

CURRICULUM VITAE: Kirstin H. Petersen

Associate Professor
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RESEARCH TOPIC

I am interested in simple robotic solutions to complex problems, with a focus on bio-inspired design and coordination of robot collectives, as well as studies of their biological counterparts. Major research topics in my lab include swarm intelligence, embodied intelligence, autonomous construction, digital agriculture, bio-cyber physical systems, human-swarm interaction, and soft robot swarms. Although my work is centered in engineering, my close collaborators span entomology, plant sciences, and architecture.

EDUCATION

- 1. Ph.D., Computer Science**
Harvard University, USA. Advisor: Prof. Radhika Nagpal (rad@eecs.harvard.edu)
Dissertation: “Collective Construction by Termite-Inspired Robots”, September 2014
- 2. M.Sc., Computer Systems Engineering**
University of Southern Denmark, Denmark. Advisor: Prof. John Hallam (john@mmmi.sdu.dk).
Thesis: “Autonomous Construction of Temporary Human Habitats”, August 2008
- 3. B.Sc., Electro-technical Engineering**
Odense University College of Engineering, Denmark. Advisor: Staff Engineer, Mike Garrett.
Thesis with Jet Propulsion Laboratory, NASA: “Flexible Interface for LiiBy”, January 2006

PROFESSIONAL EXPERIENCE

- 1. Associate Professor in ECE, Cornell University**
Director of the Collective Embodied Intelligence lab (CEI-lab). Field member of Computer Science, Systems Engineering, and Mechanical and Aerospace Engineering. Nov 1st 2023 - current.
- 2. Assistant Professor in ECE, Cornell University**
Director of the Collective Embodied Intelligence lab (CEI-lab). Field member of Computer Science, Systems Engineering, and Mechanical and Aerospace Engineering. August 1st 2016 – Oct 31st 2023.
- 3. Fellow at the Max Planck ETH Center for Learning Systems**
Joint MPI and ETH Zurich initiative. July 2015 – July 2016.
- 4. Postdoctoral Fellow at the Max Planck Institute for Intelligent Systems, Lab of Prof. Metin Sitti**
November 2014 – July 2016
- 5. Researcher at Harvard University and the Wyss Institute, Lab of Prof. Radhika Nagpal.**
September 2009 – September 2012 (Research assistant, lab manager, and outreach coordinator).
September 2012 – September 2014 (Graduate student).
- 6. Researcher at University of Southern Denmark, Lab of Prof. John Hallam.**

Member of the EU-project, Cilia-bionics. September 2008 - August 2009.

7. **Group Leader and Technical Designer at the Svenska Yrkeshögskolan, Nordplus.**
January 2006 - May 2006
8. **Intern at Jet Propulsion Laboratory, NASA.** September 2004 – January 2005

HONORS AND AWARDS

1. Elevated to IEEE senior member, 2024.
2. Douglas Whitney '61 Excellence in Teaching Award, Cornell College of Engineering, 2022.
3. Cornell Engineering Research Excellence Award, Cornell University, 2021.
4. Aref and Manon Lahham Faculty Fellow, Cornell University, 2021-2026.
5. NSF CAREER Award, 2021.
6. Packard Fellowship for Science and Engineering, 2019-2024.
7. Intl. collaborator of the new Cluster of Excellence for Integrative Computational Design, Fabrication and Construction for Architecture, (50ME) awarded to the University of Stuttgart, 2018-2028.
8. Research ranked among the top scientific innovations of the year by National Geographic, 2018.
9. Best Student Paper Award, Intl. Symposium on Distributed Autonomous Robotic Systems, Oct 2018.
10. Nominated for 3M Non-Tenure Faculty Award, October 2018.
11. On Robohub's list of 25 Amazing Women in Robotics to Know in 2018.
12. Early Career Faculty Champion Award, Cornell Office of Inclusion and Student Engagement, 2018.
13. Most read in July 2017, Advanced Materials Review paper (DOI: 10.1002/adem.201700016).
14. Disney Poster award, at Bits On Our Minds (BOOM), Cornell University, April 2017.
15. Poster award 'Best Project in Category', Cornell MEng Poster session, May 2017.
16. GETTY LAB micro-grants, USA 2014-2020
17. Elected fellow of the Elisabeth Schiemann Kolleg, Max Planck, 2016-2022.
18. Postdoctoral fellowship with the Max Planck Institute for Intelligent Systems, 2014-2016.
19. Research ranked 4th in Science Magazine's Top 10 Scientific Achievements of 2014
20. Foundation of Frimodt-Heineke, Denmark, 2007
21. Danish Society of Women, Denmark 2007
22. Foundation of Reinholdt W. Jorck and Spouse, Denmark 2006
23. Foundation of Balslev International Engineering Company, Denmark 2003

