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Educational Background

The Ohio State University — Columbus, OH
Doctor of Philosophy, Electrical and Computer Engineering — August 2014

The Ohio State University — Columbus, OH
Master of Science, Electrical and Computer Engineering — December 2013

The Ohio State University — Columbus, OH
Bachelor of Science, Electrical and Computer Engineering — June 2009

Professional Experience

University of Notre Dame — South Bend, IN
Wanzek Collegiate Chair — 2023-Present
Associate Professor, Aerospace and Mechanical Engineering — 2022-Present
Assistant Professor, Aerospace and Mechanical Engineering — 2017-2022

Massachusetts Institute of Technology — Cambridge, MA
Postdoctoral Associate, Mechanical Engineering — 2014-2017

Professional Recognition and Honors

- Joyce Award for Excellence in Undergraduate Teaching, *University of Notre Dame*, 2023
- Best Paper Award Finalist, *IEEE-RAS Technical Committee on Model-Based Optimization for Robotics*, 2022
- Honorable Mention, Best Paper Award, *IEEE Robotics and Automation Letters (RA-L)*, 2022
- Outstanding Associate Editor Award, *IEEE International Conference on Robotics and Automation (ICRA)*, 2021
- NSF CAREER Award, 2020
- Outstanding Mentor Award, *Notre Dame Graduate Student Union*, 2020
- Best Paper Award (Interactive Track), *IEEE-RAS International Conference on Humanoid Robotics*, 2019

- Best Paper Award Finalist, *IEEE International Conference on Robotics and Automation (ICRA)*, 2018
- Best Paper Award, *International Journal of Humanoid Robotics (IJHR)*, 2016
- Best Paper Award Finalist, *IEEE-RAS Technical Committee on Whole-Body Control*, 2016
- NSF Graduate Research Fellowship, 2011

Submitted Journal Manuscripts (Under Review or In Revision)

[1] T. Lee, J. Kwon, P. M. Wensing, and F. C. Park. Robot model identification and learning: A modern perspective. *Annual Review of Control, Robotics, and Autonomous Systems (invited submission; submitted, June 2023)*, 2024.

[2] F. Allione, R. Featherstone, P. M. Wensing, and D. Caldwell. Balancing on a rolling contact. *IEEE Robotics and Automation Letters (submitted, June 2023)*, 2023.

[3] D. J. Kelly and P. M. Wensing. Assessing center of mass kinematic reconstruction during human steady-state walking using optimized template models. *Scientific Reports (in review; submitted: 11/04/2022)*, 2023.

[4] P. M. Wensing, G. Niemeyer, and J.-J. E. Slotine. Observability in inertial parameter identification. *(in revision; submitted to the International Journal of Robotics Research: 9/4/18.)*, 2018. arXiv: 1711.03896.

Journal Publications

[1] R. R. Posh, J. P. Schmiedeler, and P. M. Wensing. A comparison of finite-state impedance, direct myoelectric, and hybrid volitional control for a robotic ankle prosthesis. *IEEE Transactions on Neural Rehabilitation and Engineering (to appear; accepted: June 2023)*, 2023.

[2] S. Singh, R. P. Russell, and P. M. Wensing. On second-order derivatives of rigid-body dynamics: Theory & implementation. *IEEE Transactions on Robotics (conditionally accepted)*, 2023.

[3] P. M. Wensing, M. Posa, Y. Hu, A. Escande, N. Mansard, and A. Del Prete. Optimization-based control for dynamic legged robots. *IEEE Transactions on Robotics (conditionally accepted)*, 2023. arXiv: 2211.11644.

[4] T. M. Higgins K. J. Bresingham, J. P. Schmiedeler, and P. M. Wensing. Sensor-agnostic and data-efficient human walking speed intent identification. *Wearable Technologies (to appear)*, 2023.

[5] L. Kozachkov, P. M. Wensing, and J.-J. E. Slotine. Generalization as dynamical robustness–the role of Riemannian contraction in supervised learning. *Journal of Machine Learning Research*, April 2023. arXiv: 2201.06656.

[6] G. Grandesso, G. P. R. Papini, P. M. Wensing, and A. D. Prete. CACTO: Continuous actor-critic algorithm with trajectory optimization towards global optimality. *IEEE Robotics and Automation Letters*, 8(6):3318–3325, June 2023. doi: 10.1109/LRA.2023.3266985, arXiv: 2211.06625.

