Shahab Heshmati-alamdari, PhD

Postdoctoral Associate, TUM Technical University of Munich

Date of birth: 24 May 1984

Nationality: Iranian, Greek (to be acquired)

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Research interests:

My research interests include navigation and nonlinear control of autonomous robotic systems (mobile, underwater, and aerial) under resource constraints, sensor based motion planning, constrained path planning, multi-agent control systems, high level task planning, hybrid systems, autonomous robotic vehicles, marine robotics, visual servoing, cooperative manipulation, control of multiple free flying manipulators such as Underwater Vehicle-Manipulator Systems.

Education

PhD in Automatic Control and Robotics (360 ECTS)

National Technical University of Athens (NTUA)

9/2012 - 12/2018

Athens, Greece

- Research Topic: Design, Development and implementation of robust control algorithm for single and multiple underwater robotic vehicles under resource constraints inspired by practical applications in the field of marine robotics.
- Dissertation Title: Cooperative and Interaction Control for Underwater Robotic Vehicles (PDF)
- Advisor: Prof. Kostas J. Kyriakopoulos

KTH Royal Institute of Technology

Research visit

Stockholm, Sweden

- 9/2016 12/2016
- Division of Decision and Control Systems
- Subject: Collaborative manipulation of multiple free floating manipulators under LTL specifications
- Collaborating with Prof. Dimos V. Dimarogonas

MSc in Automatic Control Systems and Robotics (120 ECTS)

12/2009 - 3/2012

National Technical University of Athens (NTUA)

Athens, Greece

- MSc Thesis Title: Analysis, Modeling and Nonlinear Control of an Inverted Pendulum (PDF)
- Advisor: Prof. Kostas J. Kyriakopoulos

MEng in Mechanical Engineering (300 ECTS)

10/2003 - 12/2009

National Technical University of Athens (NTUA)

Athens, Greece

- MEng Thesis Title: Installation, testing and comparative evaluation of smoke meter AVL415s,
- Direction: Power systems and Fluid Dynamics
- Advisor: Prof. Dimitrios Hountalas

Professional and Research Experience

TUM Technical University of Munich, Chair of Information-oriented Control Munich, Germany
Postdoctoral Associate
6/2020 - present

- Research topic:
 - * Research Topic: Machine Learning based control of autonomous robotic vehicles; Data driven task and motion planning for unmanned autonomous vehicles under resource constraints. In this work I am collaborating with Prof. Sandra Hirche
- Professional Experience:
 - * I am involved in the European project SeaClear: SEarch, identificAtion and Collection of marine Litter with Autonomous Robots Link: https://seaclear-project.eu/ that deals with collecting marine waste by employing unmanned underwater robots.

KTH Royal Institute of Technology, Department of Automatic Control Postdoctoral Associate

Stockholm, Sweden 1/2019 - 6/2020

- Research topic:
 - * Research Topic: Design, Development and implementation of robust control algorithm for single and multiple underwater robotic vehicles under under High-Level Specifications and resource constraints inspired by practical applications in the field autonomous robots. In this work I am collaborating with Prof. Dimos V. Dimarogonas
- Professional Experience:
 - * I was involved in the writing of the H2020 project proposal "CHRONUS: Collaborative Heterogeneous Marine Robots for Infrastructure Inspection and Maintenance". The project' vision is to develop core robotics technology and easy-to-use configuration tools that are model-based, efficient, reliable, resilient, secure, and safe-by-design. This technology, will have a high impact on infrastructure inspection and maintenance operations in underwater environments, by using cost-effective systems of collaborative heterogeneous marine robots.
 - * I was involved in the writing of the H2020 project proposal "AEROWORKS Tools: Aerial Robotic Workers for Inspection and Maintenance of Infrastructure". The proposed project involves design of high level and low level feedback control laws along applied to aerial robots for manipulation tasks in real and outdoor environment.
 - * I was involved in the writing of the Swedish project proposal "CMRSC: Collaborative Maritime Robots in Smart Cities". The main objective of this project is employing the smart Autonomous Underwater Robotic Vehicles as infrastructures for enhanced aquaculture, Blue Growth and Marine Security in cities situated in close connection to waters (bay, coast, river).
 - * I was involved in the writing of a proposal for doctoral student funding which was offered by "Wallenberg AI, Autonomous Systems and Software Program (WASP)". The proposal has been accepted.