PROFESSIONAL ACTIVITIES (SELECTED)

1. 17th International Symposium for Distributed Autonomous Robot Systems (DARS), organizer 2024.
2. IEEE/RAS International Conference on Robotics and Automation (ICRA) workshop on Collective Robotic Construction, co-organizer, 2022.
3. ICRA workshop on Modular Self-Reconfigurable Robots, co-organizer, 2022.
4. Workshop on Swarms: From Biology to Robotics and Back at ICRA, co-organizer, May 2018.
5. Workshop on Distributed, Collective Computation in Biological and Artificial Systems at the Janelia Research Institute workshop, co-organizer, March 2018.
6. Workshop on Assembly and Coordination across the Scales at the Max Planck ETH Center for Learning Systems, co-organizer, June 2016.
7. 4-day Workshop on Swarmbot Assemblages at Smart Geometry, co-organizer, June 2016.

PRESENTATIONS (SELECTED)

1. CVR, “Robot Superorganisms”, **keynote**, May 2024.
2. DARS, “Designing Robotic Systems with Collective Embodied Intelligence”, **keynote**, November 2022.
3. Jet Propulsion Laboratory Multi-Agent Tech Talks, “Embodied Intelligence and Coordination in Bio-Inspired Robot Collectives”, invited speaker, June 2022.
4. Max Planck Institute and Schloss Ringberg, “Collective Embodied Intelligence in Robotic Systems”, **keynote** at the workshop on Shaping the Future of Robotics through Materials Innovation, June 2022.
5. Shenzhen Institute of Artificial Intelligence and Robotics for Society (AIRS), “Deformable Modular Robots”, AIRS in the AIR seminar series on Modular Self-reconfigurable Robots, June 2022.
6. Carnegie Mellon University, “Designing Robotic Systems with Collective Embodied Intelligence”, Robotics Institute colloquium speaker, April 2022.
7. MIT and Stanford’s Robotics Today online seminar series, “Form, Function, and Robotic Superorganisms”, invited speaker, October 2020.
8. 7th Annual Entomology Symposium at Cornell University, “Form, Function, and Robotic Superorganisms”, **keynote**, January 2020.
9. The First Northeast Regional Conference on Complex Systems (NERCCS), “Design of Robot Collectives”, **keynote**, April 2018.
10. Northeastern Robotics Colloquium (NERC), “Designing Robot Collectives”, **keynote**, October 2016.
11. Stanford University, “Designing Robot Collectives”, invited seminar at the department of Electrical Engineering, February 2016.

REVIEWING ACTIVITIES

Science Robotics, AAAS; Science Advances, AAAS; Nature Scientific Reports; IEEE Transactions of Robotics; Robotics: Science and Systems (RSS); IEEE International Conference of Robotics and Automation (ICRA); IEEE/RSJ International Conference on Robots and Systems (IROS); International Conference on Advanced Robotics (ICAR); International Symposium on Distributed Autonomous Robotic Systems (DARS); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO); IEEE International Conference Series on Cognitive Informatics and Cognitive Computing (ICCI-CC).