[7] H. Chen, Z. Hong, S. Yang, P. M. Wensing, and W. Zhang. Quadruped capturability and push recovery via a switched-systems characterization of dynamic balance. *IEEE Transactions on Robotics*, 2023. doi: 10.1109/TRO.2023.3240622.

[8] J. Nganga and P. M. Wensing. Accelerating hybrid systems differential dynamic programming. *ASME Dynamic Systems and Control Letters*, 3(1):011002:1–8, Jan. 2023. doi: 10.1115/1.4056747.

[9] S. Li, H. Chen, W. Zhang, and P. M. Wensing. A geometric sufficient condition for contact wrench feasibility. *IEEE Robotics and Automation Letters*, 7(4):12411–12418, Oct. 2022. doi: 10.1109/LRA.2022.3217687.

[10] R. M. Karulkar and P. M. Wensing. Personalizing intended gait speed estimation for lower-limb exoskeleton users with novel walking data. *IEEE Robotics and Automation Letters*, 7(4):9723–9730, Oct. 2022. doi: 10.1109/LRA.2022.3191039.

[11] C. Rucker and P. M. Wensing. Smooth parameterization of rigid-body inertia. *IEEE Robotics and Automation Letters*, 7(2):2771–2778, April 2022. doi: 10.1109/LRA.2022.3144517.

[12] S. Singh, R. Russell, and P. M. Wensing. Efficient analytical derivatives of rigid-body dynamics using spatial vector algebra. *IEEE Robotics and Automation Letters*, 7(2):1776–1783, April 2022. doi: 10.1109/LRA.2022.3141194, arXiv: 2105.05102, **(2022 Best Paper Award Honorable Mention)**.

[13] G. Bravo Palacios, G. Grandesso, A. Del Prete, and P. M. Wensing. Robust co-design: Coupling morphology and feedback design through stochastic programming. *ASME Journal of Dynamic Systems, Measurement, and Controls*, 144(2):021007:1–12, Feb. 2022. doi: 10.1115/1.4052463.

[14] J. Liu, H. Chen, P. M. Wensing, and W. Zhang. Instantaneous capture input for balancing the variable height inverted pendulum. *IEEE Robotics and Automation Letters*, 6(4):7421–7428, Oct. 2021. doi: 10.1109/LRA.2021.3097074, arXiv: 2106.14741.

[15] J. Nganga and P. M. Wensing. Accelerating second-order differential dynamic programming for rigid-body systems. *IEEE Robotics and Automation Letters*, 6(4):7659–7666, Oct. 2021. doi: 10.1109/LRA.2021.3098928, arXiv: 2103.03293.

[16] R. M. Karulkar and P. M. Wensing. Using footsteps to estimate changes in the desired gait speed of an exoskeleton user. *IEEE Robotics and Automation Letters*, 6(4):6781–6788, Oct. 2021. doi: 10.1109/LRA.2021.3096163.

[17] P. M. Wensing. The rapid rise of quadruped robots. *IEEE Robotics and Automation Magazine*, 28(3):168, Sept. 2021. doi: 10.1109/MRA.2021.3095991.

[18] S. Echeandia and P. M. Wensing. Numerical methods to compute the Coriolis matrix and Christoffel symbols for rigid-body systems. *ASME Journal of Computational and Nonlinear Dynamics*, 16(9):091004:1–9, Sept. 2021. doi: 10.1115/1.4051169, arXiv: 2010.01033.

[19] G. Grandesso, G. Bravo-Palacios, P. M. Wensing, M. Fontana, and A. Del Prete. Exploring the limits of a hybrid actuation system through co-design. *IEEE Access*, 9:56802–56811, April 2021. doi: 10.1109/ACCESS.2021.3072783.

[20] H. Li, R. J. Frei, and P. M. Wensing. Model hierarchy predictive control of robotic systems. *IEEE Robotics and Automation Letters*, 6(2):3373–3380, April 2021. doi: 10.1109/LRA.2021.3061322, arXiv: 2010.08881.

[21] V. Kurtz, P. M. Wensing, and H. Lin. Approximate simulation for template-based whole-body control. *IEEE Robotics and Automation Letters*, 6(2):558–565, April 2021. doi: 10.1109/LRA.2020.3047794, arXiv: 2006.09921.

