

George P. Kontoudis

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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.

PROFESSIONAL & RESEARCH EXPERIENCE

Assistant Professor, Colorado School of Mines Department of Mechanical Engineering	<i>Jan 2024–present</i>
Postdoctoral Research Associate, University of Maryland Motion and Teaming Lab (PI: Michael Otte)	<i>Jan 2022–Dec 2023</i>
Graduate Research Assistant, Virginia Tech Center for Marine Autonomy & Robotics (PI: Daniel J. Stilwell) Computational Multiphysics Systems Laboratory (PI: Tomonari Furukawa)	<i>Aug 2016–Dec 2021</i>
Undergraduate Research Assistant, National Technical University of Athens Control Systems Laboratory (PI: Kostas J. Kyriakopoulos)	<i>Apr 2014–Mar 2016</i>
Founder & Research Associate, OpenBionics	<i>Sep 2014–present</i>

EDUCATION

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

TEACHING EXPERIENCE

Instructor, MEGN544 Robot Mechanics: Kinematics, Dynamics, and Control Department of Mechanical Engineering, Colorado School of Mines	<i>Fall 2024</i>
Instructor, MEGN315 Dynamics Department of Mechanical Engineering, Colorado School of Mines Participation: 31 undergraduate students (S ’24) Evaluation: 4.04/5.00 (S ’24)	<i>Spring 2024</i>
Co-Instructor, ENAE488O/788O Introduction to Autonomous Multi-Robot Swarms Department of Aerospace Engineering, University of Maryland	<i>Spring 2023</i>
Graduate Teaching Assistant, ME4005 Mechanical Engineering Lab I Department of Mechanical Engineering, Virginia Tech	<i>Spring 2017</i>
Graduate Teaching Assistant, ME4006 Mechanical Engineering Lab II Department of Mechanical Engineering, Virginia Tech	<i>Fall 2016</i>

AWARDS & HONORS

NSF FRR-NRI Aspiring Robotics PI	2023, 2024
2022 Robotics: Science and Systems (RSS) Pioneer	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 nd place among 900 projects (\$10K)	2015
Robotdalen Innovation Award, 1 st place (SEK 100K)	2015

INDUSTRY EXPERIENCE

Mechanical Engineer, Sychem S.A.	Oct 2010–Aug 2015
Aircraft Maintenance Engineer Trainee, Olympic Aviation	May 2008–Jan 2010

PUBLICATIONS

*denotes student mentee co-author
+denotes student advisee co-author

Journal Manuscripts Under Review (J:UR)

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

Referred Journal Publications (J)

- [6] **George P. Kontoudis**, Daniel J. Stilwell, “Scalable, Federated Gaussian Process Training for Decentralized Multi-Agent Systems,” *IEEE Access*, 2024.
- [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)

- [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)

- [17] **George P. Kontoudis**, Daniel J. Stilwell, “Decentralized Federated Learning using Gaussian Processes,” *IEEE International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, Boston, USA, 2023.
- [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. (Also appears as a chapter in the book: *Distributed Autonomous Robotic Systems, Springer Tracts in Advanced Robotics*, p. 286–299. 2024.)
- [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

- “Decentralized Informative Path Planning with Gaussian Processes,” *NSF FRR-NRI PI Meeting*, Baltimore, USA, 2024. **[Poster Presentation]**
- “Optimal Kinodynamic Motion Planning and Informative Path Planning,” *Computer Science and Robotics Seminar, Colorado School of Mines*, Golden, USA, 2024. **[Oral Presentation]**
- “Decentralized Federated Learning using Gaussian Processes,” *IEEE International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, Boston, USA, 2023. **[Oral Presentation]**
- “Adaptive Exploration-Exploitation Active Learning of Gaussian Processes,” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Detroit, USA, 2023. **[Oral & Poster Presentation]**
- “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,” *IEEE-RAS Intern. 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

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, 2024
- Online Platform Chair, Conference on Robot Learning (CoRL) 2022

Reviewer

- **Journals:** IEEE Transactions on Neural Networks and Learning Systems (TNNLS) · IEEE Transactions on Robotics (TRO) · IEEE Transactions on Automatic Control (TAC) · IEEE Transactions on Automation Science and Engineering (TASE) · IEEE Robotics and Automation Letters (RAL) · IEEE Control Systems Letters (CSL) · IEEE Robotics & Automation Magazine (RAM) · Autonomous Robots (AURO) · IEEE Journal of Oceanic Engineering (JOE) · IEEE Transactions on Systems, Man and Cybernetics: Systems (TSMCA) · IEEE Transactions on Cybernetics · IEEE Computational Intelligence Magazine (CIM) · Frontiers in Robotics and AI (FROBAI) · Frontiers in Artificial Intelligence (FAI) · Journal of Optimization Theory and Applications (JOTA) · International Journal of Advanced Robotic Systems (IJARS)
- **Conferences:** IEEE International Conference on Robotics and Automation (ICRA) · IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) · Robotics: Science and Systems (RSS) · American Control Conference (ACC) · IEEE Conference on Decision and Control (CDC) · International Symposium on Distributed Autonomous Robotic Systems (DARS) · IEEE Conference on Control Technology and Applications (CCTA) · International Conference on Ubiquitous Robots (UR) · IEEE International Conference on Automation Science and Engineering (CASE) · IEEE-RAS International Conference on Humanoid Robots (Humanoids) · European Control Conference (ECC) · IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob) · Mediterranean Conference on Control and Automation (MED)

RESEARCH ADVISING

PhD Students

- Mykola Mazur, Colorado School of Mines (*co-advised with Anthony Petrella*) 2024–present
 - Joshua Netter, Georgia Institute of Technology 2020–2023
- Publications: C-[12], J:UR-[3]

Master’s Students

- Alkesh K. Srivastava, University of Maryland 2022–2023
 - Zirui Xu, Georgia Institute of Technology 2018–2020
- Publications: C-[14], W-[2], C:UR-[1], C:UR-[2]
Publications: C-[7], BC-[1], J-[5]

Undergraduate Students

- Ross Hodson, Colorado School of Mines *2024–present*
- Remi Jones, Colorado School of Mines *2024–present*
- Elijah Paiz, Colorado School of Mines *2024–present*

PhD Qualifying Exam Committees

- Eugene Hamzezadeh, Colorado School of Mines *May 2024*
- Seth Stewart, Colorado School of Mines *May 2024*