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 devices to bridge the gap between machine learning and autonomous systems. 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. Also, I contribute to the OpenBionics initiative on the design and development of robot hands and prosthetic devices.

RESEARCH EXPERIENCE

Postdoctoral Research Associate, University of Maryland
Motion and Teaming Lab (PI: Michael Otte) *Jan 2022–present*

Graduate Research Assistant, Virginia Tech
Center for Marine Autonomy & Robotics (PI: Daniel J. Stilwell) *Aug 2018–Dec 2021*
Computational Multiphysics Systems Laboratory (PI: Tomonari Furukawa) *Aug 2016–Jul 2018*

Undergraduate Research Assistant, National Technical University of Athens
Control Systems Laboratory (PI: Kostas J. Kyriakopoulos) *Apr 2014–Mar 2016*

Founder & Research Associate, OpenBionics *Sep 2014–present*

EDUCATION

PhD in Electrical Engineering, Virginia Tech *2018–2021*
Advisor: Daniel J. Stilwell
Dissertation Title: "Communication-Aware, Scalable Gaussian Processes for Decentralized Exploration"
GPA: 3.94/4.00

MSc in Mechanical Engineering, Virginia Tech *2016–2018*
Advisors: Tomonari Furukawa & Kyriakos G. Vamvoudakis
Thesis Title: "Adaptive, Anthropomorphic Robot Hands for Grasping and In-Hand Manipulation"
GPA: 4.00/4.00

Diploma (BSc & MSc) in Mechanical Engineering, National Technical University of Athens *2012–2016*
Advisor: Kostas J. Kyriakopoulos
Thesis Title: "Design and Development of an Underactuated, Anthropomorphic Robot Hand"

BSc in Mechanical Engineering, University of West Attica *2005–2010*

TEACHING EXPERIENCE

Instructor, ENAE488O/788O Introduction to Autonomous Multi-Robot Swarms
Department of Aerospace Engineering, University of Maryland *Spring 2023*

Graduate Teaching Assistant, ME4005 Mechancal Engineering Lab I
Department of Mechanical Engineering, Virginia Tech *Spring 2017*

Graduate Teaching Assistant, ME4006 Mechancal Engineering Lab II
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, 2nd place among 900 projects ($10K) *2015*
Robotdalen Innovation Award, 1st 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

Journal Manuscripts Under Review (J:UR)

[4] **George P. Kontoudis**, Daniel J. Stilwell, "Fully Decentralized, Scalable Gaussian Process Training for Multi-Agent Learning."

[3] **George P. Kontoudis**, Daniel J. Stilwell, "Fully Decentralized, Scalable Gaussian Process Prediction for Multi-Agent Learning."

[2] Alkesh K. Srivastava, **George P. Kontoudis**, Michael Otte, "Bayesian Network Approach for Information Gathering using Path-Based Sensors."

[1] Zirui Xu, **George P. Kontoudis**, Kyriakos G. Vamvoudakis, "Online and Robust Intermittent Motion Planning in Dynamic and Changing Environments," *IEEE Transactions on on Neural Networks and Learning Systems. (resubmitted)*

Referred Journal Publications (J)

[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 Trans. 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.

Referred Conference Publications (C)

[16] **George P. Kontoudis**, Michael Otte, "Exploration-Exploitation Active Learning of Gaussian Process Surrogates for Adaptive Sampling," *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 Int. Conf. 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

- "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

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 Automation Science and Engineering *2020–2023*
- 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

PhD Students

- Joshua Netter, Georgia Institute of Technology *2021–present*
  Advisor: Kyriakos G. Vamvoudakis

Master's Students

- Alkesh K. Srivastava, University of Maryland *2022–present*
  Advisor: Michael Otte
  Publications: C-[14], W-[2], J:UR-[2]
- Joshua Netter, Georgia Institute of Technology *2020–2021*
  Advisor: Kyriakos G. Vamvoudakis
  Publications: C-[12]
- Zirui Xu, Georgia Institute of Technology, *2018–2020*
  Advisor: Kyriakos G. Vamvoudakis
  Publications: C-[7], BC-[1], J:UR-[1]
  Currently: PhD Candidate, University of Michigan