Steven H. Collins

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Faculty Appointments

Associate Professor	**Stanford University** (September 2017—present) Department of Mechanical Engineering
Associate Professor	**Carnegie Mellon University** (2015—2017) Department of Mechanical Engineering Robotics Institute (by courtesy)
Assistant Professor	**Carnegie Mellon University** (2010—2015) Department of Mechanical Engineering Robotics Institute (by courtesy)

Education

Postdoctoral Fellow	**Delft University of Technology** (2008—2010) BioMechanical Engineering Supervisor: Martijn Wisse
M.S., Ph.D.	**University of Michigan** (2002—2008) Mechanical Engineering Advisor: Art Kuo
B.S.	**Cornell University** (1997—2002) Mechanical Engineering Research advisor: Andy Ruina

Journal Articles

Papers, videos and other supporting materials available at: web.stanford.edu/people/stevecollins
Numbers: 28 articles, 3 book chapter, 16 proceedings, 16 patents, 51 podium presentations, 5,516 citations, h-index: 25. Citation data from Google Scholar. Author and advisee names underlined.

1. Collins, S. H., Wisse, M., Ruina, A. (2001) A three-dimensional passive-dynamic walking robot with two legs and knees. *International Journal of Robotics Research*, **20**:607-615. Cited by 913.

2. Collins, S. H., Ruina, A. L., Tedrake, R., Wisse, M. (2005) Efficient bipedal robots based on passive-dynamic walkers. *Science*, **307**:1082-1085. Cited by 1,821.

3. Adamczyk, P. G., Collins, S. H., Kuo, A. D. (2006) The advantages of a rolling foot in human walking. *Journal of Experimental Biology*, **209**:3953-3963. Cited by 210.

4. Vanderpool, M. T., Collins, S. H., Kuo, A. D. (2008) Ankle fixation need not increase the energetic cost of human walking. *Gait & Posture*, **28**:427-433. Cited by 42.

5. Collins, S. H., Adamczyk, P. G., Ferris, D. P., Kuo, A. D. (2009) A simple method for calibrating force plates and force treadmills using an instrumented pole. *Gait & Posture*, **29**:59-64. Cited by 82.

6. Collins, S. H., Adamczyk, P. G., Kuo, A. D. (2009) Dynamic arm swinging in human walking. *Proceedings of the Royal Society of London B.*, **276**:3679-3688. Cited by 231.

7. van der Krogt, M. M., Bregman, D. J. J., Wisse, M., Doorenbosch, C. A. M., Harlaar, J., Collins, S. H. (2010) How crouch gait can dynamically induce stiff-knee gait. *Annals of Biomedical Engineering*, **38**:1593-1606. Cited by 34.

8. Collins, S. H., Kuo, A. D. (2010) Recycling energy to restore impaired ankle function during human walking. *Public Library of Science ONE*, **5**:e9307. Cited by 154.

9. Bregman, D. J., van der Krogt, M. M., de Groot, V., Harlaar, J., Wisse, M., Collins, S. H. (2011) The effect of ankle foot orthosis stiffness on the energy cost of walking: a simulation study. *Clinical Biomechanics*, **26**:955-961. Cited by 82.

10. Morgenroth, D. C., Segal, A. D., Zelik, K. E., Czerniecki, M. J., Klute, G. K., Adamczyk, P. G., Orendurff, M. S., Hahn, M. E., Collins, S. H., Kuo, A. D. (2011) The effect of prosthetic foot push-off on mechanical loading associated with knee osteoarthritis in lower extremity amputees. *Gait & Posture*, **34**:502-507. Cited by 79.

11. Zelik, K. E., Collins. S. H., Adamczyk, P. G., Segal, A. D., Klute, G. K., Morgenroth, D. C., Hahn, M. E., Orendurff, M. S., Czerniecki, J. M., Kuo, A. D. (2011) Systematic variation of prosthetic foot parameter affects center-of-mass mechanics and metabolic cost during walking. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, **19**:411-419. Cited by 58.

12. Segal, A. D., Zelik, K. E., Klute, G. K., Morgenroth, D. C., Hahn, M. E., Orendurff, M. S., Adamczyk, P. G., Collins, S. H., Kuo, A. D., Czerniecki, J. M. (2012) The effects of a controlled energy storage and return prototype prosthetic foot on transtibial amputee ambulation. *Human Movement Science*, **31**:918-931. Cited by 54.

13. Collins, S. H., Kuo, A. D. (2013) Two independent contributions to step variability during over-ground human walking. *Public Library of Science ONE*, **8**:e73597. Cited by 39.

14. Caputo, J. M., Collins, S. H. (2014) A universal ankle–foot prosthesis emulator for human locomotion experiments. *Journal of Biomechanical Engineering*, **136**:035002. Cited by 60.

15. Caputo, J. M., Collins, S. H. (2014) Prosthetic ankle push-off work reduces metabolic rate but not collision work in non-amputee walking. *Nature Scientific Reports*, **4**:7213. Cited by 44.

16. Malcolm, P., Quesada, R. E., Caputo, J. M., and Collins, S. H. (2015) The influence of push-off timing in a robotic ankle-foot prosthesis on the energetics and mechanics of walking. *Journal of NeuroEngineering and Rehabilitation*, **12**:21. Cited by 25.

17. Collins, S. H., Wiggin, M. B., and Sawicki, G. S. (2015) Reducing the energy cost of human walking using an unpowered exoskeleton. *Nature*, **522**:212-215. Cited by 170.

18. Kim, M., and Collins, S. H. (2015) Once-per-step control of ankle-foot prosthesis push-off work reduces effort associated with balance during human walking. *Journal of NeuroEngineering and Rehabilitation*, **12**:43. Cited by 26.

19. Jackson, R. W., and Collins, S. H. (2015) An experimental comparison of the relative benefits of work and torque assistance in ankle exoskeletons. *Journal of Applied Physiology,* **119**:541-557. Cited by 46.

20. Quesada, R. E., Caputo, J. M., and Collins, S. H., Restoring ankle push-off work with a powered prosthesis does not necessarily reduce metabolic rate for trans-tibial amputees, *Journal of Biomechanics*, **49**:3452-3459. Cited by 14.

21. Kim, M., Collins, S. H. (2017) Once-per-step control of ankle push-off work improves balance in a three-dimensional simulation of bipedal walking. *Transactions on Robotics*, **33**:406-418. Cited by 5.

22. Jackson, R. W., Dembia, C. L., Delp, S. L., Collins, S. H. (2017) Muscle-tendon mechanics explain unexpected effects of exoskeleton assistance on metabolic rate during walking. *Journal of Experimental Biology*, **220**:2082-2095. Cited by 4.

23. Zhang, J., Fiers, P., Witte, K. A., Jackson, R. W., Poggensee, K. L., Atkeson, C. G., Collins, S. H. (2017) Human-in-the-loop optimization of exoskeleton assistance during walking. *Science*, **356**:1280-1284. Cited by 16.

24. Zhang, J., Collins, S. H. (2017) The passive series stiffness that optimizes torque tracking for a lower-limb exoskeleton in human walking. *Frontiers in Neurorobotics*, **11**:68.