NTUA, Control Systems Lab, Underwater Robotics Group

Athens, Greece 6/2012 - 12/2018

Research Associate/Research Engineer

 EU project R3COP: Robust & Safe Mobile Co-operative Autonomous Systems 2010-2013 (participated from 2012)

Funding agency: ARTEMIS Joint Technological Initiative

Role: Research Engineer. Responsibilities:

✓ Development of laser based vision algorithms for localization of underwater robotic vehicles.

- EU project THE: The Hand Embodied

2010-2014

Funding agency: European Commission (FP7-ICT: Cooperation)

Role: Research Engineer. Responsibilities:

- ✓ Design and experimental validation of Image Based Visual Servoing algorithm based on Prescribed Performance Control (PPC) technique for autonomous positioning of manipulator.
- EU project PANDORA: Persistent Autonomy through learNing, aDaptation, Observation and ReplAnning 2012-2015

Funding agency: European Commission (FP7: Cognitive Systems and Robotics (STREP)

- * The aim of this work was to design feedback control laws for underwater robots in order for them to achieve desired manipulation tasks imposed by the user.
- * Role: Research Engineer. Responsibilities:
 - ✓ Design of event-based Model Predictive Control (MPC) for Unmanned Underwater Vehicles (UUV) subject external disturbances and field-of-view constraints.
 - ✓ Design and experimental validation of a robust Image Based Visual Servoing control scheme for UUV's employing Model Predictive Control.
 - ✓ Development of a 2-1/2 Visual Servoing Strategy for inspection of unknown target using underwater vehicle manipulator systems.

- * My main research objective in this project was the developing and implementing of efficient control strategies for autonomous single and multiple underwater robotic systems considering significant issues such as: external disturbances, limited power resources, strict communication constraints along with underwater sensing and localization issues. Moreover, I worked in this project as the Grant Holder and Workpackage leader with responsibilities such as: preparation of deliverables, representation of NTUA at annual and review meetings, group leading in management issues, preparation of Network Training held in Athens with title: "Robotic Motion Planning for Non-holonomic and Multi-Agent Systems".
- * Role: PhD student & Grant Holder. Scientific Responsibilities:
 - ✓ Development of robust control algorithms for disturbance rejection.
 - ✓ Development of a predictive control scheme for underwater vehicle manipulator systems based on task-specific pose configurations for optimization of manipulation efficacy.
 - ✓ Design and experimental validation of a robust imaged based self-triggered predictive controller for small autonomous robots.
 - ✓ Development and real time validation of trajectory tracking algorithm for underactuated underwater vehicles under model uncertainties and external disturbances.
 - ✓ Design and experimental validation of distributed cooperative control approach for multiple underwater vehicle manipulator systems under implicit communication.
 - \checkmark Design and experimental validation of robust predictive control strategies for AUV exploiting sea currents dynamics.
 - ✓ Design and experimental validation of robust model-free interaction control approach for underwater vehicle manipulator systems.
 - ✓ Design and experimental validation of nonlinear model predictive control scheme for cooperative manipulation with singularity and collision avoidance.
- EU project CO4ROBOTS: Achieving Complex Collaborative Missions via Decentralized Control and Coordination of Interacting Robots , Funding agency: H2020-ICT-2016-1 EU project,
 2017-2020

Role: Research Engineer. Responsibilities:

✓ Development of an automatic approach for selection of the optimal grasp points on an object for collaborating mobile manipulators in order to increasing manipulability

NTUA, Section of Thermal Engineering

Athens, Greece

Research Engineer

9/2008 - 9/2009

 Research Engineer in numerical experiments and statistical analysis with smoke meter AVL415s under the guidance of Professor Dimitrios Hountalas. This position was in the framework of my MEng Thesis.

Awards, Scholarships and Honors

KTH, Department of Automatic Control

Stockholm, Sweden

• Awarded a Postdoctoral position founded by Kunt & Alice Wallenberg foundation (KAW) among 120 candidates from all over the world.

