AntunSkuric

PhD in physical human-robot interaction

Personal Info

location:
Bordeaux, France

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Online Profiles:

Languages:
Croatian - native
English - proficient
French - proficient

Personal interests:
playing guitar,
cycling,
running, hiking, cycling,

I feel passionate about:
hands-on learning,
sharing educational projects,
open-sourcing

Research Interests

- Physical human-robot interaction
- Human-centred robotics
- Polytope evaluation methods
- Optimal control strategies
- Quadratic programming (QP)
- Design and control of mechatronic systems

Education

2020 - 2023 **PhD Thesis** — PHYSICAL HUMAN-ROBOT INTERACTION
INRIA Bordeaux, AUCTUS team & University of Bordeaux, France
THESIS: A COUPLED VIEW OF THE PHYSICAL ABILITIES OF HUMAN-ROBOT DYAD FOR THE ONLINE QUANTITATIVE EVALUATION OF ASSISTANCE NEEDS
- Exploration of physical capabilities for physical-human robot interaction
- Project LiChIE in collaboration with **Airbus DS** (Defense and Space)
- Under supervision of Vincent Padois and David Daney.

2014 - 2017 **M.Sc. in Electrical Engineering** — CONTROL THEORY AND MECHATRONICS
University of Zagreb, Faculty of Electrical Engineering and Computing
- Collaboration with **Robrt Bosch GmbH**, Stuttgart, Germany
- Under supervision of Jadranko Matusko and Sandor Iles

2011 - 2014 **B.Sc. in Electrical Engineering** — CONTROL THEORY
University of Zagreb, Faculty of Electrical Engineering and Computing
- GPA: 4.0/5.0 - ranked among the top 10% of my generation

Honors and Awards

2021 **IEEE Transactions on Automation Science and Engineering Best Paper Award** IEEE TASE
For the paper: *A Recursive Watermark Method for Hard Real-Time Industrial Control System Cyber-Resilience Enhancement*

2019 **1st at the RoboCup 2019 - Humanoid KidSize Soccer League** RoboCup
I had the opportunity to participate at the RoboCup 2019 held in Sidney, Australia as a part of the team **Rhoban**.

2016-2017 **Scholarship for Internship in Germany** Zoran Djindjic Foundation (DAAD)
- Awarded by German Academic Exchange Service (DAAD).

2016 **1st place in competition Elektroboj** eStudent Zagreb
- Innovation competition founded by international student organisation eStudent.
- First place prize 1000€ and 1 year incubation for **GuitarFriend** project.

2015 - 2016 **1st place in PLC+ competition** **SIEMENS** | EESTEC LC Zagreb
- Regional competition (Croatia, Slovenia and Serbia), organized by Eestec LC Zagreb, sponsored by **SIEMENS**.
- Winner two years in a row: 2015 and 2016.

Open-source projects

These are the open-source projects that I'm particularly proud of.

2021-now **pycapacity:** Real-time capable task-space capacity evaluation python module
INRIA Bordeaux, AUCTUS team
A python package providing a framework for the generic task-space capacity calculation for robotic serial manipulators and human musculoskeletal models. For more info about the theoretic and implementation details check the documentation, paper.

2020 - now **SimpleFOCproject:** Arduino Compatible Open Source Field Oriented Control (FOC) project
Founder & Project Administrator
A Cross-Platform FOC implementation for BLDC and Stepper motors based on the Arduino IDE and PlatformIO.The goal is to support a wide range different motors, position sensors, drivers and microcontrollers. Project has 50+ contributors and 1000+ community members, ranging from amateurs to professionals and reasearchers. More info on GitHub and Community

2019 **Inverted inertia pendulum**
Faculty of Electrical Engineering in Zagreb | **Self initiated**
Development of inertial force based inverted pendulum as a low-cost, testing platform for optimal control algorithms. Currently used for the Mechatronics class at the University of Zagreb. Github YouTube Thingiverse

Work Experience

2024 - now — **R&D engineer | Freelance** — Bordeaux, France
POLLEN ROBOTICS
Working on the new version of the Reachy robot. Robot control algorithms, dimensional design and development of low-level motion control.