25. Steele, K. M., Jackson, R. W., Shuman, B., Collins, S. H. (2017) Muscle recruitment and coordination with an ankle exoskeleton. *Journal of Biomechanics*, **59**:50-58. Cited by 1.

26. Kim, M., Collins, S. H. (2017) Step-to-step ankle inversion/eversion torque modulation can reduce effort associated with balance. *Frontiers in Neurorobotics*, **11**:62.

27. Galle, S., Malcolm, P., Collins, S. H., De Clercq, D. (2017) Reducing the metabolic cost of walking with an ankle exoskeleton: interaction between actuation timing and power. *Journal of NeuroEngineering and Rehabilitation*, **14**:35. Cited by 7.

In press: (available on request)

28. Kim, M., Chen, T., Chen, T., Collins, S. H. (2018) An ankle-foot prosthesis emulator with control of plantarflexion and inversion-eversion torque. *Transactions on Robotics*, **in press**.

In review: (available on request)

29. Wu, M., Adamczyk, P. G., and Collins, S. H., The relationship between effort of walking and amount of walking performed: A pilot study. **In review**, *Journal of Exercise Science & Fitness*.

30. Kim, M., Lyness, H., Chen, T., Collins, S. H. Prosthesis inversion-eversion stiffness reduces balance-related variability during level walking. **In review**, *Transactions on Neural Systems & Rehabilitation Engineering.*

Book Chapters

B1. Zhang, J., Cheah, C. C., and Collins, S. H., Torque control in legged locomotion. In *Bio-Inspired Legged Locomotion Concepts, Control and Implementation* (eds. Sharbafi, M., and Seyfarth, A.) Amsterdam: Elsevier. In press.

B2. Witte, K. A., and Collins, S. H. Lower-limb exoskeleton emulators: principles of design for rapid exploration of hardware and assistive strategies. In *Wearable Robotics: Systems and Applications*, with editors P. Ferguson and J. Rosen, Elsevier. In preparation.

B3. Voloshina, A., and Collins, S. H. The state of the art in control of lower-limb prosthetic devices. In *Wearable Robotics: Systems and Applications*, with editors P. Ferguson and J. Rosen, Elsevier. In preparation.

Peer-Reviewed Conference Proceedings

C1. Pratt, J. E., Krupp, B. T., Morse, C. J., Collins, S. H. (2004) The RoboKnee: an exoskeleton for enhancing strength and endurance during walking. In *Proc. IEEE Int. Conf. Robotics and Automation*, New Orleans, LA, pages 2430-2435. Acceptance rate: 59%. Cited by 531.

C2. Collins, S. H., Ruina, A. (2005) A bipedal walking robot with efficient and human-like gait. In *Proc. IEEE International Conference on Robotics & Automation*, Barcelona, Spain, pages 1983-1988. Acceptance rate: 45%. Cited by 437.

C3. Wiggin, M. B., Sawicki, G. S., Collins, S. H. (2011) An exoskeleton using controlled energy storage and release to aid ankle propulsion. In *Proc. IEEE International Conference on Rehabilitation Robotics*, Zurich, Switzerland. 5 pages. Acceptance rate: 62%. Cited by 60.

C4. Caputo, J. M., and Collins, S. H. (2013) An experimental robotic testbed for accelerated development of ankle prostheses. In *Proc. IEEE International Conference on Robotics and Automation*, Karlsruhe, Germany. pages 2630-2635. Acceptance rate oral: 18%. Cited by 25.

C5. Zhang, J., Cheah, C. C., and Collins, S. H. (2013) Stable human-robot interaction control for upper-limb rehabilitation robotics. In *Proceedings IEEE International Conference on Robotics and Automation*, Karlsruhe, Germany. pages 2201-2206. Acceptance rate oral: 18%. Cited by 8.

C6. Song, S., LaMontagna, C., Collins, S. H., and Geyer, H. (2013) The effect of foot compliance encoded in the windlass mechanism on the energetics of human walking. In *Proceedings*

International Conference of the IEEE Engineering in Medicine and Biology Society, Osaka, Japan. pages 3179-3182. Acceptance rate: 40%. Cited by 8.

C7. Kim, M. and Collins, S. H. (2013) Stabilization of a three-dimensional limit cycle walking model through step-to-step ankle control. In *Proceedings IEEE International Conference on Rehabilitation Robotics*, Seattle, WA, USA. 6 pages. Acceptance rate: 62%. Cited by 7.

C8. Collins, S. H. and Jackson, R. W. (2013) Inducing Self-Selected Human Engagement in Robotic Locomotion Training. In *Proceedings IEEE International Conference on Rehabilitation Robotics*, Seattle, WA, USA. 6 pages. Acceptance rate for oral presentations: 11%. Cited by 9.

C9. Zhang, J., Cheah, C. C., and Collins, S.H. (2015) Experimental comparison of torque control methods on an ankle exoskeleton during human walking. In *Proc. IEEE International Conference on Robotics and Automation*, Seattle, WA, USA. pages 5584-5589. Acceptance rate: 41%. Cited by 23.

C10. Witte, K. A., Zhang, J., Jackson, R. W., and Collins, S.H. (2015) Design of two lightweight, high-bandwidth torque-controlled ankle exoskeletons. In *Proc. IEEE International Conference on Robotics and Automation*, Seattle, WA, USA. pages 1223-1228. Acceptance rate: 41%. Cited by 31.

C11. Collins, S. H., Kim, M., Chen, T., and Chen, T. (2015) An ankle-foot prosthesis emulator with control of plantarflexion and inversion-eversion torque. In *Proc. IEEE International Conference on Robotics and Automation*, Seattle, WA, USA. pages 1210-1216. Acceptance rate: 41%. Cited by 17.

C12. Caputo, J. M., Adamczyk, P. G., and Collins, S. H. (2015) Informing ankle-foot prosthesis prescription through haptic emulation of candidate devices. In *Proc. IEEE International Conference on Robotics and Automation*, Seattle, Washington, USA. pages 6445-6450. Acceptance rate for oral presentations: 41%. Cited by 8.

C13. Diller, S., Majidi, C. and Collins, S. H. (2016) A lightweight, low-power electroadhesive clutch and spring for exoskeleton actuation. In *Proc. IEEE International Conference on Robotics and Automation*, Stockholm, Sweden. Acceptance rate: 35%. Cited by 14.

C14. Witte, K. A., Fatschel, A. M., Collins, S. H. (2017) Design of a lightweight, tethered, torque-controlled knee exoskeleton. In Proceedings *IEEE International Conference on Rehabilitation Robotics*, London, United Kingdom. pages 1646-1653. Acceptance rate: 74%. Cited by 1.

Invited Conference Proceedings

C15. Collins, S. H. (2013) What do walking humans want from mechatronics? In: *Proceedings of the IEEE International Conference on Mechatronics (ICM)*, Vicenza, Italy. pp. 24-27. Cited by 6.

C16. Collins, S. H., Caputo, J. M., and Adamczyk, P. G. (2014) Emulating prosthetic feet during the prescription process to improve outcomes and justifications. In: *Proceedings of the IEEE Workshop on Advanced Robotics and its Social Impacts (ARSO)*, Evanston, IL, USA. pages 127-128. Cited by 1.