8/2018

ERCIM Alain Bensoussan Postdoctoral Fellowship

Trondheim, Norway

• Awarded ERCIM Alain Bensoussan Postdoctoral Fellowship within 222 submissions of 9/2018 researchers from all over the world

Marie Sklodowska-Curie actions research fellowships

Europe

Awarded Marie Sklodowska-Curie actions research fellowship under the research project 2014-2017 "Robocademy" for the development of the research career, in Control System Laboratory, Mechanical Engineering Department of National Technical University of Athens.

National Technical University of Athens

Athens, Greece

Thomaidion Award for Scientific Publications for consecutive years

2014-2018

Athens, Greece 2003-2009

Teaching

Lecture for undergraduate level courses on:

- Scientific Seminar Networked Systems and Control, Department of Electrical and Computer Engineering, Technical University of Munich, 2020-21
 - Role: Teaching lecture, preparing the course materials, meetings and acting as the reference person in case of any inquiries. Giving guidance and supporting students in technical matters and presentation of the results.
- Project Laboratory Networked and Cooperative Control, Chair of Information-oriented Control, Department of Electrical and Computer Engineering, Technical University of Munich, 2020-21
 - Role: Teaching lecture, preparing the course materials & meetings and acting as the reference person in case of any inquiries, Giving guidance and supporting students in technical matters, introducing students to the required tasks, final report and presentation of results and helping students with procurement of software and hardware.

Teaching Assistant for undergraduate level courses on:

- Control systems I & II (Linear Systems & Optimal Control), Mechanical Engineering Department, NTUA, 2014-2018
 - Role: Teaching assistant for analysis and design of feedback control systems, including classical control theory in the time and frequency domain. Demonstrating the use of theory from the lectures in solving relevant problems.
- Robotics I & II (Introduction to Robotics & Analysis & Intelligent Robotic Systems), Mechanical Engineering Department, NTUA, 2014-2018
 - Role: Teaching assistant for technological aspects, types of robots, application areas. Kinematic & dynamic analysis of robot manipulators, simple trajectory planning and control. Presenting a real time experimental validation employing inverted pendulum setup, grading exams.
- Robotics Laboratory,

Mechanical Engineering Department, NTUA, 2015-2018

- Role: Instructor of laboratory, presenting underwater group to student, presenting a simple real time trajectory tracking with small underwater robot.

Supervision

• Martin Zimmermann, Bachelor student at Technical University of Munich (TUM)

Munich, Germany

- Supervision of Bachelor thesis, Technical University of Munich, Germany

in progress

- Subject: Development of a data based sensor fusion algorithm for unmanned underwater vehicles
- Alexandros Nikou, Researcher at Ericsson Research

Stockholm, Sweden

- Supervision of master thesis, National Technical University of Athens, Greece,

2014-2015

- Subject: Designing adaptive control for a free flying manipulator

- Aris Kanellopoulos, PhD student at Kevin T. Crofton Department of Aerospace & Ocean Engineering Virginia
 Tech, USA
 - Supervision of master thesis, National Technical University of Athens, Greece, 2016
 - Subject: Robust Non-linear Variable-Horizon Model Predictive Control for Aggressive Maneuvering
- Spyridon Tarantos, PhD student at Sapienza Universita di Roma, Rome, Italy
 - Supervision of master thesis National Technical University of Athens, Greece,
 - Subject: Optimal Grasp Points Selection for Cooperative Underwater Vehicle Manipulator Systems

Certifications

Advanced Principles of Robotics

Network workshop

• Additional Education, 6 months. Objective: Underpinning fundamentals in Marine Feb-Dec/2015 Robotics including three scientific actions lines: i) Perception and ii) Autonomy.

Autonomous Underwater Robotics

University of Girona, Spain

Additional Education, 1 week. Objective: Localization (grid and map-based local-

1/2015

2017

• ization, SLAM, Monte Carlo Localization) and control architectures (path planning, learning and mission control).

Machine Learning for Autonomous Robots

DFKI, Germany

• Additional Education, 1 week. Objective: Machine Learning by covering the principles and the commonly used methods of AI-based machine learning.