[22] H. Chen, B. Wang, Z. Hong, P. M. Wensing, and W. Zhang. Underactuated motion planning and control for jumping with wheeled-bipedal robots. *IEEE Robotics and Automation Letters*, 6(2):2377–3766, April 2021. doi: 10.1109/LRA.2020.3047787, arXiv: 2012.06156.

[23] H.-W. Park†, P. M. Wensing†, and S. Kim. Jumping over obstacles with MIT Cheetah 2. *Robotics and Autonomous Systems*, 136:103703:1–12, Feb. 2021. doi: 10.1016/j.robot.2020.103703, (†authors contributed equally).

[24] A. Janot and P. M. Wensing. Sequential semidefinite optimization for physically and statistically consistent robot identification. *Control Engineering Practice*, 107:104699:1–15, Feb. 2021. doi: 10.1016/j.conengprac.2020.104699.

[25] T. M. Gambon, J. P. Schmiedeler, and P. M. Wensing. Effects of user intent changes on onboard sensor measurements during exoskeleton-assisted walking. *IEEE Access*, 8:224071–224082, Dec 2020. doi: 10.1109/ACCESS.2020.3044255.

[26] H. Li and P. M. Wensing. Hybrid systems differential dynamic programming for whole-body motion planning of legged robots. *IEEE Robotics and Automation Letters*, 5(4):5448–5455, Oct. 2020. doi: 10.1109/LRA.2020.3007475.

[27] P. M. Wensing and J.-J. E. Slotine. Beyond Convexity – Contraction and Global Convergence of Gradient Descent. *PLOS ONE*, 15(8):1–29, Aug. 2020. doi: 10.1371/journal.pone.0236661, arXiv: 1806.06655.

[28] G. Bravo Palacios, A. Del Prete, and P. M. Wensing. One robot for many tasks: Versatile co-design through stochastic programming. *IEEE Robotics and Automation Letters*, 5(2):1680–1687, April 2020. doi: 10.1109/LRA.2020.2969948.

[29] H. Chen, P. M. Wensing, and W. Zhang. Optimal control of a differentially flat 2D spring loaded inverted pendulum model. *IEEE Robotics and Automation Letters*, 5(2):307–314, April 2020. doi: 10.1109/LRA.2019.2956457, arXiv: 1911.07168.

[30] T. Lee, P. M. Wensing, and F. C. Park. Geometric robot dynamic identification: A convex programming approach. *IEEE Transactions on Robotics*, 36(2):348–365, April 2020. doi: 10.1109/TRO.2019.2926491.

[31] M. Chignoli and P. M. Wensing. Variational-based optimal control of underactuated balancing for dynamic quadrupeds. *IEEE Access*, 8:1680–1687, March 2020. doi: 10.1109/ACCESS.2020.2980446.

[32] C. Boussema, M. J. Powell, G. Bledt, A. J. Ijspeert, P. M. Wensing, and S. Kim. Gait emergence and disturbance recovery for legged robots via the feasible impulse set. *IEEE Robotics and Automation Letters*, 4(2):1611–1618, April 2019. doi: 10.1109/LRA.2019.2896723.

[33] P. M. Wensing, S. Kim, and J.-J. E. Slotine. Linear matrix inequalities for physically consistent inertial parameter identification: A statistical perspective on the mass distribution. *IEEE Robotics and Automation Letters*, 3(1):60–67, Jan. 2018. doi: 10.1109/LRA.2017.2729659.

[34] J. P. Schmiedeler and P. M. Wensing. Discussion of "Review of intent detection, arbitration, and communication aspects of shared control for physical human-robot interaction". *Applied Mechanics Reviews*, 70(1):015503:1–3, Jan. 2018. doi: 10.1115/1.4039146.

[35] S. Kim and P. M. Wensing. Design of dynamic legged robots. *Foundations and Trends in Robotics*, 5(2):117–190, March 2017. doi: 10.1561/2300000044.

[36] H.-W. Park, P. M. Wensing, and S. Kim. High-speed bounding with the MIT Cheetah 2: Control design and experiments. *The International Journal of Robotics Research*, 36(2):167–192, March 2017. doi: 10.1177/0278364917694244.

[37] P. M. Wensing, A. Wang, S. Seok, D. Otten, J. Lang, and S. Kim. Proprioceptive actuator design in the MIT cheetah: Impact mitigation and high-bandwidth physical interaction for dynamic legged robots. *IEEE Transactions on Robotics*, 33(3):509–522, Jan. 2017. doi: 10.1109/TRO.2016.2640183.