Patents

P1. Collins, S. H., Kuo, A. D., Foot prosthesis and method of use. U.S. Provisional Patent 60/705,019, filed August, 2005.

P2. Kuo, A. D., Collins, S. H., Foot prosthesis and method of use. U.S. Patent US2007/0061016A1, filed August, 2006.

P3. Collins, S. H., Vrinceanu, A., Mullins, C., Donelan, J. M., Apparatus for Biomechanical Energy Harvesting. U.S. Provisional Patent 61/175,726, filed May, 2009.

P4. Wiggin, M. B., Sawicki, G. S., and Collins, S. H. Apparatus and clutch for using controlled storage and release of mechanical energy to aid locomotion. U.S. Patent US2013/0046218A1, filed August 2011.

P5. Caputo, J. M., Collins, S. H., and Adamczyk, P. G., Methods, apparatuses, and systems for amputee gait capacity assessment. U.S. Provisional Patent 62/070,134, filed May, 2014.

P6. Collins, S. H., Majidi, C., and Diller, S., Energy-recycling actuator with high-bandwidth force control. U.S. Provisional Patent 62/122,066, filed October, 2014.

P7. Collins, S. H., Kim, M., Chen, T., and Chen, T., An ankle-foot prosthesis emulator with control of plantarflexion and inversion-eversion torque. U.S. Provisional Patent filed May, 2015.

P8. Zhang, J. and Collins, S. H., Torque control of lower-limb exoskeletons and prostheses in walking using model-free, integral-action-free feedback control with iterative learning. U.S. Provisional Patent filed May, 2015.

P9. Witte, K. A., Jackson, R. W., and Collins, S. H., Lightweight, tethered torque-controlled ankle exoskeleton. U.S. Provisional Patent filed May, 2015.

P10. Emanuel, B., and Collins, S. H., A disturbance emulation system for stability and recovery testing. U.S. Provisional Patent filed July, 2015.

P11. Caputo, J. M., Adamczyk, P. G., and Collins, S. H., A remotely actuated and torque-controlled ankle-foot prosthesis. U.S. Provisional Patent filed July, 2015.

P12. Caputo, J. M., Kim, M., Chen, T., Chen, T., Adamczyk, P. G., Collins, S. H., Methods, Apparatuses, and Systems for Amputee Gait Capacity Assessment. U.S. Patent filed August, 2015.

P13. Gabriel, J., Collins, S. H., Kirmayer, R., Spinelli, M., Fox, N., Yasinski, E., Robotic knee prosthesis emulator. U.S. Provisional Patent filed September, 2015.

P14. Collins, S. H., Majidi, C., Diller, S. B., Energy-recycling actuator with high-bandwidth force control. Patent Cooperation Treaty Patent filed October, 2015.

P15. Caputo, J. M., Collins, S. H., Adamczyk, P. G., Kim, M., Chen, T., Chen, T., Chiu, V., Methods, apparatuses and systems for amputee gait capacity assessment. U.S. Patent Application No. 15,333,463, filed October 2016.

P16. Zhang, J., Collins, S. H., Online optimization of multivariate high level controllers in assistive robots to minimize human metabolic costs using Covariance Matrix Adaptation Evolutionary Strategies (CMA-ES). Provisional patent 62/495,690 filed July, 2017.

Podium Presentations and Seminars

Plenary and Keynote Presentations

1. *Keynote:* What can dynamic walking teach us about robots and humans? *Dynamic Walking*, Ann Arbor Michigan, USA. May 6, 2006.

2. *Plenary:* What do walking humans want from mechatronics? *International Conference on Mechatronics*, Vicenza, Italy. March 1, 2013.

3. *Young Scientist Award Talk:* Biomechanics-centered design of robotic lower-limb prostheses and orthoses. *American Society of Biomechanics*, Omaha, Nebraska, USA. September 6, 2013.

4. *Keynote:* Reducing the energy cost of human walking using an unpowered exoskeleton. *Dynamic Walking*, Columbus, Ohio, USA. July 25, 2015.

5. *High-profile:* Designing exoskeletons that enhance performance through automatic customization. IdeasLab session: Reimagining the Human Body. *World Economic Forum*, Davos, Switzerland, January 17, 2017.

6. *Keynote:* Automatic customization of exoskeleton control during walking. *Dynamic Walking*, Mariehamn, Åland, Finland, June 6, 2017.

7. *Plenary:* Designing exoskeletons and prosthetic limbs that enhance human performance. *International Society of Posture and Gait Research World Congress*, Fort Lauderdale, Florida, USA, June 26, 2017.

8. *Keynote:* The future of active prosthesis and orthosis design. Georgia Institute of Technology Prosthetic Orthotic Research Symposium, Atlanta, GA, USA, April 20, 2018.

9. *Keynote:* Efficient, customized exoskeleton design. *International Conference on Biomedical Robotics and Biomechatronics*, U. Twente, Enschede, The Netherlands, August 26, 2018.

10. *Keynote:* Individualizing orthosis and prosthesis design in a clinical setting. *Annual Meeting of the European Society for Movement Analysis in Adults and Children*, Amsterdam, The Netherlands, September 26, 2019.

Other Conference Podium Presentations

11. Control of balance during walking in young and elderly adults. *American Society of Biomechanics*, Toledo Ohio, USA. September 26, 2003.

12. A bipedal walking robot with efficient and human-like gait. *International Conference on Robotics and Automation* 2005, Barcelona, Spain. April 20, 2005.

13. Controlled energy storage and return prosthesis reduces metabolic cost of walking. *International Society of Biomechanics*, Cleveland Ohio, USA. August 3, 2005.

14. Energetics of arm swinging. *Dynamic Walking*, Åland, Finland. June 26, 2007.

15. A comparison of controlled energy-storage and return and conventional prosthetic feet: mechanics and metabolics. *Dynamic Walking*, Delft, The Netherlands. May 28, 2008.

16. When mechanics matter: utilizing passive dynamics to gain energetic benefits in human locomotion. *Society for Experimental Biology*, Glasgow, United Kingdom. July 1, 2009.

17. Exploring ankle control strategies with an experimental biomechatronic testbed. *Dynamic Walking*, Jena, Germany. July 19, 2011.

18. Toward tip-top testbeds: Biomechatronics for accelerated development of assistive devices. *Canadian Society of Biomechanics*, Vancouver, British Columbia, Canada. June 8, 2012.

19. An experimental robotic testbed for accelerated development of ankle prostheses. *International Conference on Robotics and Automation*, Karlsruhe, Germany. May 8, 2013.

20. A method for harnessing least-effort drives in robotic locomotion training. *International Conference on Rehabilitation Robotics*, Seattle, Washington, USA. June 25, 2013.

21. Emulating ankle-foot prostheses during the prescription process to improve outcomes and justifications. IEEE Workshop on Advanced Robotics and its Social Impacts (ARSO), Evanston, Illinois, USA. September 12, 2014.

22. An ankle-foot prosthesis emulator with control of plantarflexion and inversion-eversion torque. *International Conference on Robotics and Automation*, Seattle, WA, USA. May 24, 2015.

23. Optimizing (artificial) ankle function during walking. *Adaptive Motion of Animals and Machines*, Massachusetts Institute of Technology, Boston, Massachusetts, USA. June 23, 2015.