5/2015

Robotic Motion Planning for Non-holonomic & Multi-Agent Systems

Athens, Greece The course was carried out by Prof. Kostas Kyriakopulos from Greece. The participates could

10/2016

• learn from one of the leading scientists in the field of control theory for underwater robotics about motion planning for underwater vehicles and systems. The course consisted of lectures and hand-on-experience in the laboratory.

Operation of Underwater Vehicles

Graaltech, Italy

An introduction to the mechatronic characteristics of UUVs (e.g. the FOLAGA underwater vehicles manufactured by Graaltech). Visiting the GT facilities in Genova and see how the

6/2017

• UUVs are manufactured. Operating principles and practical experience with UUVs presented by GT operators and scientists. Having the opportunity to obtain hands-on experience in the handling and operation of the equipment.

Underwater sensing and vehicle operation

CMRE, Italy

The objective of this workshop i) give a theoretical and practical introduction to underwater

6/2017

sensing and underwater vehicle operation, ii) experience both in theoretical and practical parts of UW operations, iii) Having the opportunity to use the research vessels and underwater equipment available at CMRE for practical tests and hands-on experience

Presentation & Communication skills

Heriot Watt university, Edinburgh, UK

The course was carried out by Prof. David Lane. The aim of the

8/2015

 workshop was the learning and practice of the advanced presentation and communication skills.

Team management & Negotiation Skills

ATLAS ELEKTRONIK, Bremen, Germany

The aim of the workshop was the learning and practice of the

10/2016

• advanced techniques for negotiation as well as successful control of a group of people.

Professional Activities

Program Organizer:

NetCon workshop

• Scientific seminar on decision and control

Stockholm, Sweden Jan, 2021

Reviewer:

Journal Reviewer

International Journal of Control, IET Control Theory & Applications, European Journal of Control, Artificial Intelligence Elsevier, IEEE Transaction on Control System Technology, IEEE Transactions on Automation Science and Engineering, IEEE Transactions on Cybernetics.

Conference Reviewer

IEEE Conference on Decision and Control (CDC), IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IFAC World Congress, IEEE Conference on Control Technology and Applications

Publications

Journal Publications:

- [J1] Charalampos P Bechlioulis, George C Karras, Shahab Heshmati-alamdari, Kostas J Kyriakopoulos, "Trajectory Tracking With Prescribed Performance for Underactuated Underwater Vehicles Under Model Uncertainties and External Disturbances", IEEE Transactions on Control Systems Technology, vol 25, p. 429-440, 2016.
- [J2] Shahab Heshmati-alamdari, Charalampos P. Bechlioulis, George C. Karras, Alexandros Nikou, Dimos V Dimarogonas, Kostas J. Kyriakopoulos"A Robust Interaction Control Approach for Underwater Vehicle Manipulator Systems", IFAC Annual Reviews in Control Journal, Vol 46, p.315-325, 2018. [Video]
- [J3] Charalampos P Bechlioulis, Shahab Heshmati-alamdari, George C. Karras, Kostas J. Kyriakopoulos "Robust Image Based Visual Servoing with Prescribed Performance under Field of View Constraints", IEEE Transactions on Robotics, 2019, [Video].
- [J4] Shahab Heshmati-alamdari, George C. Karras, Panos Marantos, and Kostas J. Kyriakopoulos, "A Robust Predictive Control Approach for Underwater Robotic Vehicles", IEEE Transactions on Control Systems Technology, 2019, [Video].
- [J5] Shahab Heshmati-alamdari, Charalampos P. Bechlioulis, George C. Karras, Kostas J. Kyriakopoulos, "Cooperative Impedance Control for Multiple Underwater Vehicle Manipulator Systems under Lean Communication", IEEE Journal of Oceanic Engineering, 2020, DOI: 10.1109/JOE.2020.2989603, (Published).
- [J6] Shahab Heshmati-alamdari, George C. Karras, Kostas J. Kyriakopoulos"A Predictive Control Approach for Cooperative Transportation by Multiple Underwater Vehicle Manipulator Systems", IEEE Transactions on Control Systems Technology, 2019 (Minor revision), [Video].
- [J7] Alexandros Nikou, Shahab Heshmati-alamdari, Dimos V. Dimarogonas "Towards a Scalable Time-constrained Planning of Multi-robot Systems", Autonomous Robots, Springer, 2020, DOI: https://doi.org/10.1007/s10514-020-09937-6 (Published), [Video].
- [J8] Shahab Heshmati-alamdari, Alexandros Nikou, Dimos V. Dimarogonas "Robust Trajectory Tracking Control for Underactuated Autonomous Underwater Vehicles in Uncertain Environment", IEEE Transactions on Automation Science and Engineering, 2020, DOI: 10.1109/TASE.2020.3001183, (Published), Video.
- [J9] Alexandros Nikou, Shahab Heshmati-alamdari, Dimos V. Dimarogonas "A Robust Nonlinear MPC Framework for Control of Underwater Vehicle Manipulator Systems under High-Level Tasks", IET Control Theory & Applications, 2019, (Under revision).

