirements of motion planning problems, my research is naturally multidisciplinary and spans over three disciplines: control theory, mathematics and computer science. This is reflected in my academic background. The main topic I dedicate my studies to is trajectory design for autonomous vehicles, robots, but also humans interacting with an assistive robot, especially with clothoid curves [2,6,8,10,12,13,15,18,21,26,30] and with other related curves like Dubins, Reeds-Shepp [10,12,13,19,23,25,35] and biarcs [10,12,13,16,17], combined with optimization techniques [4,5,6,7,8,12]. The motion planning problem is classically split into two subproblems, the geometric definition of a path and the design of a suitable speed profile to keep the vehicle on the desired reference path [4,5,6,7,8,11,14,22,24].

I started these studies during my PhD while collaborating with my supervisors, at the Dep. of Industrial Engineering of UniTN, to develop an ADAS for a project with Ferrari. Since existing results on clothoids used to model the car trajectories were not satisfactory because of a lack of generality, completeness and efficiency for real-time scenarios, I started giving my contribution in this field. The two main problems to

face were the absence of a general and reliable framework for handling those curves and the fact that there was no software that allowed researchers to use them efficiently. Indeed, although the good properties of clothoids were described in many papers, the main remaining criticism was the speed of their computation, as described, for instance, in the works of prof. Fossen and prof. Lekkas at NTNU, who sought other families of spiral curves.
With my first paper on clothoids [2], I proved that it was possible to employ them in a reliable way and in real-time, in settings where they were claimed to be computationally too intensive and thus not applicable.
My contributions represent the state of the art of the topic from the algorithmic point of view, for the application to vehicles and robotic platforms, and for the implementation for real-time performance. Indeed, papers [2,15] deal with the design of a path that connects two given poses, [12] extends the construction to splines of such curves, [13,18] find the distance and the projection of a point from a spline of clothoids, a tool that allows the implementation of controllers that reduce the error of the vehicle from the reference [11,14], intersection of curves (with hindrance) for collision detection/avoidance [11,14,21]. All the algorithms are included in the library clothoids, which is released as open source, in C++ with Matlab interface as toolbox [10].
It contains also results on other curve primitives used in path planning, like Dubins and Reeds-Sheep [10,12,13,19,23,25,35], as well as biarcs [10,12,13,16,17], which are used in CNC and manufacturing.
In the last five years, the control community has been very active on the Dubins problem, with important papers appearing on Automatica and Control Engineering Practice. Related to the Dubins and Reeds-Sheep problems, I proposed a new formalization, which exploits the double symmetries of the problem. This allowed a more compact representation of the solution space, which was then learnt by a ML approach, yielding a new and alternative method of solution, which is considerably faster than the traditional methods [19,23,35]. Another very active area of research is that of the 3 Point Dubins Problem (3PDP), where I also contributed with a paper currently under review.

The second layer, over path planning, is the design of the speed profile and the related control law to keep the vehicle over the reference. An important contribution was to find a semi-analytic solution to the optimal control problem of the time-optimal speed profile over a given path modelled with a spline of clothoids (that contain, as subcases, Dubins, Reeds-Shepp and biarcs). Additional constraints include the dynamic of the vehicle, modelled with linear and nonlinear frictions (laminar and aerodynamic drag) that resulted in a nonlinear differential Riccati equation. To keep the car on the track at the limits of adherence, also an approximation of the friction ellipse was considered, which resulted in a bound on the maximum lateral accelerations. Finally, other asymmetrical box constraints like maximum acceleration and braking, maximum allowed speed, were considered. Also, the control law was shaped according to the dynamic model of the car-like vehicle. The solution is a sequence of bang-bang arcs with the presence of singular arcs and arcs where the control is constrained by the active bounds. Since the solution is parametric in the values of the variables that define the vehicle's characteristics, its applicability is general and has been used for high performance cars as well as for slower vehicles and robots. From the theoretical viewpoint, we could state also a theorem that certifies the existence and uniqueness of the solution. Moreover, being the solution semi-analytic, it offers also robustness in terms of guaranteed end of the algorithm in a fixed time (e.g., a NLP could not converge or have slow convergence, to a local minimum; our method converges always to the global minimum, if a solution exists, or returns an infeasibility error, when it does not exist). It is computationally inexpensive, which made it suitable for implementation on embedded systems even with low performance. All these properties are of

paramount importance in safe-critical applications like self-driving cars. This was done in papers [4,5,6,7,8,11,14,24].