24. Prosthetic limbs that reduce the energy cost of walking to below non-amputee levels are possible but hard to discover. *American Society of Biomechanics*, Columbus, Ohio, USA. August 8, 2015.

25. Designing wearable robots to enhance human locomotor performance. *Rehabilitation Robotics Workshop*, Arizona State University, Tempe, Arizona, USA. February 9, 2016.

26. Assisting human locomotion with unpowered devices. Human 2.0 Workshop at the *International Conference on Robotics and Automation*, Stockholm, Sweden. May 15, 2016.

27. Discovering exoskeletons that augment locomotor performance. *Nike Global Research Symposium*, Portland, Oregon, USA, October 24, 2016.

28. Human-in-the-loop optimization of exoskeleton assistance. *International Conference on Rehabilitation Robotics*, Workshop on Assessing and Optimizing Human Robot Interaction in Wearable Robotic Devices. London, United Kingdom, July 17, 2017.

29. NRI: Rapid exploration of ankle exoskeleton control strategies. *NSF National Robotics Initiative PI Meeting*, Alexandria, Virginia, USA, November 10, 2017.

30. Human-in-the-loop optimization of exoskeleton assistance. *Sensori-Motor Control of Animals and Robots*, Mathematical Biosciences Institute, Columbus, Ohio, USA, November 15, 2017.

31. Human-in-the-loop optimization of powered orthosis design. *Orthotic and Prosthetic Innovative Technologies Conference*, San Francisco, California, USA, May 11, 2018.

32. On useful wearable robotics. *Dynamic Walking*, Pensacola, Florida, USA, May 21, 2018.

33. Human-in-the-loop optimization of exoskeleton assistance during walking. *World Congress of Biomechanics*, Dublin, Ireland, July 8, 2018.

Presentations in Academic Departments

34. What walking robots can tell us about ankle-foot prosthesis control. Joint Biped Loco-motion Workshop, Disney Research, Pittsburgh, Pennsylvania, USA. November 3, 2012.

35. Learning to help walk: Developing wearable robots for people with lower-limb disabilities. Department Seminar, Department of Mechanical Engineering, The Ohio State University, Columbus, Ohio, USA. November 9, 2012.

36. Universal robotic prosthesis emulators. Mechanical Engineering Colloquium, Department of Mechanical Engineering, Massachusetts Institute of Technology, Boston, Massachusetts, USA. November 8, 2013.

37. Tools for accelerating the development of intelligent prostheses. Center for Bionic Medicine Seminar, Rehabilitation Institute of Chicago and Northwestern University, Chicago, Illinois, USA. November 15, 2013.

38. Characterizing human locomotor response to wearable robot functionality. Bioengineering Department & National Center for Simulation in Rehabilitation Research, Stanford University, Palo Alto, California, USA. November 18, 2013.

39. Biomechanics-centered design of robotic lower-limb prostheses. Robotics Institute Seminar, Carnegie Mellon University, Pittsburgh, PA, USA. January 23, 2014.

40. Universal prosthesis emulators for rapid evaluation of human response to intervention. Department Seminar, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA. April 18, 2014.

41. How to develop wearable robots that make walking easier. Department Seminar, Department of Mechanical Engineering, Harvard University, Boston, Massachusetts, USA. October 15, 2014.

42. What I learned from my wearable robot: the unexpected physiological effects of forceful human-robot interactions. Seminar, School of Applied Physiology, Georgia Institute of Technology, Atlanta, Georgia, USA. November 12, 2014.

43. Improving the development, prescription and tuning of robotic prostheses using versatile emulator systems. Department Seminar, Department of Mechanical Engineering, University of Washington, Seattle, Washington, USA. December 2, 2014.

44. Designing robotic prostheses and exoskeletons that enhance human mobility. BioMedical Engineering Seminar, Department of Mechanical Engineering, University of British Columbia, Vancouver, British Columbia, Canada. March 12, 2015.

45. Human-in-the-loop prosthesis design using versatile robotic emulator systems. Dynamic Systems and Controls Seminar, Department of Mechanical and Aerospace Engineering, University of California, San Diego, San Diego, California, USA. April 24, 2015.

46. How to design wearable robots that augment human locomotor performance. Department of Bioengineering, University of Pittsburgh, Pittsburgh, Pennsylvania, USA. January 28, 2016.

47. Designing robotic prostheses and exoskeletons that improve human mobility. Job talk, Department of Mechanical Engineering, Stanford University, Palo Alto, California, USA. February 18, 2016.

48. How should we develop wearable devices that improve mobility? Department of Integrative Physiology, University of Colorado Boulder, Boulder, Colorado, USA.
February 22, 2016.

49. Designing exoskeletons and prostheses that enhance human performance. Stanford Robotics Seminar, Stanford University, Stanford, California, USA, February 2, 2018.

Other Significant Presentations

50. How to design wearable robots that augment human locomotor performance. Nike, Portland, Oregon, USA. January 21, 2016.

51. Low-power ankle exoskeletons that improve human locomotor performance. Nike, Portland, Oregon, USA. January 21, 2016.

Grants

Principal Investigator: ($5.3M, responsible for $4.7M)

1. Development of an actively-controlled prosthetic foot. National Science Foundation, Phase I STTR. PI, 2006-2007, $100,000.

2. Controlled energy storage and release in an intelligent prosthetic foot. National Science Foundation, Phase I STTR. PI, 2003-2004, $100,000.

3. Field-based gait monitoring system for the elderly. National Institutes of Health, Phase I STTR. PI, 2006-2007, $100,000.

4. Development of prosthetic foot with controlled energy storage and release. National Institutes of Health, Phase II STTR. PI, 2007-2010, $750,000.

5. Collaborative Research: User-optimal robotic prosthesis design. National Science Foundation, CMMI, Engineering and Systems Design. PI, 2013-2016, $216,000.

6. NRI: Small: Rapid exploration of robotic ankle exoskeleton control strategies. National Science Foundation, National Robotics Initiative. PI. 2013-2018, $800,000

7. *Internal:* New measurement capabilities for bio- and neuro-mechanics experiments. Carnegie Mellon University College of Engineering Dean's Equipment Grant. PI, 2014, $32,000.

8. *Internal:* Instrumented treadmill for biomechanics experiments. Carnegie Mellon University College of Engineering Dean's Equipment Grant. PI, 2015, $183,000.

9. Development and comparison of new methods for stabilizing amputee gait. National Science Foundation, CBET, General & Age-Related Disabilities Engineering. PI, 2015-2018, $370,226.

10. Ankle exoskeletons that make recreational runners faster. Nike. PI, 2016-2017, $265,000.

11. Algorithms for co-adaptive gait assistance. Panasonic. PI, 2016-2017, $148,000.

12. Optimizing hip, knee and ankle exoskeleton assistance during walking and running at various speeds and loads. U.S. Army, NSRDEC. PI, 2017-2019, $2,225,718 (responsible for $1,600,000).

Co-Principal Investigator: ($5.5M, responsible for $1.3M)

13. Clinic-based robotic prosthesis emulator for amputee gait assessment. National Institutes of Health, Phase I SBIR. Co-PI (PI: Peter Adamczyk), 2013-2014, $150,000 (responsible for $50,000).