2020 - 2023 — **Teaching assistant** — Bordeaux, France
UNIVERSITY OF BORDEAUX | ESNAM | ENSC
Participated in TP and TD exercises for students in ENSC, ENSAM and ASPIC in Bordeaux (about 150h over the course of 3 years).

2020 - 2023 — **PhD candidate** — Bordeaux, France
INRA BORDEAUX | AUCTUS TEAM
I was fortunate to be able to do my PhD thesis on human-robot physical interaction at the INRIA institute in Bordeaux, at the AUCTUS team.

2020 — **Freelancer**
UPWORK | SELF-EMPLOYED
Fields: Control Engineering, Sensor Fusion for motion tracking and Software development.

2019 — **Research Engineer** — Bordeaux, France
AIO | PROJET NUMII®
Human pose estimation algorithms based on RGBd cameras, skeletal fusion algorithms, hardware/software/firmware development.

2018-2019 — **Research Associate** — Zagreb, Croatia
FACULTY OF ELECTRICAL ENGINEERING, UNIVERSITY OF ZAGREB
Distributed model predictive control (MPC) for building management systems, control algorithms for a reconfigurable three-wheeled vehicle.

2017-2018 — **Graduate Internship - Control Engineering** — Princeton, USA
SIEMENS CT
Maintenance and enhancements of industrial embedded software, development of a novel watermarking algorithm for hard real-time control.

2016-2017 — **GuitarFriend - Startup co-founder** — Zagreb, Croatia
STUDENT START-UP INCUBATOR SPOCK, UNIVERSITY OF ZAGREB
GuitarFriend is an innovative device enabling people with hand disabilities to learn and play guitar. The startup was incubated for a year.

2016-2017 — **Student Internship and Masters thesis** — Renningen, Germany
ROBERT BOSCH GMBH
Automating of an adaptable fixing device for cyber-physical production systems.

Talks and presentations

Jul 2023 — **Poster at JNRH 2023** — Bordeaux, France
Approximating robot reachable space using convex polytopes.

Jun 2023 — **Presentation at R4 network** — Bordeaux, France
Unifying view of physical ability metrics for humans, robots and their collaboration . Video link

Jun 2023 — **Podcast: "Désassemblons le numérique"** — Bordeaux, France
A short vulgarisation discussion on human-centered collaborative robotics by G Laisné and A Skuric. Podcast link

May 2023 — **Introductory presentation for Biomimetics lab at the MIT**
Unifying view of physical ability metrics for humans, robots and their collaboration.

Apr 2023 — **"Unithé ou Café" at Inria** — Bordeaux, France
Presentation of the challenges and potentials of estimating human physical abilities by D Daney , G Laisné , A Skuric.

Dec 2022 — **Demo presentation for Aquitaine Robotics cluster** — Bordeaux, France
Presenting the work "Online task-space trajectory planning using real-time estimations of robot motion capabilities".

Nov 2022 — **Introductory presentation** — Boston, USA
Talks on evaluation of human and robot capabilities using polytopes at the Institute for Experiential Robotics (prof. Takin Padir) and at the Action Lab (prof. Dagmar Sternad).

Sep 2022 — **Paper oral at HFR2022** — Delft, Netherlands
Paper "Approximating robot reachable space using convex polytopes". Presentation

May 2022 — **Paper oral at ICRA2022** — Philadelphia, USA
Paper "On-line force capability evaluation based on efficient polytope vertex search". Video

Nov 2021 — **Presentation at Airbus Defence and Space** — Paris, France
A coupled view of the physical abilities of human-robot dyad for the online quantitative evaluation of assistance needs.