I continued the development of this field also within the EU projects I joined, and I extended the use of clothoids to HMI in the framework of the European Project Acanto and SafeStrip. Indeed, clothoid curves are naturally walked by humans. We developed a socially-aware robotic walker based on the Headed Social Force Model (HSFM), which runs over clothoids. Important contributions from my side were the definition of a comfort index based on the jerk, a specialization of the HSFM to predict the intention of the pedestrians around the walker, a comprehensive planner at both low and high-level for the ensemble walker-human. This involves a reactive re-planner as well as a mission planner and a global activity planner [5,11,12,19,22,25].

In another project with partners like EIT-Digital and UPS and in the Eu Project SafeStrip, I moved my techniques to the world of automated warehouses and smart cities, contributing in transforming a traditional forklift into a fully autonomous AGV. My contribution was in the motion planner of the AGV, the definition of the routes in the warehouse and a Traffic Management System (TMS) to avoid collisions and congestions of vehicles. This TMS combines linear programming with semi-analytic solutions of optimal control problems (OCP) to guarantee minimum time and minimum jerk motions of the vehicles. The OCP part ensured optimality, the semi-analyticity allowed computational efficiency, the linear programming guaranteed the existence and the convergence to a solution, when starting in a feasible condition. A similar technique has been adapted to handle the traffic in an automated road crossing, where the geometry of the road was acquired from Google Street information (which are also modelled as clothoids), [20,24,25].

After joining the Free University of Bozen-Bolzano and the HCT Lab, I extended the state of the art on clothoids to 3D, a problem which was open for about 30 years. My contribution was to define the problem as a 12x12 linear time variant system, for which I was able to prove, using Lie-groups techniques and the Magnus expansion, a closed-form solution for linear (affine) curvature and torsion, under mild assumptions. I could prove its stability with Lyapunov techniques and the important property that a 3D curve is not more computationally demanding than a 2D curve, which makes 3D clothoids interesting from the applicative point of view. I showed that a closed-form solution is not possible if the assumptions are not satisfied, but only a numerical one, which, however, cannot be obtained with standard integrators like RK, since the ODE is of the class of “highly oscillatory”, therefore symplectic/geometric integrators have to be used. To avoid using a general integrator (for improved efficiency due to overhead) and to get the best computational performance, I developed two such integrators of order 4, one based on the Magnus expansion, the other using a commutator-free approach, [26,30].
Another research topic I have been following since I joined UniBZ is in the wood cutting field, in collaboration with a local company. This problem falls under the umbrella of geometric optimization problems and is a variant of the bin packing or of the knapsack problem. It asks to cut optimal lumber from a set of given logs, where “optimal” can be a performance index of quantity, quality or other properties. The problem is nonlinear and nonconvex, with integer and continuous variables, therefore it is very hard to solve even with state of the art MINLP solvers. We developed efficient heuristics that give good results in short time, [29,32].
With the PhD student I co-supervised, we combined traditional model-based methods with Machine Learning techniques to try to exploit the best of both worlds. We applied the results to robotic manipulators and to a system of coupled tanks. We integrated standard model predictive control (MPC) models with a combination of various Markov Decision