14. *Internal:* OptiTrack Motion Capture System. Carnegie Mellon University College of Engineering Dean's Equipment Grant. Co-PI (PI: Koushil Sreenath), 2014, $75,000 (responsible for $37,500).

15. NRI: Balance recovery control for amputees suing powered leg prostheses. National Science Foundation, National Robotics Initiative. Co-PI (PI: Hartmut Geyer), 2015-2018, $900,000 (responsible for $450,000).

16. A prosthetic foot emulator to optimize prescription of prosthetic feet in veterans and service members with leg amputations. Department of Defense, CDMRP OPORP. Co-PI (PI: David Morgenroth), 2016-2018, $2,500,000 (responsible for $48,000).

17. Bio-Inspired ankle-knee coupling to enhance walking for individuals with transtibial amputation. National Science Foundation, CBET, Disability and Rehabilitation Engineering. Co-PI (PI: Karl Zelik), 2017-2020, $340,000 (responsible for $10,000).

18. Individualized co-robotics. National Science Foundation, CISE, National Robotics Initiative. Co-PI (PI: Chris Atkeson), 2017-2020, $1,500,000 (responsible for $750,000).

Co-Investigator: ($3.2M, responsible for $310,000)

19. MRI: Acquisition of an additive manufacturing machine for 3D metal components for research and education. National Science Foundation. Co-I (PI: Burak Ozdoganlar), 2014, $546,000 (responsible for $50,000).

20. *Internal*: Acquisition of Arcam electron beam melting additive manufacturing equipment for direct metal fabrication. College of Engineering. Co-I (PI: Gary Fedder), 2014, $1,164,000 (responsible for $110,000).

21. Additive manufacturing research infrastructure. Department of Defense, Defense University Research Instrumentation Program. Co-I (PI: Jack Beuth), 2015, $1,500,000 (responsible for $150,000).

Research Collaborations

1. Scott Delp, Bioengineering, Stanford University. Collaborating on exoskeleton optimization. Aim to propose grant as Co-PIs this year.

2. Emma Brunskill, Computer Science, Stanford University. Collaborating on human-in-the-loop optimization. Aim to propose grant as Co-PIs this year.

3. Maarten Lansberg, Neurology, Stanford University. Collaborating on stroke gait rehabilitation. Aim to propose grant as Co-PIs this year.

4. Chris Atkeson, Robotics Institute, Carnegie Mellon University. Co-PIs on NSF NRI Individualized co-robotics project. Co-advise postdoctoral researcher Seungmoon Song.

5. Hartmut Geyer, Robotics Institute, Carnegie Mellon University. Co-PIs on NSF NRI Balance recovery project.

6. Carmel Majidi, Department of Mechanical Engineering, Carnegie Mellon University. Electroadhesive clutch development. Co-advise PhD student Stuart Diller.

7. Greg Sawicki, Biological Sciences, Georgia Institute of Technology. Exoskeleton physiology experiments. Co-PIs on U.S. Army lower-limb exoskeleton project.

8. Manoj Srinivasan, Department of Mechanical Engineering, Ohio State University. Collaborator on prosthesis optimization grant.

9. Karl Zelik, Department of Biomedical Engineering, Vanderbilt University. Co-PIs on NSF DARE Bi-articular knee-ankle prosthesis grant.

10. David Morgenroth, Center for Limb Loss and Mobility, VA Hospital, Seattle. Co-PIs on DoD prosthesis prescription grant.

11. Koushil Sreenath, Mechanical Engineering, University of California, Berkeley. Collaborate on exoskeleton control. Co-advise Katherine L. Poggensee.

Professional Awards

1. McManus Design Award. Mechanical Engineering, Cornell University, 2002. The graduate or undergraduate student with the most outstanding solution to a design problem.

2. Department Fellowship. Mechanical Engineering, University of Michigan, 2002-2003.

3. NASA Fellowship. National Aeronautics and Space Administration Graduate Student Researchers Program, 2004-2005.

4. Struminger Faculty Teaching Fellow. Department of Mechanical Engineering, 2012.

5. Young Scientist Award, Post-Doctoral. *American Society of Biomechanics*, 2013.

6. Professor of the Year. Awarded by Mechanical Engineering Senior Class of 2014.

7. Best Medical Robotics Paper Award, *International Conference on Robotics and Automation*, Seattle, WA, USA, May 2015. One of eight awards from among 2,275 papers submitted.

Courses Taught

Carnegie Mellon University: (averages: course 4.1; instructor 4.0)

Course #	Course Title	Units	Class	Offered	Students	Course	Instructor
24-370	Design I	12	Jun	Spring 11	99	4.3	4.2
24-674	Biomechatronics	12	Gr	Fall 11	30	3.9	3.9
24-370	Design I	12	Jun	Spring 12	109	3.8	3.7
24-674	Biomechatronics	12	Gr	Fall 12	47	4.2	4.1
24-370	Design I	12	Jun	Spring 13	118	4.4	4.3
24-674	Biomechatronics	12	Gr	Fall 13	45	4.0	4.1
24-370	Design I	12	Jun	Spring 14	123	4.0	3.9
24-674	Biomechatronics	12	Gr	Fall 14	37	4.1	4.0
24-370	Design I	12	Jun	Spring 15	123	3.8	3.7
24-674	Biomechatronics	12	Gr	Fall 15	49	4.2	4.2
24-370	Design I	12	Jun	Fall 15	110	3.8	3.8
24-674	Biomechatronics	12	Gr	Spring 17	26	3.8	4.2
24-686	Adv. Mech. Des.	12	Gr	Spring 17	28	4.4	4.2

Stanford University: (averages: learned 4.0; instruction 4.0)

Quarter	Course Number & Title	Units	Enrollment	Learned	Instruction
Winter 18	ME 112: Mech. Syst. Des.	4	177	4.0	4.0

Educational Initiatives:

At Stanford University:

1. *Contributed to curriculum revitalization:* BSME 2.0
   a. *Primary actions:*
      i. Participated in committee meetings, workshops and documentation
      ii. Helped organize the Design and Manufacturing Core (ME 102, 103 & 104)
      iii. Coordinated with Biomechanics group on plans for concentration

2. *Revising a core undergraduate course:* ME 104, Mechanical Systems Design
   a. *Primary actions:*
      i. Adjusting syllabus to update content, coordinate with core, and reduce units
      ii. Adjusting format to allow effective teaching to larger cohorts (180 per year)
      iii. Preparing for increased use of flipped classroom.

