

# George P. Kontoudis

3242 Kim Engineering Building, College Park, MD 20742, USA

🏠 [www.georgekontoudis.com](http://www.georgekontoudis.com) ✉ [kont@umd.edu](mailto:kont@umd.edu) ☎ (+1) 540 449-7026 ⬢ Updated: September 2, 2023

## RESEARCH INTERESTS

My primary research interests lie in the integration of **robotics**, **control theory**, and **machine learning**. What interests me most is the formulation of hybrid theoretical schemes and the development of novel robotic systems to bridge the gap between machine learning and autonomy. I am particularly interested in how learning algorithms and control theory can enable multi-agent systems to efficiently collaborate with minimal information exchange for robotic navigation and exploration tasks. I also contribute to the OpenBionics initiative on the design and development of robot hands and prosthetic devices.

## PROFESSIONAL & RESEARCH EXPERIENCE

<b>Assistant Professor, Colorado School of Mines</b> Department of Mechanical Engineering	Jan 2024–
<b>Postdoctoral Research Associate, University of Maryland</b> Motion and Teaming Lab (PI: Michael Otte)	Jan 2022–present
<b>Graduate Research Assistant, Virginia Tech</b> Center for Marine Autonomy & Robotics (PI: Daniel J. Stilwell) Computational Multiphysics Systems Laboratory (PI: Tomonari Furukawa)	Aug 2016–Dec 2021
<b>Undergraduate Research Assistant, National Technical University of Athens</b> Control Systems Laboratory (PI: Kostas J. Kyriakopoulos)	Apr 2014–Mar 2016
<b>Founder &amp; Research Associate, OpenBionics</b>	Sep 2014–present

## EDUCATION

<b>Ph.D. in Electrical Engineering, Virginia Tech</b> Dissertation Title: “Communication-Aware, Scalable Gaussian Processes for Decentralized Exploration”	2018–2021
<b>M.S. in Mechanical Engineering, Virginia Tech</b> Thesis Title: “Adaptive, Anthropomorphic Robot Hands for Grasping and In-Hand Manipulation”	2016–2018
<b>Diploma (B.S. &amp; M.S.) in Mechanical Engineering, National Technical University of Athens</b> Thesis Title: “Design and Development of an Underactuated, Anthropomorphic Robot Hand”	2012–2016
<b>B.S. in Mechanical Engineering, University of West Attica</b>	2005–2010

## TEACHING EXPERIENCE

<b>Instructor, ENAE4880/7880 Introduction to Autonomous Multi-Robot Swarms</b> Department of Aerospace Engineering, University of Maryland	Spring 2023
<b>Graduate Teaching Assistant, ME4005 Mechanical Engineering Lab I</b> Department of Mechanical Engineering, Virginia Tech	Spring 2017
<b>Graduate Teaching Assistant, ME4006 Mechanical Engineering Lab II</b> Department of Mechanical Engineering, Virginia Tech	Fall 2016

## AWARDS & HONORS

2022 RSS Pioneer (Acceptance Rate: 35%)	2022
2022 MRC Postdoctoral Fellowship (\$60K)	2022
5 × IEEE Student Travel Support for IROS, ACC, and CDC	2015, 2019–2021
2 × Virginia Tech GSA Travel Fund Award for Humanoids and ICORR	2019, 2020
NSF Student Travel Grant for WuWNet (\$1K)	2019
NTUA Thomaideion Award for IROS	2016
Hackaday Prize, 2 <sup>nd</sup> place among 900 projects (\$10K)	2015
Robotdalen Innovation Award, 1 <sup>st</sup> place (SEK 100K)	2015

## INDUSTRY EXPERIENCE

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Mechanical Engineer, Sychem S.A.  
Aircraft Maintenance Engineer Trainee, Olympic Aviation

Oct 2010–Aug 2015  
May 2008–Jan 2010

## PUBLICATIONS

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### Journal Manuscripts Under Review (J:UR)

- [3] Josh Netter, **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Decentralized Multi-Agent Motion Planning Using Cognitive Hierarchy and Gaussian Process Classification.”
- [2] **George P. Kontoudis**, Daniel J. Stilwell, “Fully Decentralized, Scalable Gaussian Process Training for Multi-Agent Learning.”
- [1] **George P. Kontoudis**, Daniel J. Stilwell, “Fully Decentralized, Scalable Gaussian Process Prediction for Multi-Agent Learning.”

