

# AntunSkuric

PhD candidate in human-robot interaction



## Personal Info

### location:

Bordeaux, France

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### mobile:

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### Online Profiles:



### Languages:

Croatian - native

English - proficient

French - proficient

### I am passionate about:

playing guitar,  
reading,  
running, hiking, cycling,  
making things,  
creating and sharing  
educational projects

## Research Interests

- Physical human-robot interaction modeling
- Human and robot capacity estimation
- Human centered robot control
- Polytope evaluation methods
- Optimal control strategies
- Quadratic programming (QP)

## Education

2020 - now

### 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
- Design of human-centered robot control
- Project LiChIE in collaboration with **Airbus DS** (Defense and Space)
- Under supervision of Vincent Padois and David Daney.

**University of Zagreb, Faculty of Electrical Engineering and Computing**, leading Croatian research and higher education institution, holder of ASIIN accreditation certificate.

2014 - 2017

### M.Sc. in Electrical Engineering

CONTROL THEORY AND MECHATRONICS

Department of Electric Machines, Drives and Automation

THESIS: AUTOMATING OF AN ADAPTABLE FIXING DEVICE FOR CYBER PHYSICAL PRODUCTION SYSTEMS

- Collaboration with **Robt Bosch GmbH**, Stuttgart, Germany
- GPA: 4.5/5.0

2011 - 2014

### B.Sc. in Electrical Engineering

CONTROL THEORY

- GPA: 4.0/5.0 - ranked among the top 10% of my generation

## Publications

2022

### On-line feasible wrench polytope evaluation based on human musculoskeletal models: an iterative convex hull method

Submitted to IEEE ICRA2022 & IEEE RA-L

**A Skuric**, V Padois, N Rezzoug, D Daney

A new efficient polytope evaluation algorithm for feasible wrench analysis of the human musculoskeletal models. [gitlab](#), [pdf](#), [pptx](#), [video](#)

2021

### Common wrench capability evaluation of a human-robot collaborative system

46th Congrès de la Société de Biomécanique

**A Skuric**, N Rezzoug, D Daney, V Padois

A proposition of a formal technique for calculating joint wrench capacity of a human-robot collaboration, based on the wrench polytopes. [pdf](#)

2021

### On-line force capability evaluation based on efficient polytope vertex search

IEEE ICRA 2021

**A Skuric**, V Padois, D Daney

New on-line polytope vertex search algorithm optimised for force and velocity polytope evaluation of serial robots. [gitlab](#), [pdf](#), [video](#)

2020

### A Recursive Watermark Method for Hard Real-Time Industrial Control System Cyber-Resilience Enhancement

IEEE Transactions on Automation Science and Engineering

Z Song, **A Skuric**, K Ji

Novel recursive watermarking method for hard real-time networked control systems preventing man in the middle attacks.

- Received the IEEE TASE best 2021 paper award, and featured in [IEEE Spectrum](#)

2019

### Rhoban Football Club: RoboCup Humanoid KidSize 2019 Champion Team Paper

Robot World Cup

L Gondry, L Hofer, P Laborde-Zubieta, Or Ly, L Mathé, G Passault, A Pirrone, **A Skuric**

Description of the approaches and techniques used to win RoboCup 2019.

## 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*
- 2016-2017 **Scholarship for Internship in Germany** Zoran Djindjic Foundation (DAAD)  
- Awarded by German Academic Exchange Service (DAAD).
- 2016 **1<sup>st</sup> 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 **1<sup>st</sup> 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.

## Work Experience

- 2020 - now **Teaching assistant**  
**UNIVERSITY OF BORDEAUX, ESNAM, ENSC**  
- Human-robot interfaces class - *École nationale supérieure de cognitique (ENSC)*  
- Mathematics and Informatics class - *École nationale supérieure d'arts et métiers (ENSAM)*  
- Embedded Systems class - *University of Bordeaux (ASPIC)*
- 2020 - now **PhD candidate**  
**INRA BORDEAUX, TEAM AUCTUS**  
- 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.
- 2020 **Freelancer**  
**UPWORK, SELF-EMPLOYED**  
- Fields: Control Engineering, Sensor Fusion for motion tracking and Software development. [UpWork profile link](#)
- 2019 **Research Engineer** March - October  
**AIO PESSAC | PROJET NUMII®**  
- Human pose estimation algorithms based on RGB and Depth cameras  
- Skeletal fusion algorithms  
- Hardware, software and firmware development - prototyping
- 2018-2019 **Research Associate** July - March  
**FACULTY OF ELECTRICAL ENGINEERING, UNIVERSITY OF ZAGREB**  
DEPARTMENT OF ELECTRIC MACHINES, DRIVES AND AUTOMATION  
- Distributed model predictive control (MPC) for Building management systems  
- Advanced control algorithms for a reconfigurable three-wheeled vehicle  
- Supervised by Jadranko Matusko, Sandor Iles and Mario Vasak
- 2017-2018 **Graduate Internship - Control Engineering** October - June  
**SIEMENS CT PRINCETON, USA**  
- Maintenance and enhancements of industrial embedded software (2 invention disclosures)  
- Development of a novel watermarking algorithm for hard real-time control systems Engineering  
- Supervised by Kun Ji and Zhen Song
- 2016-2017 **GuitarFriend - Founder** October - June  
**STUDENT START-UP INCUBATOR SPOCK, UNIVERSITY OF ZAGREB**  
GuitarFriend is an innovative device enabling people with hand disabilities to learn and play guitar.  
- Fully developed working proof of concept prototype
  - Mechanics - CAD, 3D print
  - Electrics - Matlab, BLDC motors, Encoders, FOC
  - Software - Python, Web  
- Product presented at *IDEA Knockout*, *LEAP summit*, *miPRO* and *TEDx*. [Facebook](#) [Videos](#)
- 2016-2017 **Student Internship** July - February  
**BOSCH GMBH RENNINGEN, GERMANY**  
**Master's Thesis** (6 months)  
AUTOMATING OF AN ADAPTABLE FIXING DEVICE FOR CYBER PHYSICAL PRODUCTION SYSTEMS  
- Design and implementation of the complete control software stack for the given mechatronic device  
- Technologies: Embedded C/C++, Matlab, Angular2 JavaScript framework and Java.  
**Student Internship - Industry 4.0** (3 months)  
- Design of an advanced user interface for high level control and process initialization of an industry 4.0 factory.  
- Technologies: Angular2 JavaScript framework, REST Api and MEAN stack concept.