[38] Y. Liu, P. M. Wensing, J. P. Schmiedeler, and D. E. Orin. Terrain-blind humanoid walking based on a 3D actuated dual-SLIP model. *IEEE Robotics and Automation Letters*, 1(2):1073–1080, July 2016. doi: 10.1109/LRA.2016.2530160.

[39] P. M. Wensing and D. E. Orin. Improved computation of the humanoid centroidal dynamics and application in dynamic whole-body control. *International Journal of Humanoid Robotics (Special Issue on Whole-Body Control)*, 13(1):1550039:1–23, March 2016. doi: 10.1142/S0219843615500395, **(2016 IJHR Best Paper Award)**.

[40] G. B. Hammam, P. M. Wensing, B. Dariush, and D. E. Orin. Kinodynamically consistent motion retargeting for humanoids. *International Journal of Humanoid Robotics*, 12(4):1550017:1–27, December 2015. doi: 10.1142/S0219843615500176.

[41] P. M. Wensing, L. R. P. III, and D. E. Orin. Efficient recursive dynamics algorithms for operational-space control with application to legged locomotion. *Autonomous Robots*, 38(4):363–381, April 2015. doi: 10.1007/s10514-015-9420-9.

[42] M. A. Vernier, P. M. Wensing, C. Morin, A. Phillips, B. Rice, K. Wegman, C. Hartle, P. Clingan, K. Kecskemety, and R. Freuler. Design of a full-featured robot controller for use in a first-year robotics design project. *ASEE Computers in Education Journal*, 25(1), Jan.-Mar. 2015. doi: 10.18260/1-2–20260.

[43] P. M. Wensing, G. B. Hammam, B. Dariush, and D. E. Orin. Optimizing foot centers of pressure through force distribution in a humanoid robot. *International Journal of Humanoid Robotics*, 10(3):1350027:1–21, Sept. 2013. doi: 10.1142/S0219843613500278.

[44] M. A. Vernier, C. E. Morin, P. M. Wensing, R. M. Hartlage, B. E. Carruthers, and R. J. Freuler. Use of a low-cost camera-based positioning system in a first-year engineering cornerstone design project. *ASEE Computers in Education Journal*, 20(2):6–14, June 2010. doi: 10.18260/1-2–5632.

Submitted Conference Manuscripts (Under Review or In Revision)

[1] J. Nganga, H. Li, and P. M. Wensing. Second-order differential dynamic programming for whole-body mpc of legged robots. In *Modeling, Estimation, and Control Conference (in review)*, 2023.

[2] H. Li, T. Zhang, G. Yu, and P. M. Wensing. A unified perspective on multiple shooting in differential dynamic programming. In *IEEE/RSJ International Conference on Intlligent Robots and Systems (in review)*, 2023.

[3] R. R. Posh, J. A. Tittle, J. P. Schmiedeler, and P. M. Wensing. Calibration of a tibia-based phase variable for control of robotic transtibial prostheses. In *IEEE/RSJ International Conference on Intlligent Robots and Systems (in review)*, 2023.

[4] N. Fey, R. Frei, and P. M. Wensing. 3D hopping in cluttered terrain using impulse planning with mixed-integer strategies. In *IEEE International Conference on Robotics and Automation (in revision; submitted: 09/15/2022)*, 2023.

Refereed Conference Publications

[1] H. Li, T. Zhang, G. Yu, and P. M. Wensing. Versatile real-time motion synthesis via kino-dynamic MPC with hybrid-systems DDP. In *IEEE International Conference on Robotics and Automation (to appear)*, 2023.

[2] H. Li, W. Yu, T. Zhang, and P. M. Wensing. Zero-shot retargeting of learned quadruped locomotion policies using hybrid kinodynamic model predictive control. In *Proceedings of the 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 11971–11977, Kyoto, Japan, Oct. 2022. doi: 10.1109/IROS47612.2022.9981967.

[3] S. Singh, R. P. Russell, and P. M. Wensing. Analytical second-order partial derivatives of rigid-body inverse dynamics. In *Proceedings of the 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 11781–11788, Kyoto, Japan, Oct. 2022. doi: 10.1109/IROS47612.2022.9981356, **(2022 Best Paper Award Finalist - IEEE-RAS Technical Committee on Model-Based Optimization for Robotics)**.