### Referred Journal Publications (J)

- [5] Zirui Xu, **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Online and Robust Intermittent Motion Planning in Dynamic and Changing Environments,” *IEEE Transactions on Neural Networks and Learning Systems*, 2023. (early access)
- [4] **George P. Kontoudis**, Stephen Krauss, Daniel J. Stilwell, “Model-Based Learning of Underwater Acoustic Communication Performance for Marine Robots,” *Robotics and Autonomous Systems*, 2021.
- [3] Geng Gao, Mojtaba Shahmohammadi, Lucas Gerez, **George P. Kontoudis**, Minas Liarokapis, “On Differential Mechanisms for Underactuated, Lightweight, Adaptive Prosthetic Hands,” *Frontiers in Neurorobotics*, 2021.
- [2] **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Kinodynamic Motion Planning with Continuous-Time Q-Learning: An Online, Model-Free, and Safe Navigation Framework,” *IEEE Transactions on Neural Networks and Learning Systems*, 2019.
- [1] **George P. Kontoudis**, Minas Liarokapis, Kyriakos G. Vamvoudakis, Tomonari Furukawa, “An Adaptive Actuation Mechanism for Anthropomorphic Robot Hands,” *Frontiers in Robotics and AI*, 2019.

### Chapters in Edited Volumes (BC)

- [1] **George P. Kontoudis**, Kyriakos G. Vamvoudakis, Zirui Xu, “RRT-QX: Real-Time Kinodynamic Motion Planning in Dynamic Environments with Continuous-Time Reinforcement Learning,” in *Brain and Cognitive Intelligence: Control in Robotics*, B. Wei (Ed.), Taylor & Francis Group, CRC Press, 2022.

### Conference Papers Under Review (C:UR)

- [3] **George P. Kontoudis**, Daniel J. Stilwell, “Decentralized Federated Learning using Gaussian Processes.”
- [2] Alkesh K. Srivastava, **George P. Kontoudis**, Donald Sofge, Michael Otte, “Hazard Detection in Communication-Denied Environments using Bayesian Network Modeling of Path-Based Sensors.”
- [1] Alkesh K. Srivastava, Samuel Migirditch, Mohamed Khalid M Jaffar, Carlos Nieto-Granda, Aamodh Suresh, **George P. Kontoudis**, Michael Otte, “Learning a Surrogate to Plan Paths for Information Gathering about Hazards in Dangerous Environments.”

### Referred Conference Publications (C)

- [16] **George P. Kontoudis**, Michael Otte, “Adaptive Exploration-Exploitation Active Learning of Gaussian Processes,” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Detroit, USA, 2023.
- [15] **George P. Kontoudis**, Michael Otte, “Closed-Form Active Learning of Expected Variance Reduction using Gaussian Process Surrogates for Adaptive Sampling,” *American Control Conference (ACC)*, San Diego, USA, 2023.
- [14] Alkesh K. Srivastava, **George P. Kontoudis**, Donald Sofge, Michael Otte, “Distributed Multi-Robot Information Gathering using Path-Based Sensors in Entropy-Weighted Voronoi Regions,” *International Symposium on Distributed Autonomous Robotic Systems (DARS)*, Montbéliard, France, 2022.