Processes (MDP) techniques, like Q-learning, Sarsa/expected Sarsa, [27,28,31].
With another PhD student I support, we are applying similar techniques to HMI, combining the performance and exactness of MDPs with an additional gamification layer to improve the skill level and acceptance level of the workers of a local shop-floor with the needs of the company in terms of professional growth of the workers, their team building and optimization of the production. In order to do so, we need to predict the new tasks required by the production of new goods with a model of the humans. These user studies are still ongoing and a first result is [38].
We also started a recent project we won, Orfaro, Automatic optimal-reward-frequency selection by arousal estimation and optimization for the enhancement of ILF-neurofeedback treatments. Recent advances in the neurofeedback technologies allow to measure the arousal state of a person by means of various physiological signals, like EEG, Galvanic skin response, blood pressure, respiration, etc. Having a feedback, it is possible to give an input to the person (we propose an audio/video stimulus shown to the user) and it is possible to hypothesizes to control the arousal level. My contribution here will be in the (optimal) control of the emotive state of a person by trying to identify a model of such state and the possible control variables. Applications are in the field of biomedical engineering, for instance to mitigate post-Covid stress and insomnia.
Related to Covid, I contributed to a stochastic model based on a (partially observable) MDP and Bayesian Networks, to model the spread of the pandemic, [33]. We proposed a compartmental model called SAIROD, which accounts for Susceptible, Asymptomatic, Infected, Recovered, Quarantined, Hospitalized and Dead. In this work, the state transitions are modelled with discrete probabilities of infections due to possible interactions with other people. For a given control policy, it is possible to verify if it satisfies an analytical property on the stochastic evolution of the state (e.g., to compute probability that the hospital beds will reach a capacity level, or the mortality rate a specified percentage of the population).
Finally, motivated by the recent shocks of climate changes causing horrific consequences in our mountains, a contribution on the local environment, in collaboration with UniTN, consisted of studies regarding a novel robotic solution for exploration and rescue in hostile mountain environments, e.g., after a landslide, [34,36]. We proposed a roped robot able to climb the vertical wall of a mountain to assess the composition of the rocks, bring a payload of tools, and to perform activities without the need of a human to be put in a dangerous situation. My contribution was in the optimal control of the movement of the robot and in the jumps with its legs.

The following table collects the funded projects.

Date granted	Award Holder(s)	Funding Body	Title	Amount received
2021	M. Frego	UniBZ RTD2021	Clo4Rob	13k
2023	M. Frego	Euregio	Euregio Mobility Fund	8k
2024	M. Frego	MUR/PRIN	Clothoids in 3d for engineering and biomechanical applications	180k

Publications

I am author of 38 scientific works (plus some accepted but not yet indexed, and others currently under review), among them, 23 are journal papers and 15 conference papers. I participated in the principal top conferences on control, robotics and applied mathematics, such as ICRA, IROS, CDC, ECC, CCA, MED, CODIT, IMACC, MASCOT and others, where I had also the honor of being session chair for trajectory

optimization, computational methods, agents and autonomous robots.

For the SSD ING-INF/04, the following ones marked with a "*" are the 15 most pertinent. They appear in (Impact Factor from homepage, Quartile in Scimago, Percentile in Scopus):

- 1 in IEEE Transactions of Industrial Informatics (IF 12.3 Q1 98%)
- 2 in Automatica (IF 6.4 Q1 97%)
- 4 in IEEE Robotics and Automation Letters (IF 5.2 Q1 95%)
- 1 in Engineering Applications of Artificial Intelligence (IF 8 Q1 93%)
- 1 in Applied Mathematics and Computation (IF 4 Q1 95%)
- 2 in Mathematical Methods in the Applied Sciences (IF 4.5 Q1 91%)
- 2 in Mathematics and Computers in Simulation (IF 4.6 Q1 93%)
- 1 in Journal of Computational and Applied Mathematics (IF 2.4 Q2 87%)
- 1 in IEEE Access (IF 3.9 Q1 92%)
- 1 in IEEE International Conference on Control Applications

In several of them I am first the author, the corresponding author or the only author of the paper.