[4] G. Bravo-Palacios and P. M. Wensing. Large-scale ADMM-based co-design of legged robots. In *Proceedings of the 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 8842–8849, Kyoto, Japan, Oct. 2022. doi: 10.1109/IROS47612.2022.9981641.

[5] D. Kelly and P. M. Wensing. Optimizing template models to quantifiably assess center of mass kinematic reconstruction. In *Proceedings of the 2022 International Conference on Rehabilitation Robotics (ICORR)*, pages 1–6, Rotterdam, Netherlands, July 2022. doi: 10.1109/ICORR55369.2022.9896496.

[6] M. Lemmon, P. Wensing, V. Kurtz, and H. Lin. Learning to control robot hopping over uneven terrain. In *Proceedings of the 2022 American Control Conference (ACC)*, pages 520–525, Atlanta, GA, June 2022. doi: 10.23919/ACC53348.2022.9867630.

[7] V. Kurtz, H. Li, P. M. Wensing, and H. Lin. Mini Cheetah, the falling cat: A case study in machine learning and trajectory optimization for robot acrobatics. In *Proceedings of*

the 2022 IEEE International Conference on Robotics and Automation (ICRA), pages 4635–4641, Philadelphia, PA, May 2022. doi: 10.1109/ICRA46639.2022.9812120.

[8] V. Kurtz, P. M. Wensing, and H. Lin. Control barrier functions for singularity avoidance in passivity-based manipulator control. In *Proceedings of the 2021 IEEE Conference on Decision and Control (CDC)*, pages 6125–6130, Austin, TX, Dec. 2021. doi: 10.1109/CDC45484.2021.9683597.

[9] S. Li, H. Chen, W. Zhang, and P. M. Wensing. Quadruped robot hopping on two legs. In *Proceedings of the 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 7448–7455, Prague, Czech Republic (virtual), Oct. 2021. doi: 10.1109/IROS51168.2021.9636120.

[10] R. R. Posh, J. P. Schmiedeler, and P. M. Wensing. Hybrid volitional control as a framework for lower-limb prosthetic control. In *Proceedings of the 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 6167–6173, Prague, Czech Republic (virtual), Oct. 2021. doi: 10.1109/IROS51168.2021.9636450.

[11] S. Yang, H. Chen, L. Zhang, Z. Cao, P. M. Wensing, Y. Liu, J. Pang, and W. Zhang. Reachability-based push recovery for humanoid robots with variable-height inverted pendulum. In *Proceedings of the 2021 IEEE International Conference on Robotics and Automation (ICRA)*, pages 3054–3060, Xi'an, China (virtual), May/June 2021. doi: 10.1109/ICRA48506.2021.9561872.

[12] R. M. Karulkar and P. M. Wensing. Application of interacting models to estimate the gait speed of an exoskeleton user. In *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 3452–3458, Las Vegas, NV (virtual), Oct. 2020. doi: 10.1109/IROS45743.2020.9341110.

[13] M. Fevre, P. M. Wensing, and J. P. Schmiedeler. Rapid bipedal gait optimization in CasADi. In *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 3672–3678, Las Vegas, NV (virtual), Oct. 2020. doi: 10.1109/IROS45743.2020.9341586.

[14] T. M. Gambon, J. P. Schmiedeler, and P. M. Wensing. Exoskeleton user intent identification via the Mahalanobis distance. In *Proceedings of the 2020 IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BIOROB)*, pages 1115–1121, New York, NY (virtual), Nov./Dec. 2020. doi: 10.1109/BioRob49111.2020.9224299.

[15] O. A. V. Magaña, V. Barasuol, P. M. Wensing, and C. Semini. MPC-based controller with terrain insight for dynamic legged locomotion. In *Proceedings of the 2020 IEEE International Conference on Robotics and Automation (ICRA)*, pages 2436–2442, Paris, France (virtual), May-Aug. 2020. doi: 10.1109/ICRA40945.2020.9197312.

[16] V. Kurtz, P. M. Wensing, and H. Lin. Robust approximate simulation for hierarchical control of linear systems under disturbances. In *Proceedings of the 2020 American Control Conference (ACC)*, pages 5352–5357, Denver, CO (virtual), July 2020. doi: 10.23919/ACC45564.2020.9147511.