- [13] Christos N. Mavridis, **George P. Kontoudis**, John S. Baras, “Sparse Gaussian Process Regression using Progressively Growing Learning Representations,” *IEEE Conference on Decision and Control (CDC)*, Cancun, Mexico, 2022.
- [12] Josh Netter, **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Bounded Rational RRT-QX: Multi-Agent Motion Planning in Dynamic Human-Like Environments Using Cognitive Hierarchy and Q-Learning,” *IEEE Conference on Decision and Control (CDC)*, Austin, USA, 2021.
- [11] **George P. Kontoudis**, Daniel J. Stilwell, “Decentralized Nested Gaussian Processes for Multi-Robot Systems,” *IEEE International Conference on Robotics and Automation (ICRA)*, Xi’an, China, 2021.
- [10] Minas Liarokapis, **George P. Kontoudis**, “Teaching Robotic and Biomechatronic Concepts with a Gripper Design Project and a Grasping and Manipulation Competition,” *IEEE International Conference on Robotics and Automation (ICRA)*, Xi’an, China, 2021.
- [9] **George P. Kontoudis**, Daniel J. Stilwell, “Prediction of Acoustic Communication Performance in Marine Robots Using Model-Based Kriging,” *American Control Conference (ACC)*, New Orleans, USA, 2021.
- [8] Gal Gorjup, **George P. Kontoudis**, Anany Dwivedi, Geng Gao, Saori Matsunaga, Toshisada Mariyama, Bruce MacDonald, and Minas Liarokapis “Combining Programming by Demonstration with Path Optimization and Local Replanning to Facilitate the Execution of Assembly Tasks,” *IEEE International Conference on Systems, Man and Cybernetics (SMC)*, Toronto, Canada, 2020.
- [7] **George P. Kontoudis**, Zirui Xu, Kyriakos G. Vamvoudakis, “Online, Model-Free Motion Planning in Dynamic Environments: An Intermittent, Finite Horizon Approach with Continuous-Time Q-Learning,” *American Control Conference (ACC)*, Denver, USA, 2020.
- [6] **George P. Kontoudis**, Daniel J. Stilwell, “A Comparison of Kriging and Cokriging for Estimation of Underwater Acoustic Communication Performance,” *ACM International Conference on Underwater Networks and Systems (WuWNet)*, Atlanta, USA, 2019.
- [5] **George P. Kontoudis**, Minas Liarokapis, Kyriakos G. Vamvoudakis, “An Adaptive, Humanlike Robot Hand with Selective Interdigitation: Towards Robust Grasping and Dexterous, In-Hand Manipulation,” *IEEE-RAS International Conference on Humanoid Robots (Humanoids)*, Toronto, Canada, 2019.
- [4] **George P. Kontoudis**, Minas Liarokapis, Kyriakos G. Vamvoudakis, “A Compliant, Underactuated Finger for Anthropomorphic Hands,” *IEEE/RAS-EMBS Inter. Conference on Rehabilitation Robotics (ICORR)*, Toronto, Canada, 2019.
- [3] **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Robust Kinodynamic Motion Planning using Model-Free Game-Theoretic Learning,” *American Control Conference (ACC)*, Philadelphia, USA, 2019.
- [2] Kyriakos D. Tsoukalas, **George P. Kontoudis**, Kyriakos G. Vamvoudakis, “Active-Bayesian Learning for Cooperation Connectivity in Dynamic Cyber-Physical-Human Systems,” *IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning (ADPRL)*, Honolulu, USA, 2017.
- [1] **George P. Kontoudis**, Minas Liarokapis, Agisilaos G. Zisimatos, Christoforos I. Mavrogiannis, Kostas J. Kyriakopoulos, “Open-Source, Anthropomorphic, Underactuated Robot Hands with a Selectively Lockable Differential Mechanism: Towards Affordable Prostheses,” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, 2015.

#### Preprints (P)

- [1] **George P. Kontoudis**, Daniel J. Stilwell, “Fully Decentralized, Scalable Gaussian Processes for Multi-Agent Federated Learning,” *arXiv preprint, arXiv:2203.02865*, 2022.