MEMBERSHIPS

1. IEEE membership 2016-ongoing.

GRADUATE FIELDS

1. Field-member of Electrical and Computer Engineering, Cornell University (2016-current)
2. Field-member of Mechanical Engineering, Cornell University (2016-current)
3. Field-member of Computer Science, Cornell University (2016-current)
4. Field-member of Systems Engineering, Cornell University (2019-current)
5. Field-member of Aerospace Engineering, Cornell University (2018-current)

SERVICE ACTIVITIES

1. Organizer for the 17th Intl. Symposium for Distributed Autonomous Robotic Systems (DARS), 2024.
2. Co-organizer for the MRS Symposium on Materials for Robotics, MRS Fall meeting, 2024.
3. Cornell Institute for Digital Agriculture (CIDA), executive committee member, 2021-current.
4. Journal for Swarm Intelligence, editorial board member, 2020-current.
5. The Wiley journal of Advanced Intelligent Systems (AISY), member of the international advisory board, 2019-current.
6. IEEE Robotics Automation Letters (RA-L), associate editor, 2018-current.
7. IEEE/RAS International Conference on Soft Robotics (RoboSoft), workshop committee member, 2021.
8. Cornell ECE COVID-19 response with over 200 participants, co-organizer, Spring 2020.
9. International Symposium on Multi-Robot and Multi-Agent Systems, area chair, 2019.
10. ACM Symposium on Computational Fabrication, area chair, 2019.
11. Robotics: Science and Systems (R:SS), area chair, 2018.

FUNDING

1. Cornell Sprout award: “Collective Comb Building in Constrained Geomet”, PIs: N. Napp and K Petersen, \$100,000, 2024.
2. NSF-FRR: “CLB Supplement: CAREER: Environmentally-Mediated Coordination in Natural and Robot Swarms”, \$63,609, 2022.
3. CIDA Research Innovation Fund, “Automated Monitoring of Strawberry Pollination”, 2022, \$6,750.
4. Aref and Manon Lahham Faculty Fellowship, 2021-2026. \$50,000.
5. NSF grant #2042411. “CAREER: Environmentally-Mediated Coordination in Natural and Robot Swarms”, 2021-2026, \$530,000.
6. Packard Fellowship for Science and Engineering, “Information and Intelligence Propagation in Robot and Natural Swarms”, 2019-2024. \$875,000.
7. NIFA Research Innovation Fund award. “Improving Strawberry Yield through Native and Robotic Pollinators”. PIs: K. Petersen, S. McArt, Cornell. 01-Oct-2019 to 30-Sep-2021. \$150,000.
8. NSF grant #1933284. “EAGER: Collaborative Research: Creation of Active Granular Materials and Study of Emergent Properties”. PIs: Prof. D. Goldman, Georgia Tech and K. Petersen. 03-Aug-2019 to 03-Aug-2021. \$150,000.
9. NIFA grant #2019-67021-29225. “CPS: TTP Option: Medium: Touch Sensitive Technologies for Improved Vineyard Management”. PIs: K. Petersen, K. Cox, A. Lal, J. Vanden Heuvel, R. Shepherd, Cornell. 01-Apr-2019 to 31-03-2022, \$1,191,236.
10. NSF grant #1830471. “NRI:INT: Ad-Hoc Collaborative Human-Robot Swarms”. PIs: H. Kress-Gazit, G. Hoffman, and K. Petersen, Cornell. 01-Sep-2018 to 31-Aug-2022, \$1,490,568.
11. GETTY LAB micro-grant. PI: K. Petersen, Cornell. 01-Jun-2018 to 31-Aug-2020, \$114,000.
12. NSF grant #1739671. “CPS: MEDIUM: Leveraging Honeybees as Bio-Cyber Physical Systems.” PIs: K. Petersen and A. Molnar, Cornell. 01-Sep-2017 to 31-Aug-2020, \$956,755.
13. NIFA grant #1014705. Cornell Digital Agriculture Initiative. “Improving Vineyard Management Using Touch Sensitive Soft Robots.” PIs: K. Petersen and J. Vanden-Heuvel, Cornell. 01-Oct-2017 to 01-Oct-2020, \$157,132.
14. McCormick Center for Teaching Excellence grant. “(ECE 3400) Intelligent Physical Systems, Course Redesign”. PI: K. Petersen, Cornell. 11-Jul-2017 to 14-Jun-2019, \$48,185.