2025

[41] Fast Shortest Path Polyline Smoothing With Continuity and Bounded Curvature
P Pastorelli, S Dagnino, E Saccon, M Frego, L Palopoli
IEEE Robotics and Automation Letters

2024

[40] Non-Orthogonal Serret–Frenet Parametrization Applied to Path Following of B-Spline Curves by a Mobile Manipulator
F Dyba, M Frego
Robotics 13 (9), 139

[39] A Non-Smooth Numerical Optimization Approach to the Three-Point Dubins Problem (3PDP).
M Piazza, E Bertolazzi, M Frego
Algorithms 17 (8)

[38] Simulation-Driven Evaluation of Reward Systems for Activity-Based Manufacturing Environments
U Sait, M *Frego*, A De Angeli, A Peer
Design, Simulation, Manufacturing: The Innovation Exchange, 63-74
DOI: 10.1007/978-3-031-61797-3_6

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M *Frego*, C Consonni
Axioms 13 (4), 245
DOI: 10.3390/axioms13040245

[36] ALPINE: a climbing robot for operations in mountain environments
M Focchi, A Del Prete, D Fontanelli, M *Frego*, A Peer, L Palopoli
arXiv preprint arXiv:2403.15142 (under review)
DOI: 10.48550/arXiv.2403.15142

2023

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C Consonni, M Brugnara, P Bevilacqua, A Tagliaferri, M *Frego*
Engineering Applications of Artificial Intelligence 122, 106166
DOI: 10.1016/j.engappai.2023.106166

[34] Clio: a novel robotic solution for exploration and rescue missions in hostile mountain environments
M Focchi, M Bensaadallah, M *Frego*, A Peer, D Fontanelli, A Del Prete, L Palopoli, D Fontanelli
2023 IEEE International Conference on Robotics and Automation (ICRA), 7742-7748
DOI: 10.1109/ICRA48891.2023.10160440

(*) [33] A Markovian model for the spread of the SARS-CoV-2 virus
L Palopoli, D Fontanelli, M *Frego*, M Roveri
Automatica 151, 110921
DOI: 10.1016/j.automatica.2023.110921

[32] Cutting Unequal Rectangular Boards from Cylindrical Logs in Wood Products Manufacturing: A Heuristic Approach
SM Hosseini, M *Frego*, A Peer
2023 31st Mediterranean Conference on Control and Automation (MED), 946-953
DOI: 10.1109/MED59994.2023.10185875

[31] Data-Driven Model Predictive Control Using Deep Double Expected Sarsa
H MoradiMaryamnegari, M *Frego*, A Peer
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DOI: 10.1109/CoDIT58514.2023.10284335

[30] The clothoid: a historical, literary and artistic introduction with applications to technology
E Bertolazzi, C Frego, M *Frego*, SM Hosseini, A Peer
2023 8th IEEE History of Electrotechnology Conference (HISTELCON), 16-19
DOI: 10.1109/HISTELCON56357.2023.10365736

[29] Improving Wood Yield Recovery in Live Sawing Using Strip-bottom-left-fill Bin-packing Heuristic
SM Hosseini, M *Frego*, A Peer
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DOI: 10.1109/ETFA54631.2023.10275524

[28] Learning-Based Model Predictive Control Using Double Q-Learning
H MoradiMaryamnegari, M Frego, A Peer
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DOI: 10.1109/ICSTCC59206.2023.10308475

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(*) [27] Model Predictive Control-Based Reinforcement Learning Using Expected Sarsa
H Moradimaryamnegari, M *Frego*, A Peer
IEEE Access 10, 81177-81191
DOI: 10.1109/ACCESS.2022.3195530

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M *Frego*
Applied Mathematics and Computation 421, 126907
DOI: 10.1016/j.amc.2021.126907