#### Referred Workshop Publications (W)

- [2] Alkesh K. Srivastava, **George P. Kontoudis**, Donald Sofge, Michael Otte, “Path-Based Sensors: Will the Knowledge of Correlation in Random Variables Accelerate Information Gathering?” *IEEE International Conference on Robotics and Automation (ICRA), Workshop on Communication Challenges in Multi-Robot Systems: Perception, Coordination, and Learning*, London, UK, June 2023.
- [1] **George P. Kontoudis**, “Scalable Multi-Robot Active Exploration,” *Robotics: Science and Systems (RSS), Pioneers Workshop*, New York City, USA, June 2022.

## Theses (T)

- [3] **George P. Kontoudis**, “Communication-Aware, Scalable Gaussian Processes for Decentralized Exploration,” *Doctoral Dissertation, Virginia Tech, USA*, December 2021.
- [2] **George P. Kontoudis**, “Adaptive, Anthropomorphic Robot Hands for Grasping and In-Hand Manipulation,” *Master Thesis, Virginia Tech, USA*, December 2018.
- [1] **George P. Kontoudis**, “Design and Development of an Underactuated, Anthropomorphic Robot Hand,” *Diploma Thesis, National Technical University of Athens, March 2016. (in Greek)*

## Technical Reports (TR)

- [2] **George P. Kontoudis**, Minas Liarokapis, Agisilaos G. Zisimatos, Christoforos I. Mavrogiannis, Kostas J. Kyriakopoulos, “How to Create Affordable, Anthropomorphic, Light-Weight Prosthetic Hands,” *Control Systems Lab, National Technical University of Athens, Athens, Greece*, October 2015.
- [1] Agisilaos G. Zisimatos, Minas Liarokapis, Christoforos I. Mavrogiannis, **George P. Kontoudis**, Kostas J. Kyriakopoulos, “How to Create Affordable, Modular, Light-Weight, Underactuated, Compliant Robot Hand,” *Control Systems Lab, National Technical University of Athens, Athens, Greece*, January 2015.

## TALKS & PRESENTATIONS

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- “Closed-Form Active Learning Using Expected Variance Reduction of Gaussian Process Surrogates for Adaptive Sampling” *American Control Conference (ACC)*, San Diego, USA, 2023. [**Oral Presentation**]
- “Decentralized Gaussian Process Learning for Exploration with Multi-Robot Systems” *Maryland Robotics Center Research Symposium*, College Park, USA, May 2023. [**Oral Presentation - Invited Talk**]
- “Scalable Exploration-Exploitation Active Learning of Gaussian Process Surrogates for Adaptive Sampling” *Maryland Robotics Center Research Symposium*, College Park, USA, May 2023. [**Poster Presentation**]
- “Multi-Robot Adaptive Sampling using Decentralized Gaussian Processes,” *International Symposium on Distributed Autonomous Robotic Systems (DARS)*, Monbeliard, France, November 2022. [**Poster Presentation**]
- “Scalable Multi-Robot Active Exploration,” *Robotics: Science and Systems (RSS), Pioneers Workshop*, New York City, USA, June 2022. [**Spotlight Presentation**]
- “Communication-Aware, Scalable Gaussian Processes for Decentralized Exploration” *Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, USA*, December 2021. [**PhD Defense**]
- “Decentralized Nested Gaussian Processes for Multi-Robot Systems,” *IEEE International Conference on Robotics and Automation (ICRA)*, Xi’an, China, 2021. [**Virtual Presentation**]
- “Online, Model-Free Motion Planning in Dynamic Environments: An Intermittent, Finite Horizon Approach with Continuous-Time Q-Learning,” *American Control Conference (ACC)*, Denver, USA, 2020. [**Rapid-Interactive Presentation**]
- “A Comparison of Kriging and Cokriging for Estimation of Underwater Acoustic Communication Performance,” *ACM International Conference on Underwater Networks and Systems (WuWNet)*, Atlanta, USA, 2019. [**Oral Presentation**]
- “An Adaptive, Humanlike Robot Hand with Selective Interdigitation: Towards Robust Grasping and Dexterous, In-Hand Manipulation,” *Workshop on New Challenges in Humanoid Grasping and Manipulation in IEEE-RAS International Conference on Humanoid Robots (Humanoids)*, Toronto, Canada, 2019. [**Oral Presentation - Invited Talk**]
- “An Adaptive, Humanlike Robot Hand with Selective Interdigitation: Towards Robust Grasping and Dexterous, In-Hand Manipulation,” *IEEE-RAS International Conference on Humanoid Robots (Humanoids)*, Toronto, Canada, 2019. [**Poster Presentation**]
- “Robust Kinodynamic Motion Planning using Model-Free Game-Theoretic Learning,” *American Control Conference (ACC)*, Philadelphia, USA, 2019. [**Oral Presentation**]
- “A Compliant, Underactuated Finger for Anthropomorphic Hands,” *IEEE/RAS-EMBS International Conference on Rehabilitation Robotics (ICORR)*, Toronto, Canada, 2019. [**Poster Presentation**]
- “Adaptive, Anthropomorphic Robot Hands for Grasping and In-Hand Manipulation,” *Department of Mechanical Engineering, Virginia Tech, Blacksburg, USA*, December 2018. [**Master’s Defense**]
- “Evaluation Strategies of Adaptive, Anthropomorphic Robot Hands for Dexterous In-Hand Manipulation: Early Results,” *National Institute of Standards and Technology (NIST)*, USA, 2018. [**Invited Talk**]
- “Open-Source, Anthropomorphic, Underactuated Robot Hands with a Selectively Lockable Differential Mechanism: Towards Affordable Prostheses,” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, 2015. [**Oral Presentation**]