3. *Developing a new mezzanine elective:* ME 2XX, Advanced Mechanical Design
   a. *Actions:*
      i. Introducing a new course for BSME 2.0 undergraduate concentration area
      ii. Aims also to meet needs of PhD students with hardware research projects
      iii. Developing format and infrastructure for three targeted build projects

4. *Developing a new graduate elective:* ME 3XX, Exoskeletons and Prosthetics
   a. *Actions:*
      i. Introducing a new elective for graduate students
      ii. Developing format around structured literature review

At Carnegie Mellon University:

5. *Overhaul of a core Junior-level course:* 24-370, Engineering Design I: Skills and Methods
   a. *Primary actions:*
      i. Added three projects with physical prototyping
      ii. Flipped classroom
      iii. Developed new Topic Readings as substitute for textbook
   b. *Results:*
      i. FCEs increased by about 0.6 points
      ii. Many MechE students report this is their favorite course at Carnegie Mellon

6. *Developed new core Sophomore-level course:* 24-202 Intro to Computer Aided Design
   a. *Primary actions:*
      i. Developed syllabus and format
      ii. Recruited and trained adjunct faculty
   b. *Results:*
      i. Positive FCEs (about 4.0)
      ii. Students report being better prepared for internships and later courses

7. *Developed new graduate elective:* 24-674 Design of Biomechatronic Systems
   a. *Actions:*
      i. Introduced new graduate course

ii. Developed semester-long project format
iii. Weekly one-hour meetings with each project team

b. *Results:*
i. Well-subscribed, enrollment between 25 and 50
ii. Positive FCEs (about 4.0).
iii. Excellent projects, many continue for independent research

8. *Developed New Graduate Seminar:* 24-892 Bipedal Locomotion Seminar
a. Actions:
i. Founded CMU Bipedal Locomotion Seminar, brought together collabroators
ii. Organize weekly speakers, manage locations, website, and mailing list
b. *Results:*
i. Well-attended, with about 30 participants from about 7 labs at 3 Institutions

9. *Infrastructure development:* College of Engineering machine shop reorganization
a. Actions:
i. Gathered shop usage information across the College
ii. Developed new usage plans and draft floor plans for architects
iii. Participated in fundraising activities
b. *Results:*
i. New ANSYS Design and Innovation Center currently under construction

10. *High-school outreach education:* Pittsburgh SciTech High School projects, 2013—2015
a. Actions:
i. Mentor high school team of 4-5 underprivileged students each year
ii. Lead weekly one-hour meetings
iii. Organize separate weekly meetings with CMU Senior undergraduates
b. Results:
i. All past students have gone on to STEM studies in college

11. *Developed new graduate elective:* 24-686 Advanced Mechanical Design
a. Actions:
i. Introduced new graduate course
ii. Developed format and infrastructure for five targeted build projects
b. *Results:*
i. Well-subscribed, enrollment of about 30
ii. Positive FCEs (about 4.3).

Student Advising and Mentoring

PhD Students supervised: (16 total, 4 graduated)

1. Joshua M. Caputo, Ph.D., Department of Mechanical Engineering (CMU), Fall 2010—Spring 2015. Bertucci Fellow. Now President of HuMoTech, a robotics startup company.

2. Juanjuan Zhang, Ph.D., Department of Mechanical Engineering (CMU), Fall 2010—Summer 2016. NTU Fellow. Dual-degree with NTU, Assoc. Prof. C. C. Cheah. Now an Associate Professor at Nankai University in China.

3. Myunghee Kim, Ph.D., Department of Mechanical Engineering (CMU), Fall 2011—Fall 2015. Now an Assistant Professor at the University of Illinois at Chicago.

4. Rachel W. Jackson, Department of Mechanical Engineering (CMU), Fall 2011—Spring 2017. NSF Fellow. Now a postdoctoral research fellow in Bioengineering at Stanford University.

5. Stuart B. Diller, Department of Mechanical Engineering (CMU), Fall 2013—present Bertucci Fellow. Co-advised with Assistant Professor Carmel Majidi

6. Katherine L. Poggensee, Department of Mechanical Engineering, Fall 2014—present. NSF Fellow. Luce Fellow. Co-advised with Assistant Professor Koushil Sreenath.

7. Kirby A. Witte, Department of Mechanical Engineering (CMU), Fall 2014—present. NSF Fellow.

8. Vincent Chiu, Department of Mechanical Engineering, Fall 2015—present.

9. Gwen Bryan, Department of Mechanical Engineering, Fall 2016—present.

10. Patrick Franks, Department of Mechanical Engineering, Fall 2016—present.

11. Stefan Klein, Department of Mechanical Engineering, Fall 2016—present.

12. Thu Nguyen, Department of Mechanical Engineering, Fall 2016—present. NSF Fellow.

13. Guan Rong Tan, Department of Mechanical Engineering, Fall 2016—present.

14. Julia Butterfield, Department of Mechanical Engineering, Fall 2017—present. Stanford Graduate Fellow. NSF Fellow.

15. Rachel Adenekan, Department of Mechanical Engineering, Winter 2018—present. Stanford Graduate Fellow.

16. Erez Krimsky, Department of Mechanical Engineering, Winter 2018—present. NSF Fellow.

Postdoctoral researchers supervised: (4 total, 2 completed)

1. Philippe Malcolm, Ph.D., Department of Mechanical Engineering, Summer 2014. Now faculty at the University of Nebraska at Omaha.

2. Pieter Fiers, Ph.D., Department of Mechanical Engineering, Spring 2016—Summer 2017. Now faculty line at the University of Ghent.

3. Alexandra Voloshina, Ph.D., Department of Mechanical Engineering, Spring 2017—present.

4. Seungmoon Song, Ph.D., Department of Mechanical Engineering, Winter 2018—present.

Master's Project Students Supervised: (25 total)

Lowie van Zijl (T.U. Delft), Laurent Huberty (T.U. Delft), Michiel Plooij (T.U. Delft), Matthew Glisson, Kanchi Nayaka, Ben Matzke, Jaan Warnaars (T.U. Delft), Jackie Yang, Tianyao Chen, Winton Zheng, Mailing Wu, Kirby Witte, Tanuf Tembulkar, Roberto Quesada, Biju Obi, Rohan Krishnan, Tianjian Chen, Zach Batts, Russell Kirmayer, Kyle Rawding, James Gabriel, Blair Emanuel, Evan Dvorak, Tyler Del Sesto, Robert Peuchen (T.U. Delft).

Undergraduate Research Students Supervised: (31 total)

Jonathan Boerner, Sarah Kunka, Lizmarie Comenencia-Ortiz, Matthew Stanton, Jessica Lee, Pace Nalbone, Robert Wojno, Mark Erazo, Steven Pepin, Jayon Wang, Ruthika, Eli Zauner, Patrick Sumner, Elena Yasinski, Eric Volk, Mike Spinelli, Faith Quist, Alvan Mbongo, Noah Fox, Stephanie Chen, Alec Assaad, Sean Archie, Michelle Mann, Hannah Lyness, Wentao He, Timothy Barber, Gustavo Costa, Andreas Fatschel, Cecilia Morales, Henry Peck, Jack Kaplan.

Other Students Mentored: (16 total)

Doctoral: Marjolein van der Krogt, Daan Bregman, Sjoerd Bruijn, Vrije Universiteit Amsterdam; Tomas de Boer, Erik Schuitema and Daniël Karssen, Delft University of Technology; Karl Zelik, Shawn O'Connor, Peter Adamczyk and John Rebula, University of Michigan; Bruce Wiggin, North Carolina State University. *Undergraduate and Master's:* Karin Griffoen, Delft University of Technology; Matthew Vanderpool and Andrew Chang, University of Michigan; Chaim Garfinkel and Jerry Chien, Cornell University

Other Teaching Experience

1. Guest lecturer, MAE 225, Mechanical Synthesis, Cornell University, 2001—2002

2. Teaching assistant, Physics 101. Cornell University, 1999—2001

Other Professional Appointments

1. Mechanical design engineer, Yobotics Inc., Boston, Massachusetts, 2000—2001
   Supervisor: Jerry Pratt, Ph.D.

2. President and founder, Intelligent Prosthetic Systems L.L.C., Ann Arbor, MI, 2003—2010

3. Consultant, Bionic Power Inc., Vancouver, British Columbia, Canada, 2008—2010
   Supervisor: J. Maxwell Donelan, Ph.D.