- [J10] Shahab Heshmati-alamdari, Alina Eqtami, George C. Karras, Dimos V. Dimarogonas, Kostas J. Kyriakopoulos "A Self-triggered Position Based Visual Servoing Model Predictive Control Scheme for Underwater Robotic Vehicles" Machines, MDPI, 2020, DOI:https://doi.org/10.3390/machines8020033 (Published).
- [J11] Shahab Heshmati-alamdari, Alexandros Nikou, Lars Lindemann, Dimos V. Dimarogonas "Signal Temporal Logic under Prescribed Performance Predictive Control", 2020, (Under preparation).

Conference Publications:

- [C1] Alina Eqtami, Shahab Heshmati-alamdari, Dimos V Dimarogonas, Kostas J Kyriakopoulos, "Self-triggered model predictive control for nonholonomic systems", European Control Conference (ECC), 2013.
- [C2] Alina Eqtami, Shahab Heshmati-alamdari, Dimos V Dimarogonas, Kostas J Kyriakopoulos, "A self-triggered model predictive control framework for the cooperation of distributed nonholonomic agents", IEEE 52nd Annual Conference on Decision and Control (CDC), 2013.
- [C3] Shahab Heshmati-alamdari, Alina Eqtami, George C Karras, Dimos V Dimarogonas, Kostas J Kyriakopoulos, "A self-triggered visual servoing model predictive control scheme for under-actuated underwater robotic vehicles", IEEE International Conference on Robotics and Automation (ICRA), 2014, [Video].
- [C4] Shahab Heshmati-alamdari, George K Karavas, Alina Eqtami, Michael Drossakis, Kostas J Kyriakopoulos, "Robustness analysis of model predictive control for constrained image-based visual servoing", IEEE International Conference on Robotics and Automation (ICRA), 2014.
- [C5] Natalia Hurtos, Narcis Palomeras, Arnau Carrera, Marc Carreras, Charalampos P. Bechlioulis, George C. Karras, Shahab Heshmati-alamdari, Kostas Kyriakopoulos, "Sonar-Based Chain Following Using an Autonomous Underwater Vehicle", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2014), 2014.
- [C6] Shahab Heshmati-alamdari, Charalampos P Bechlioulis, Minas V Liarokapis, Kostas J Kyriakopoulos, "Prescribed performance image based visual servoing under field of view constraints", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2014), 2014, [Video].
- [C7] Shahab Heshmati-alamdari, George C. Karras, Alina Eqtami and Kostas J. Kyriakopoulos, "A Robust Self Triggered Image Based Visual Servoing Model Predictive Control Scheme for Small Autonomous Robots", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015, [Video].
- [C8] Alexandros Nikou, Christos Verginis, Shahab Heshmati-alamdari, Dimos V Dimarogonas, "A Nonlinear Model Predictive Control Scheme for Cooperative Manipulation with Singularity and Collision Avoidance", IEEE 25th Mediterranean Conference on Control and Automation, 2017.
- [C9] Alexandros Nikou, Shahab Heshmati-alamdari, Christos Verginis, Dimos V Dimarogonas, "Decentralized Abstractions and Timed Constrained Planning of a General Class of Coupled Multi-Agent Systems", IEEE 56nd Annual Conference on Decision and Control (CDC), 2017.
- [C10] Shahab Heshmati-alamdari, Alexandros Nikou, Kostas J. Kyriakopoulos, Dimos V. Dimarogonas, "A Robust Force Control Approach for Underwater Vehicle Manipulator Systems", The 20th World Congress of the International Federation of Automatic Control (IFAC 2017), 2017.
- [C11] Shahab Heshmati-alamdari, George C. Karras, Panos Marantos, and Kostas J. Kyriakopoulos, "A Robust Model Predictive Control Approach for Underwater Robotic Vehicles Operating in a Constrained workspace", Accepted IEEE International Conference on Robotics and Automation (ICRA-2018), [Video].
- [C12] Michael Logothetis, George Karras, Shahab Heshmati-alamdari, Panagiotis Vlantis, Kostas Kyriakopoulos, "A Model Predictive Control Approach for Vision-based Object Grasping via Mobile Manipulator", IEEE International Conference on Intelligent Robots, IROS, 2018, [Video].
- [C13] Shahab Heshmati-alamdari, Charalampos P. Bechlioulis, George C. Karras, Kostas J. Kyriakopoulos, "Decentralized Impedance Control for Cooperative Manipulation of Multiple Underwater Vehicle Manipulator Systems under Lean Communication", IEEE OES Autonomous Underwater Vehicle Symposium, 2018.
- [C14] Shahab Heshmati-alamdari, George C. Karras, Kostas J. Kyriakopoulos, "A Distributed Predictive Control Approach for Cooperative Manipulation of Multiple Underwater Vehicle Manipulator Systems", IEEE International Conference on Robotics and Automation (ICRA), 2019, [Video].
- [C15] Alexandros Nikou, Shahab Heshmati-alamdari, Dimos V. Dimarogonas, "Design and Experimental Validation of Tube-based MPC for Timed-constrained Robot Planning", IEEE International Conference on Automation