[17] V. Kurtz, R. R. da Silva, P. M. Wensing, and H. Lin. Formal connections between template and anchor models via approximate simulation. In *Proceedings of the 2019 IEEE RAS International Conference on Humanoid Robotics*, pages 64–71, Toronto, ON,

Canada, Oct. 2019. doi: 10.1109/Humanoids43949.2019.9035022, **(Best Paper Award - Interactive Track)**.

[18] T. M. Gambon, J. P. Schmiedeler, and P. M. Wensing. Characterizing intent changes in exoskeleton-assisted walking through onboard sensors. In *Proceedings of the 2019 IEEE/RAS-EMBS International Conference on Rehabilitation Robotics (ICORR)*, pages 471–476, Toronto, ON, CA, June 2019. doi: 10.1109/ICORR.2019.8779503.

[19] G. Bledt, M. J. Powell, B. Katz, J. Di Carlo, P. M. Wensing, and S. Kim. MIT Cheetah 3: Design and control of a robust, dynamic quadruped robot. In *Proceedings of the 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 2245–2252, Madrid, Spain, Oct. 2018. doi: 10.1109/IROS.2018.8593885.

[20] J. Di Carlo, P. M. Wensing, B. Katz, G. Bledt, and S. Kim. Dynamic locomotion in the MIT Cheetah 3 through convex model-predictive control. In *Proceedings of the 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 7440–7447, Madrid, Spain, Oct. 2018. doi: 10.1109/IROS.2018.8594448.

[21] P. M. Wensing and J.-J. E. Slotine. Cooperative adaptive control for cloud-based robotics. In *Proceedings of the 2018 IEEE International Conference on Robotics and Automation (ICRA)*, pages 6401–6408, Brisbane, Australia, May 2018. doi: 10.1109/ICRA.2018.8460856.

[22] G. Bledt, P. M. Wensing, S. Ingersoll, and S. Kim. Contact model fusion for event-based locomotion in unstructured terrains. In *Proceedings of the 2018 IEEE International Conference on Robotics and Automation (ICRA)*, pages 4399–4406, Brisbane, Australia, May 2018. doi: 10.1109/ICRA.2018.8460904, **(ICRA Best Paper Award Finalist)**.

[23] T. Flayols, A. Del Prete, P. M. Wensing, A. Mifsud, M. Benallegue, and O. Stasse. Experimental evaluation of simple estimators for humanoid robots. In *Proceedings of the 2017 IEEE-RAS International Conference on Humanoid Robots*, pages 889–895, Birmingham, UK, Nov. 2017. doi: 10.1109/HUMANOIDS.2017.8246977.

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[26] Y. Liu, P. M. Wensing, D. E. Orin, and Y. F. Zheng. Trajectory generation for dynamic walking in a humanoid over uneven terrain using a 3D-actuated dual-SLIP model. In *Proceedings of the 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 374–380, Hamburg, Germany, Sept./Oct. 2015. doi: 10.1109/IROS.2015.7353400.

[27] H.-W. Park, P. M. Wensing, and S. Kim. Online planning for autonomous running jumps over obstacles in high-speed quadrupeds. In *Proceedings of Robotics: Science & Systems*, pages 47:1–9, Rome, Italy, July 2015. doi: 10.15607/RSS.2015.XI.047.

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[29] P. M. Wensing and D. E. Orin. 3D-SLIP steering for high-speed humanoid turns. In *Proceedings of the 2014 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 4008–4013, Chicago, Illinois, September 2014. doi: 10.1109/IROS.2014.6943126.

[30] M. A. Vernier, P. M. Wensing, C. Morin, A. Phillips, B. Rice, K. Wegman, C. Hartle, P. Clingan, K. Kecskemety, and R. Freuler. Design of a full-featured robot controller for use in a first-year robotics design project. In *Proceedings of the 2014 American Society for Engineering Education Annual Conference*, pages 10270:1–21, Indianapolis, Indiana, June 2014.

[31] P. M. Wensing and D. E. Orin. Development of high-span running long jumps for humanoids. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 222–227, Hong Kong, China, May/June 2014. doi: 10.1109/ICRA.2014.6906613.

[32] P. M. Wensing and D. E. Orin. High-speed humanoid running through control with a 3D-SLIP model. In *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 5134–5140, Tokyo, Japan, Nov. 2013. doi: 10.1109/IROS.2013.6697099.