4. Board Member: Scientific Advisory Board of the NIH National Center for Simulation in Rehabilitation Research, Spring 2016—present.

5. Adjunct Associate Professor, Department of Biomechanics, University of Nebraska at Omaha, Omaha Nebraska, 2017—2018

6. Adjunct Associate Professor, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh Pennsylvania, Fall 2017—present

7. Faculty Affiliate, Bio-X, Stanford University, Stanford California, 2018—present

8. Founding Faculty Member, Stanford Robotics Center, Stanford University, Stanford California, 2018—present

Academic Service

Conference organizing:

1. Conference aide: Dynamic Walking, Ann Arbor, MI, May 2006.
   Conference with about 60 attendees.

2. Scientific board: Dynamic Walking, June 2008-present.
   Assist with speaker recruitment, reviews, and high-level organization of an annual conference.

3. Co-organizer, co-host: Dynamic Walking 2008, Delft, the Netherlands.
   Conference with about 200 attendees.

4. Co-organizer, scientific program lead: Dynamic Walking 2009, Vancouver, Canada.
   Conference with about 200 attendees.

5. Lead organizer, co-host: Dynamic Walking 2013, Pittsburgh, PA, USA.
   Conference with about 200 attendees. www.cmu.edu/dynamic-walking

6. Symposium organizer: World Congress of Biomechanics 2014, Boston, MA, USA.
   Two sessions with nine invited speakers.

7. Session organizer: American Society of Biomechanics 2015, Columbus, OH, USA.
   Moderated one interactive session with five speakers selected from submitted abstracts.

8. Workshop co-organizer: Assistive robotic devices for dynamic locomotion, Robotics Science and Systems 2016, Ann Arbor, MI, USA. Full-day workshop with 12 invited speakers.

9. Workshop co-organizer: Exoskeleton research on the edge between robotics and human physiology, International Conference on Intelligent Robots and Systems 2016, Daejeon, Korea.

10. Workshop organizer: Human-in-the-loop optimization of active prostheses and exoskeletons. American Control Conference 2020, Denver Colorado, USA.

Journal editing: (23 reviews managed for 1 journal)

11. Associate Editor: *International Journal of Robotics Research*, Fall 2017—present.

Peer review of publications: (157 reviews for 35 journals and conferences)

12. Referee for:
    1. *Proceedings of the National Academy of Sciences*
    2. *Science Robotics*
    3. *Science Translational Medicine*
    4. *Proceedings of the Royal Society of London Interface*
    5. *Nature Scientific Reports*
    6. *British Medical Journal Open*
    7. *Public Library of Science ONE*
    8. *Journal of Biomechanics*
    9. *Journal of Experimental Biology*
    10. *Journal of Biomechanical Engineering*
    11. *International Journal of Robotics Research*
    12. *Transactions on Neural Systems & Rehabilitation Engineering*
    13. *Journal of Theoretical Biology*
    14. *Gait & Posture*
    15. *Experimental Brain Research*
    16. *Journal of NeuroEngineering and Rehabilitation*
    17. *Robotics and Automation Letters*
    18. *Robotics & Autonomous Systems*
    19. *Intelligent Autonomous Systems*
    20. *Autonomous Robots*
    21. *Human Movement Science*
    22. *Humanoids*
    23. *Robotics & Automation Magazine*
    24. *Transactions on Robotics*
    25. *Robotica*
    26. *Journal of Medical Devices*
    27. *European Journal of Applied Physiology*
    28. *Journal of Rehabilitation Research and Development*
    29. *Mechatronics*
    30. *Annual Meeting of the American Society of Biomechanics (ASB)*
    31. *International Conference on Robotics and Automation (ICRA)*
    32. *International Conference on Rehabilitation Robotics (ICORR)*
    33. *International Conference on Robotics and Biomimetics (ROBIO)*
    34. *International Conference on Intelligent Robots and Systems (IROS)*
    35. *Dynamic Systems and Control Conference (DSCC).*

Grants review: (51 proposals reviewed in 5 programs)

13. National Institutes of Health (NIH) Musculoskeletal Rehabilitation Sciences (MRS) Study Section.

14. National Science Foundation (NSF) General and Age-Related Disabilities Engineering (GARDE) Program.

15. National Science Foundation (NSF) Undisclosed Program.

16. National Science Foundation (NSF) National Robotics Initiative (NRI) Program.

17. NIH National Center for Simulation in Rehabilitation Research Pilot Program.

External faculty review:

18. Four external reviews of faculty promotion, tenure and hiring cases to date.

Departmental Service: Mechanical Engineering at Stanford University

19. Member: Undergraduate Curriculum Committee, Fall 2017—present.

20. Liaison: BSME 2.0 with Design & Manufacturing Core, Biomechanics, Fall 2017—present.

21. Proctor: Qualifying Exams. Robotics. 1 exam.

22. Coordinator: Biomechanics Group Meetings. Winter 2018—present.

Departmental Service: Mechanical Engineering and Robotics at Carnegie Mellon University

23. Proctor: Qualifying Exams. Control, Solid Mechanics, Design and Research, 2010—2017. (champion for number of exams administered, at the time, with 86 in 7 cycles)

24. Member: Mechanical Engineering Undergraduate Education Committee, Fall 2010—2017

25. Lead: Mechanical Engineering Undergraduate Teaching Fellow program, Fall 2011—2017

26. Member: Mechanical Engineering Robotics Strategic Planning Committee, 2013—2015

27. Member: Mechanical Engineering Shop Reorganization Committee, 2013—2017

28. Reviewer: CMU Robotics Minor program, 2014-2017

29. Member: College of Engineering Manufacturing Facilities Committee, 2014—2017

30. Member: Faculty search committee, 2015—2017

31. Ph.D. Committee member:
    a. Siddharth Sanan, Robotics Institute, CMU, 2010-2013.
    b. Sehyuk Yim, Mechanical Engineering, CMU, 2012.
    c. Mohamed Saleh, Mechanical Engineering, CMU, 2013-2015.
    d. Matthew Woodward, Mechanical Engineering, CMU, 2014-2017.
    e. Alexander Schepelmann, Robotics Institute, CMU, 2014-2016.
    f. Nitish Thatte, Robotics Institute, CMU, 2016—present.