2020

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E Saccon, P Bevilacqua, D Fontanelli, M *Frego*, L Palopoli, R Passerone
2021 IEEE 45th Annual Computers, Software, and Applications Conference (compsac)
DOI: 10.1109/COMPSAC51774.2021.00015

(*) [24] Minimum Time—Minimum Jerk Optimal Traffic Management for AGVs
M Frego, P Bevilacqua, S Divan, F Zenatti, L Palopoli, F Biral, D Fontanelli, IEEE Robotics and Automation Letters 5 (4), 5307-5314
DOI: 10.1109/LRA.2020.3007435

(*) [23] An Iterative Dynamic Programming Approach to the Multipoint Markov-Dubins Problem
M Frego, P Bevilacqua, E Saccon, L Palopoli, D Fontanelli
IEEE Robotics and Automation Letters 5 (2), 2483-2490
DOI: 10.1109/LRA.2020.2972787

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P Bevilacqua, M *Frego*, L Palopoli, D Fontanelli
IEEE Transactions on Industrial Informatics
DOI: 10.1109/TII.2020.3012094

(*) [21] Efficient intersection between splines of clothoids
E Bertolazzi, P Bevilacqua, M *Frego*
Mathematics and Computers in Simulation 176, 57-72
DOI: 10.1016/j.matcom.2019.10.001

(*) [20] Point data reconstruction and smoothing using cubic splines and clusterization
E Bertolazzi, M *Frego*, F Biral
Mathematics and Computers in Simulation
DOI: 10.1016/j.matcom.2020.04.002

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[19] A novel formalisation of the Markov-Dubins Problem
P Bevilacqua, *M Frego,* D Fontanelli, L Palopoli,
Proceedings of the European Control Conference 2020, pp. 1987-1992,12-15 May 2020, Saint Petersburg, Russia.
DOI: 10.23919/ECC51009.2020.9143597

[18] Point-Clothoid Distance and Projection Computation
M *Frego*, E Bertolazzi
SIAM Journal on Scientific Computing 41 (5), A3326-A3353
DOI: 10.1137/18M1200439

[17] Interpolating Splines of Biarcs from a Sequence of Planar Points
E Bertolazzi, M *Frego*, F Biral
Computer-Aided Design & Applications 18 (1), 66-85
DOI: 10.14733/cadaps.2021.66-85

2018

[16] A Note on Robust Biarc Computation
E Bertolazzi, M *Frego*
Computer-Aided Design & Applications 16 (5), 822-835
DOI: 0.14733/cadaps.2019.822-835

(*) [15] On the G2 Hermite interpolation problem with clothoids
E Bertolazzi, M *Frego*
Journal of Computational and Applied Mathematics 341, 99-116
DOI: 10.1016/j.cam.2018.03.029

[14] Efficient re-planning for robotic cars
E Bertolazzi, P Bevilacqua, F Biral, D Fontanelli, M Frego, L Palopoli
2018 European Control Conference (ECC), 1068-1073
DOI: 10.23919/ECC.2018.8550215

[13] On the distance between a point and a clothoid curve
M *Frego*, E Bertolazzi
2018 European Control Conference (ECC), 1-6
DOI: 10.23919/ECC.2018.8550554

(*) [12] Interpolating clothoid splines with curvature continuity
E Bertolazzi, M *Frego*
Mathematical Methods in the Applied Sciences 41 (4), 1723-1737
DOI: 10.1002/mma.4700

(*) [11] Reactive planning for assistive robots
P Bevilacqua, M *Frego*, D Fontanelli, L Palopoli
IEEE Robotics and Automation Letters 3 (2), 1276-1283
DOI: 10.1109/LRA.2018.2795642

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E Bertolazzi, P Bevilacqua, M *Frego*
Rend. Sem. Mat. Univ. Pol. Torino 76 (2), 47-56

[9] On the probability of incorrect decoding for linear codes
M *Frego*
IMA International Conference on Cryptography and Coding, 103-115
Lecture Notes on Computer Science 10655
DOI: 10.1007/978-3-319-71045-7_5