Oct 2021 — **SimpleFOC introductory presentation to Arduino**
Introduction to the SimpleFOCproject by A Skuric and D Gonzalez Presentation

Oct 2021 — **Invited Talk at GDR robotique GT1-GT6** — Paris, France
Session "Exosquelettes pour l'assistance physique : quelles solutions optimales ?"
Efficient calculation of human wrench capacity based on human musculoskeletal models. Presentation

May 2021 — **Paper oral at ICRA2021**
Paper "On-line force capability evaluation based on efficient polytope vertex search". Presented remotely (COVID19). Video

Publications

2024 **Online approach to near time-optimal task-space trajectory planning** — gitlab, pdf
Submitted to: IEEE Transactions on Robotics, May 2024
A Skuric, N Torres Alberto, L Josph, V Padois, D Daney

2023 **Pycapacity: a real-time task-space capacity calculation package for robotics and biomechanics** — github pdf
Journal of Open-Source Software, 2023
A Skuric, V Padois, D Daney

2023 **Model Predictive Control for robots adapting their task space motion online** — pdf
Submitted to IEEE ICRA2023
N Torres Alberto, **A Skuric**, L Joseph, V Padois, D Daney

2023 **Simulation Study of the Upper-limb Wrench Feasible Set with Glenohumeral Joint Constraints** — pdf
Submitted to Journal of Biomechanical Engineering
N Rezzoug, **A Skuric**, V Padois, D Daney

2023 **Dynamics aware Cartesian wrench polytope estimation based on human musculoskeletal models** — pdf
48ème Congrès de la Société de Biomécanique
A Skuric, V Padois, D Daney

2022 **Online task-space trajectory planning using real-time estimations of robot motion capabilities** — pdf
Preprint: Submitted to ICRA 2023
A Skuric, N Torres Alberto, L Josph, V Padois, D Daney

2022 **Approximating robot reachanble space using convex polytopes** — gitlab, pdf
15th International Workshop on Human-Friendly Robotics
A Skuric, V Padois, D Daney

2022 **On-line feasible wrench polytope evaluation based on human musculoskeletal models: an iterative convex hull method** — gitlab, pdf, video
Accepted to IEEE ICRA 2022 & IEEE RA-L
A Skuric, V Padois, N Rezzoug, D Daney

2022 **SimpleFOC: A Field Oriented Control (FOC) Library for Controlling Brushless Direct Current (BLDC) and Stepper Motors** — github, pdf
Journal of Open-Source Software, 2022
A Skuric, H Bank, O Williams, R Unger, D Gonzalez

2021 **Common wrench capability evaluation of a human-robot collaborative system** — pdf
46ème Congrès de la Société de Biomécanique
A Skuric, N Rezzoug, D Daney, V Padois

2021 **On-line force capability evaluation based on efficient polytope vertex search** — gitlab, pdf, video
IEEE ICRA 2021
A Skuric, V Padois, D Daney

2020 **A Recursive Watermark Method for Hard Real-Time Industrial Control System Cyber-Resilience Enhancement** — IEEE Best paper award, pdf
IEEE Transactions on Automation Science and Engineering
Z Song, **A Skuric**, K Ji

2019 **Rhoban Football Club: RoboCup Humanoid KidSize 2019 Champion Team Paper** — pdf
Robot World Cup 2019
L Gondry, L Hofer, P Laborde-Zubieta, Or Ly, L Mathé, G Passault, A Pirrone, **A Skuric**

Teaching

2020-2023 **ESNAM Bordeaux** — Bordeaux, France
Matematics and Informatics class - TP and TD exercises (150h), under supervision of Jean-Luc Charles and Eric Ducasse

2022 **University of Bordeaux, Master ASPIC** — Bordeaux, France
Embedded Systems class - TP exercises (16h), under supervision of Gregoire Passault

2021 **ENSC Bordeaux** — Bordeaux, France
Human-robot interfaces class - TD exercises (10h), under supervision of Jean-Marc Salotti

Organisation participation

Jul 2023 **Student organisation member at JNRH2023** — Bordeaux, France
Organised activities for student participants at the conference with V. Batto.