32. Judge: Bennett Conference, Carnegie Mellon University, Pittsburgh, PA, 2011, 2015.

School and University Level Service: Carnegie Mellon University

33. Member: College of Engineering Manufacturing Facilities Committee, Spring 2014—present

34. Judge: Meeting of the Minds, Spring 2016

35. Judge: Sweepstakes buggy design competition, Spring 2013—2016

Other Academic and Societal Service:

36. Booth: American Association for the Advancement of Science (AAAS) Family Science Days, Washington DC, USA. February, 2005

37. Ph.D. Committee member: Karl E. Zelik, University of Michigan, 2009-2012

38. Ph.D. Thesis Committee member: Sjoerd Bruijn, Vrije Universiteit Amsterdam, 2010

39. Session leader: SWE High School Days, Carnegie Mellon University, Pittsburgh, PA, 2010—2013

40. Co-Organizer: Amp Up! Pittsburgh Amputee Support Group, 2011—2012

41. Judge: Bennett Conference, Carnegie Mellon University, Pittsburgh, PA, 2011

42. Judge: FIRST Robotics competition, National Robotics Engineering Center, Pittsburgh, PA, December 2011

43. Ph.D. Committee member: Bruce Wiggin, North Carolina State University, 2012—2014

44. Mentor: SciTech High School project team. Weekly one-hour meetings. Fall 2013—present

45. Guest Lecture: How to design robotic prostheses, Ellis School for girls, Pittsburgh, PA, October 30, 2013

46. Poster at: American Orthotics and Prosthetics Association National Assembly, Las Vegas, NV, USA. Sept. 4-7 2014

47. Reviewer: CMU Robotics Minor program, Spring 2014-present

48. Guest lecture: Applied Physiology 6202, Clinical Gait Analysis, Young-Hui Chang, Georgia Institute of Technology, Altanta, GA, 12 November, 2014

49. Guest lecture: Integrative Physiology 6660, Biomechanics and Energetics of Locomotion Rodger Kram, University of Colorado, Boulder, 19 November 2014

Professional memberships

1. Member, American Society of Biomechanics (ASB), 2003—present

2. Member, Institute of Electrical and Electronics Engineers (IEEE), 2012—present

3. Member, American Physiological Society (APS), 2014—present

4. Member, Robotics and Automation Society (RAS), 2015—present

Selected popular press and reviews

1. Efficient walking robot work is reviewed in: Alexander, R. M. (2005) Perspective: Walking made simple. *Science*, **308**(5718):58-59.

2. Efficient walking robot research was reported by the following popular press outlets:
   a. AP (February 2005)
   b. AFP (February 2005)
   c. BBC (February 2005)
   d. Der Spiegel (February 2005)
   e. Discover Magazine (January 2006)
   f. Discovery Channel Canada (February 2005)
   g. The Guardian (February 2005)
   h. The Independent (February 2005)
   i. Machine Design (March 2005)
   j. Nature News (February 2005)
   k. The New Scientist (February 2005)
   l. NPR's Day to Day (February 2005)
   m. New York Times (February 2005)
   n. Popular Mechanics (June 2005)
   o. Reuters (February 2005)
   p. Science News (August 2005)
   q. Science Channel (February 2005)
   r. Scientific American (February 2005)
   s. The Telegraph (February 2005)
   t. The Times (London, February 2005)
   u. The World (BBC/PRI, February 2005)
   (hundreds of additional news outlets internationally)

3. Arm swinging work is reviewed in: Gillis, G. B. (2009) Outside JEB: Getting into the swing of walking. *J. Experimental Biology*, **212**:V.

4. Arm swinging work was reported by the following popular press:
   a. AFP (August 2009)
   b. Discovery Channel Magazine (January 2010)
   c. The Guardian (August 2009)
   d. The Independent (August 2009)
   e. Radio Nacional de Columbia (August 2009)
   f. Reuters (August 2009)
   g. Scientific American (August 2009)
   h. The Telegraph (August 2009)

5. Energy-recycling artificial foot work was reported by the following popular press
   a. CBC Radio's As It Happens (February 2010)
   b. New Scientist (February 2010)
   c. Popular Science (February 2010)
   d. NRC Handelsblad (February 2010)

6. Robotic emulator system work reported by the following popular press:
    a. Site Selection Magazine (September 2014)
    b. Newsmax (March 2015)
    c. ASME Hot Labs (January 2016)

7. Unpowered ankle exoskeleton work is reviewed in:
    a. Castelvecchi, D. (2015) News: Exoskeleton boots improve on evolution – Unpowered mechanical design lowers the energetic costs of walking. *Nature*, **doi**:10.1038/nature.2015.17237
    b. Nature Editorial Board (2015) Editorial: Walking 2.0 – A passive device that augments calf muscles improves on natural selection's best effort. *Nature*, 520:6, **doi**:10.1038/520006a.
    c. Conover, E. (2015) ScienceShot: Exoskeleton boot reduces cost of walking by 7%. *Science*, **doi**:10.1126/science.aab0409
    d. NIH National Institutes of Nursing Research News & Notes, April 23, 2015
    e. NSF Press Release 15-031, April 1, 2015

8. Unpowered ankle exoskeleton work reported by the following popular press:
    a. The New York Times (USA, April, 2015)
    b. The Washington Post (USA, April, 2015)
    c. NPR's Science Friday (USA, April, 2015)
    d. NBC News (USA, April, 2015)
    e. The Associated Press (USA, April, 2015)
    f. CBC's Quirks & Quarks (Canada, April, 2015)
    g. The Economist (United Kingdom, April, 2015)
    h. BBC News (United Kingdom, April, 2015)
    i. The Guardian (United Kingdom, April, 2015)
    j. The Independent (United Kingdom, April, 2015)
    k. Der Spiegel (Germany, April, 2015)
    l. Agence France-Presse (France, April, 2015)
    m. El País (Spain, April, 2015)
    n. NRC Handelsblad (The Netherlands, April, 2015)
    o. ORF1's Wissen Aktuell (Austria, April, 2015)
    p. Correio Braziliense (Brazil, April 2015)
    q. Popular Mechanics (USA, April 2015)
    r. Popular Science (USA, April 2015)
    s. Wired, Discovery News, Gizmodo, Engadget, Fusion, etc. (April 2015)
    t. Fox's Earth 2050 (September 2015)
    u. ASME (February 2016)
    v. Next Avenue (March 2016)
    (hundreds of additional news outlets internationally)

9. Human-in-the-loop optimization work is reviewed in:
    a. Malcolm, P., Galle, S., De Clercq, D. (2017) Fast exoskeleton optimization. *Science*, **356**:1230-1231.

10. Human-in-the-loop optimization work reported by the following popular press:
    a. Scientific American (USA, July 2017)
    b. Quirks & Quarks (Canada, June 2017)

c. Deutschlandfunk (Germany, June 2017)
d. ORF (Austria, June 2017)
e. El Pais (Spain, June 2017)
f. EOS Wetenschap (The Netherlands, June 2017)
g. Wired (USA, June 2017)
h. Motherboard (USA, June 2017)
i. Voice of America (USA, June 2017)
j. Deutsches Ärzteblatt International (Germany, June 2017)
k. N+1 (Russia, June 2017)
l. Sydney Morning Herald (Australia, July 2017)
m. CBC News (Canada, June 2017)
n. Science 360 (USA, June 2017)
o. U.S. News & World Report (USA, July 2017)
p. Phys.org (USA, June 2017)
q. O&P Edge (USA, June 2017)
r. Pittsburgh Post-Gazette (front page, July 10, 2017)
(hundreds of additional news outlets internationally)