(*) [8] Semi-analytical minimum time solutions with velocity constraints for trajectory following of vehicles
M *Frego*, E Bertolazzi, F Biral, D Fontanelli, L Palopoli
Automatica 86, 18-28
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[7] Semianalytical minimum-time solution for the optimal control of a vehicle subject to limited acceleration
E Bertolazzi, M *Frego*
Optimal Control Applications and Methods
DOI: 10.1002/oca.2376

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M *Frego*, P Bevilacqua, E Bertolazzi, F Biral, D Fontanelli, L Palopoli
2016 IEEE 55th Conference on Decision and Control (CDC), 203-209
DOI: 10.1109/CDC.2016.7798270

(*) [5] Path planning maximising human comfort for assistive robots
P Bevilacqua, M *Frego*, E Bertolazzi, D Fontanelli, L Palopoli, F Biral
2016 IEEE Conference on Control Applications (CCA), 1421-1427

DOI: 10.1109/CCA.2016.7588006

[4] Semi-analytical minimum time solutions for a vehicle following clothoid-based trajectory subject to velocity constraints
M *Frego*, E Bertolazzi, F Biral, D Fontanelli, L Palopoli
2016 European Control Conference (ECC), 2221-2227
2015 DOI: 10.1109/ECC.2016.7810621

[3] Preconditioning complex symmetric linear systems
E Bertolazzi, M *Frego*
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DOI: 10.1155/2015/548609

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(*) [2] G1 fitting with clothoids
E Bertolazzi, M *Frego*
Mathematical Methods in the Applied Sciences 38 (5), 881-897
DOI: 10.1002/mma.3114

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G Manzini, D Svyatskiy, E Bertolazzi, M *Frego*
Los Alamos National Lab.(LANL), Los Alamos, NM (United States)
Publications about the applicant LA-UR-14-27620

In this paper I am recognized as Outstanding Reviewer of the year:

Excellence in Review 2022
Mandar Chitre
IEEE Journal of Oceanic Engineering (Vol: 48, Issue: 2, April 2023)
DOI: 10.1109/JOE.2023.3256151

Further data

I presented as a speaker at the following conferences in the last 3 years, in 2020, due to Covid, the presentation was online.

2023 - The clothoid: a historical, literary and artistic introduction with applications to technology
E Bertolazzi, C Frego, M *Frego*, SM Hosseini, A Peer
2023 8th IEEE History of Electrotechnology Conference (HISTELCON), 16-19, Florence, Italy

2023 - IEEE/IFAC 31st Mediterranean Conference on Control and Automation (MED), Limassol, Cyprus, Cutting Unequal Rectangular Boards from Cylindrical Logs in Wood Products Manufacturing: A Heuristic Approach

2023 – IEEE/IFAC 9th International conference on Control, Decision and Information Technologies (Codit), Rome, Italy, Data-Driven Model Predictive Control Using Deep Double Expected Sarsa (proceeding to apper)

2020 - IEEE International Conference on Robotics and Automation - *ICRA 2020*, Paris, France, An Iterative Dynamic Programming Approach to the Multipoint Markov-Dubins Problem

2020 – IEEE/IFAC European Control Conference, St. Petersburg, Russia, with the paper A novel formalisation of the Markov-Dubins Problem

2020 - IEEE/RSJ International Conference on Intelligent Robots and Systems IROS2020, Las Vegas (USA), with the paper Minimum Time—Minimum Jerk Optimal Traffic Management for AGVs

Patents

I share with A. Fornaser and E. Bertolazzi the patent "Dispositivo e metodo per la ricostruzione discreta di forma e posizione tridimensionale". N.0001423079 Ministero dello Sviluppo Economico, Ufficio Italiano Brevetti e Marchi, i.e., "A device for the discrete 3D reconstruction of shapes and positions". The designed garment was endowed with a dense net of markers of different colors displaced so that any 3x3 block of markers was unique and invariant for rotations. This made it robust to occlusions or other visual problems and allowed the reconstruction of unseen markers from the position of the others. The markers were acquired by stereo cameras and data processed to obtain real-time digital information of the 3000 markers. The device allowed for 3D reconstruction of human body, the movement of its joints and torque estimation and was used for rehabilitation purposes at the General Hospital of Trento Santa Chiara.