Science and Engineering (CASE), 2019 (Accepted), [Video].

[C16] Shahab Heshmati-alamdari, Alexandros Nikou, Dimos V. Dimarogonas, "Robust Trajectory Tracking Control for Underactuated Autonomous Underwater Vehicles", 58th IEEE Conference on Decision and Control (CDC), Nice, France - December 11-13 2019 (Accepted).

[C17] Pedro Roque, Shahab Heshmati-alamdari, Alexandros Nikou, Dimos V. Dimarogonas, "Decentralized Formation Control for Multiple Quadrotors under Unidirectional Communication Constraints", 21st World Congress of the International Federation of Automatic Control (IFAC WC), Berlin, German, July 2020.

Book chapters:

[B1] George C. Karras, Charalampos P. Bechlioulis, Panos Marantos, Shahab Heshmati-alamdari and Kostas J. Kyriakopoulos, "Motion Control of Autonomous Underwater Vehicles, Part I: Modeling & Low Complexity State Estimation", in IET Book, "Autonomous Underwater Vehicles: Design and practice", Frank Ehlers, ISBN: 978-1-78561-703-4, in press.

[B2] Charalampos P. Bechlioulis, Shahab Heshmati-alamdari, George C. Karras, Panos Marantos and Kostas J. Kyriakopoulos, "Motion Control of Autonomous Underwater Vehicles, Part II: Robust Motion Control Strategies", in IET Book, "Autonomous Underwater Vehicles: Design and practice", Frank Ehlers, ISBN: 978-1-78561-703-4, in press.

IT Skills & Real Time Robotic Experiments

- Programming and scripting languages: C/C++, Python, MATLAB/Simulink.
- Software: Solidworks, Autodesk Inventor, Mathematica, MS Office/Excel/Power Point, MS Visio, Adobe Premiere (Video Processing).
- ROS Environment: Gazebo, UWsim, OpenCV, and Various robotics libraries.

A list of my experiments videos can be found in my Youtube page.

References

- Professor Kostas J. Kyriakopoulos
 - Address: Department of Mechanical Engineering, National Technical University of Athens, Zografou Campus 15780, Athens, Greece.
 - E-mail: kkyria@mail.ntua.gr
 - Telephone number: 0030-210773595
- Professor Dimos V. Dimarogonas
 - Address: Division of Decision and Control Systems, KTH School of Electrical Engineering and Computer Science, Malvinas väg 10, floor 6, SE-10044, Stockholm, Sweden.
 - E-mail: dimos@kth.se