## Certificates

2019	<b>PCB design in Altium Designer 2019</b> Completed 14.5 hours online course. <a href="#">Certificate Link</a>	Coursera
2019	<b>Reinforcement Learning Specialization by University of Alberta</b> Completed 4 course (16 week) online specialization. <a href="#">Certificate Link</a>	Coursera
2018	<b>Machine Learning by Stanford University</b> Completed 8 week online course. <a href="#">Certificate Link</a>	Coursera

## Open-source projects

2021-now	<b>pycapacity: Real-time capable task-space capacity evaluation python module</b> <i>INRIA Bordeaux, AUCTUS team</i> The PYCAPACITY package provides a framework for the generic task-space capacity calculation for: <ul style="list-style-type: none"><li>- Robotic serial manipulators - PYCAPACITY.ROBOT</li><li>- Human musculoskeletal models - PYCAPACITY.HUMAN</li></ul> For more info about the theoretic and implementation details check the <a href="#">documentation</a> .	
2020 - now	<b>SimpleFOCproject: Arduino Compatible Open Source Field Oriented Control (FOC) project</b> <i>Founder &amp; Project Administrator</i> <ul style="list-style-type: none"><li>- Demystifying the Field Oriented Control (FOC) algorithm for controlling brushless DC and stepper motors.</li><li>- Supporting wide range different motors, position sensors, drivers and microcontrollers</li><li>- Based on easy-to-use Arduino IDE</li><li>- More than 500 community members</li></ul> Simple <b>FOC</b> project components: <ul style="list-style-type: none"><li>- <a href="#">SimpleFOClibrary</a></li><li>- <a href="#">SimpleFOCShield</a></li><li>- <a href="#">SimpleFOCBalancer</a></li><li>- <a href="#">SimpleFOC PowerShield</a></li></ul> Simple <b>FOC</b> project links: <ul style="list-style-type: none"><li>- <a href="#">simplefoc.com</a></li><li>- <a href="#">Youtube channel</a></li><li>- <a href="#">Community forum</a></li><li>- <a href="#">Documentation</a></li></ul>	
2019	<b>Inverted inertia pendulum</b> <i>Faculty of Electrical Engineering in Zagreb   Self initiated</i> <ul style="list-style-type: none"><li>- Development of inertial force based inverted pendulum as a low-cost, testing platform for optimal control algorithms.<ul style="list-style-type: none"><li>• Mechanical design - CAD, 3D print</li><li>• Electrical design - DC motors, Incremental encoder</li><li>• Control design - Matlab, PID, LQR</li></ul></li><li>- Currently used for the Mechatronics class at the University of Zagreb. <a href="#">Github</a> <a href="#">YouTube</a> <a href="#">Thingiverse</a> <a href="#">Images</a></li></ul>	
2016	<b>Gibalo: Two wheeled inverted pendulum robot</b> <i>Faculty of Electrical Engineering in Zagreb   Self initiated   Funded Student Project</i> <ul style="list-style-type: none"><li>- Development of balancing two-wheeled robot as a low-cost, testing platform for optimal control algorithms.<ul style="list-style-type: none"><li>• Mechanical design - CAD, 3D print</li><li>• Electrical design - Stepper motors, Accelerometers</li><li>• Control design - Matlab, PID, LQR, MPC</li></ul></li><li>- Candidate for Chancellor's Research Award for the year 2016.</li><li>- Currently used as a part of a Mechatronics class at the University of Zagreb. <a href="#">Github</a> <a href="#">Google Play</a> <a href="#">Images</a></li></ul>	

## Technical skills

### Programming languages

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"><li>• Python</li><li>• C/C++</li><li>• Matlab / Simulink</li></ul> | <ul style="list-style-type: none"><li>• Java</li><li>• HTML/CSS/Javascript/SQL/php</li><li>• PLC programming (Step7, Ladder...)</li></ul> | <ul style="list-style-type: none"><li>• Robotic operating system (Linux)</li><li>• Git - collaborative development</li><li>• Embedded platforms (Arduino/stm32/esp32...)</li></ul> |
|--|---|--|

### Hands-on experience

- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"><li>• Biomechanical model manipulation</li><li>• Mechatronic design</li><li>• Control system design</li><li>• System identification</li></ul> | <ul style="list-style-type: none"><li>• Sensor Fusion</li><li>• Embedded Systems</li><li>• Robotics   Mobile/Manipulators</li><li>• PCB design</li></ul> | <ul style="list-style-type: none"><li>• CAD   3D printing   CNC</li><li>• Industrial Automation</li><li>• User Applications</li></ul> |
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