Entrepreneurship

I was a co-founder of the start-up "MathNow" of the dep. Of Mathematics at UniTN with prof. Sala and prof. Bertolazzi. This brought to the foundation of the Laboratory of Industrial Mathematics and Cryptography of UniTN. MathNow is now part of De Componendis Cifris (ref. prof. M. Sala).

Software

The library on clothoid curves, "*clothoids*", that I have been developing for more than 10 years together with prof. Bertolazzi, is released open source as Github repository, as Matlab toolbox, in C++, either on the MathWorks website or from prof. Bertolazzi's Github:

- https://it.mathworks.com/matlabcentral/fileexchange/64849-ebertolazzi-clothoids
- https://ebertolazzi.github.io/Clothoids/

It contains the implementation of the results of the papers mentioned before on clothoids, biarcs and Dubins curves.

The library on the *Multipoint Markov-Dubins Problem* (MPMDP) is also released as open-source on the Github repository of my principal co-author on the topic, E. Saccon. It is written in C++ and offers support for parallel CPUs via OpenMP and for parallel GPUs via Cuda:

- https://github.com/icosac/MPDP

Statement of interest

My motivation to remain in academia stems from a deep-rooted dedication to research and the desire to make a meaningful contribution to solving complex scientific problems. I take great pride in exploring the boundaries of theories and methods, particularly in the field of optimization and motion planning. My research interests are well aligned with the ongoing work at UniBZ, where I have worked for the

last four years. Our joint efforts, as well as partnerships with other Italian and international institutions, have enriched my academic journey and solidified my commitment to pushing the boundaries of knowledge.
Another passion of mine is teaching, especially in small groups that allow for a more personalized and interactive educational experience. Having taught at large, medium and small universities, I can safely say that the close academic community at UniBZ is ideal for creating a conducive learning environment. The smaller class sizes allow me to engage with students more effectively, tailor lectures to their specific needs and interests, and provide individualized support to enhance their academic experience.
Having grown up in this city, I am fluent in the three teaching languages of UniBZ, notably German, Italian and English. This proficiency is not only a formal requirement, but also a practical advantage in my teaching, as it allows me to bridge language gaps and ensure that all students fully understand the lessons provided.
I have successfully applied these skills, not only in my courses, but also in other lessons where I stepped in at short notice to ensure the continuity and quality of teaching.
In addition, I am strongly committed to the third mission of the university and work closely with Professors Peer, Petti, Gennari and De Angeli to organize activities aimed at attracting and guiding potential students. These initiatives are crucial for the advancement of the next generation of scientists and professionals, and I am proud to be able to contribute to this goal.

Overall, my commitment to research, my excitement for teaching, and my deep connection to the UniBZ community make me a strong candidate for the professorship. I look forward to the opportunity to continue my academic career at UniBZ, to contribute to its intellectual community, and to further its mission of excellence in education and research. With my studies on optimization aspects of motion planning, I think I complement the expertise of the automation group of UniBZ, since my skillset is a unique addition and does not overlap with the ones of the other members.

Language competence

Italian mother tongue

Patentino di Bilinguismo / Zweisprachigkeitsprüfung / Bilingual certification Italian/German of the Province of Bolzano, C1

C1 English certificate from the Free University of Bozen-Bolzano.
C1 German certificate from the Free University of Bozen-Bolzano.

C1 English certificate from the Hamburg University of Technology.
C1 German certificate from the Hamburg University of Technology.

Date
10/06/2025

(Digital) Signature
Marco Frego