15. 12 Cornell Engineering Learning Initiative Awards and Early Career Awards for work with undergraduate students, 2016-current, \$29,104 (total).

LIST OF COURSES TAUGHT

1. ECE 3400 “Intelligent Physical Systems” (2017 Fall, 98 students) (2018 Fall, 113 students)
2. ENGRG 1050 “Freshman Advising Class” (2018 Fall, 22 students)
3. ECE4960/5960 “Fast Robots” (2020 Fall, 15 students) (2022 Spring, 36 students) (2023 Spring, 35 students)
4. ECE2400 “Computer Systems Programming” (2024 Spring, 32 students)
5. ECE 6970/VIEN 4910 “Robots, Wine, and Food” (2020 Fall, 35 students)
6. ECE 6970/6680 “Multi-Agent Systems” (2016 Fall, 11 students) (2018 Spring 12 students) (2019 Spring, 18 students) (2020 Spring, 24 students) (2021 Spring, 13 students) (2023 Fall, 11 students)

PUBLICATIONS (SELECTED)

1. Smith ML, Loope KJ, Chuttong B, Dobelmann J, Makinson JC, Saga T, Petersen K, Napp N. Honey bees and social wasps reach convergent architectural solutions to nest-building problems. *PLoS Biol* 21(7): e3002211. <https://doi.org/10.1371/journal.pbio.3002211>.
2. Steven Ceron, Gaurav Gardi, Kirstin Petersen, and Metin Sitti. “Programmable self-organization of heterogeneous microrobot collectives” *PNAS*. June 5, 2023 120 (24).
3. Steven Ceron, Kevin O’Keeffe, and Kirstin Petersen. Diverse behaviors in non-uniform chiral and non-chiral swarmalators. *Nat Commun* 14, 940 (2023). <https://doi.org/10.1038/s41467-023-36563-4>
4. Yoav Matia, Gregory H Kaiser, Robert F. Shepherd, Amir D. Gat, Nathan Lazarus, and Kirstin H. Petersen (2023), Harnessing Nonuniform Pressure Distributions in Soft Robotic Actuators. *Adv. Intell. Syst.* 2200330. <https://doi.org/10.1002/aisy.202200330>. (Featured on the inside cover, vol. 5, issue 2).
5. Guarav Gardi†, Steven Ceron†, Wendong Wang, Kirstin Petersen, and Metin Sitti. Microrobot collectives with reconfigurable morphologies, behaviors, and functions. *Nature Commun* 13, 2239 (2022). <https://doi.org/10.1038/s41467-022-29882-5>
6. Luyang Robby Huang, Alexander Zhu, Kathleen Wang, Daniel Goldman, Andy Ruina, and Kirstin Hagelskjaer Petersen. “Construction and Excavation by Collaborative Double-Tailed SAW Robots,” in *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 3742-3748, April 2022, doi: 10.1109/LRA.2022.3146562.
7. Michael L Smith, Nils Napp, and Kirstin H. Petersen. “Imperfect comb construction reveals the architectural abilities of honeybees” *PNAS* August 3, 2021 118 (31).
8. Haron Abdel-Raziq, Daniel Palmer, Phoebe Koenig, Alyosha Molnar, and Kirstin Petersen. “System design for inferring colony-level pollination activity through miniature bee-mounted sensors”, *Sci Rep* 11, 4239 (2021).
9. Kirstin H. Petersen, Nils Napp, Robert Stuart-Smith, Daniela Rus, and Mirko Kovac. “A review of collective robotic construction.” *Science Robotics*, 13 Mar 2019: Vol. 4, Issue 28, DOI: 10.1126/scirobotics.aau8479.
10. Lindsey Hines†, Kirstin Petersen†, and Metin Sitti, “Inflated Soft Actuators with Reversible Stable Deformations,” *Advanced Materials Communications*, DOI: 10.1002/adma. 201600107, 2016.
11. Justin Werfel, Kirstin Petersen, and Radhika Nagpal, “Designing collective behavior in a termite-inspired robot construction team,” *Science*, 343(6172):754-758, 2014. Voted among the top ten Scientific Breakthroughs of 2014 by Science.

†Equally contributing first authors.