## SERVICE ACTIVITIES

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### Conference Committees

- General Chair, Robotics: Science and Systems (RSS), Pioneers Workshop 2023
- Program Committee Member, Conference on Artificial Intelligence (AAAI), Student Abstract and Poster 2023
- Online Platform Chair, Conference on Robot Learning (CoRL) 2022

### Reviewer, Journals

- IEEE Transactions on Neural Networks and Learning Systems 2019–2022
- IEEE Transactions on Robotics 2020, 2023
- IEEE Transactions on Automatic Control 2023
- International Journal of Robotics Research 2023
- IEEE Transactions on Automation Science and Engineering 2020–2023
- IEEE Journal of Oceanic Engineering 2023
- IEEE Transactions on Cybernetics 2020
- IEEE Transactions on Systems, Man and Cybernetics: Systems 2021
- IEEE Computational Intelligence Magazine 2020
- IEEE Control Systems Letters 2019, 2020
- IEEE Robotics and Automation Letters 2019, 2022, 2023
- IEEE Robotics & Automation Magazine 2022
- Autonomous Robots 2022
- Frontiers in Artificial Intelligence 2021
- Frontiers in Robotics and AI 2022
- Journal of Optimization Theory and Applications 2021
- International Journal of Advanced Robotic Systems 2015, 2016

### Reviewer, Conferences

- IEEE International Conference on Robotics and Automation (ICRA) 2018–2023
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2018–2023
- American Control Conference (ACC) 2018–2021
- IEEE Conference on Decision and Control (CDC) 2019, 2020, 2023
- IEEE International Conference on Automation Science and Engineering (CASE) 2019
- IEEE-RAS International Conference on Humanoid Robots (Humanoids) 2019
- IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob) 2018, 2020, 2021
- European Control Conference (ECC) 2022
- Mediterranean Conference on Control and Automation (MED) 2018

## MENTORING

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### PhD Students

- **Joshua Netter**, Georgia Institute of Technology 2020–present  
Publications: C-[12], J:UR-[3]

### Master's Students

- **Alkesh K. Srivastava** 2022–2023  
Publications: C-[14], W-[2], C:UR-[1], C:UR-[2]  
Currently: PhD Student, Temple University
- **Zirui Xu** 2018–2020  
Publications: C-[7], BC-[1], J-[5]  
Currently: PhD Candidate, University of Michigan