[33] P. M. Wensing and D. E. Orin. Generation of dynamic humanoid behaviors through task-space control with conic optimization. In *Proceedings of the 2013 IEEE International Conference on Robotics and Automation (ICRA)*, pages 3088–3094, Karlsruhe, Germany, May 2013. doi: 10.1109/ICRA.2013.6631008.

[34] P. M. Wensing, R. Featherstone, and D. Orin. A reduced-order recursive algorithm for the computation of the operational-space inertia matrix. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 4911–4917, Minneapolis, MN, May 2012. doi: 10.1109/ICRA.2012.6224600.

[35] Y. Liu, P. M. Wensing, D. Orin, and J. P. Schmiedeler. Fuzzy controlled hopping in a biped robot. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 1982–1989, Shanghai, China, May 2011. doi: 10.1109/ICRA.2011.5979780.

[36] M. S. Hester, P. M. Wensing, J. P. Schmiedeler, and D. E. Orin. Fuzzy Control of Vertical Jumping with a Planar Biped. In *Proceedings of ASME International Design Engineering Technical Conferences*, pages DETC2010–28857:1–9, Montreal, Quebec, August 2010. doi: 10.1115/DETC2010-28857.

[37] K. Harper, R. Freuler, S. Brand, C. Morin, P. Wensing, and J. Demel. Comparing the use of a graphical programming language to a traditional text-based language to learn programming concepts in a first-year course. In *Proceedings of the American Society for Engineering Education Annual Conference*, pages AC2009–1777:1–10, Austin, Texas, June 2009. doi: 10.18260/1-2–5537.

[38] M. A. Vernier, C. E. Morin, P. M. Wensing, R. M. Hartlage, B. E. Carruthers, and R. J. Freuler. Use of a low-cost camera-based positioning system in a first-year engineering cornerstone design project. In *Proceedings of the American Society for Engineering Education Annual Conference*, pages AC2009–1941:1–11, Austin, Texas, June 2009. doi: 10.18260/1-2–5632.

Non-refereed Conference Publications

[1] D. J. Kelly and P. M. Wensing. Towards task-level control of powered lower-limb prostheses. In *Proceedings of the 45th Meeting of the American Society of Biomechanics*, 2021.

[2] R. M. Karulkar and P. M. Wensing. Towards detecting the intended gait speed of exoskeleton users. In *Proceedings of the 45th Meeting of the American Society of Biomechanics*, 2021.

[3] R. Posh, J. P. Scmiedeler, and P. M. Wensing. Hybrid volitional control as a framework for lower-limb prosthetic control. In *Proceedings of the 45th Meeting of the American Society of Biomechanics*, 2021.

[4] R. M. Karulkar and P. M. Wensing. Footstep-based detection of intended gait speed for exoskeleton users. In *Proceedings of Dynamic Walking 2021*, 2021.

[5] H. Li and P. M. Wensing. Model hierarchy predictive control of legged locomotion. In *Proceedings of Dynamic Walking 2021*, 2021.

[6] G. Bravo-Palacios and P. M. Wensing. Toward engineering mechanical intelligence via scalable co-design. In *Proceedings of Dynamic Walking 2021*, 2021.

[7] R. Posh, J. P. Schmiedeler, and P. M. Wensing. Hybrid volitional control as a framework for lower-limb prosthetic control. In *Proceedings of Dynamic Walking 2021*, 2021.

[8] R. M. Karulkar and P. M. Wensing. Toward model-based intent detection for lower-extremity exoskeletons. In *Proceedings of Dynamic Walking 2020*, 2020.

[9] R. Posh, J. Schmiedeler, and P. M. Wensing. Hybrid volitional control in lower-limb prostheses. In *Proceedings of Dynamic Walking 2020*, 2020.

[10] M. Chignoli and P. M. Wensing. Variational-based optimal control of underactuated balancing for dynamic quadrupeds. In *Proceedings of Dynamic Walking 2020*, 2020.

[11] R. M. Karulkar, T. M. Gambon, and P. M. Wensing. Adapting the dual-slip model for low-speed walking using leg stiffness modulation. In *Proceedings of the Midwest American Society of Biomechanics Regional Meeting*, 2019.

[12] J. Nganga and P. M. Wensing. A comparison of machine learning architectures for robotic exoskeleton intent detection. In *Proceedings of the Midwest American Society of Biomechanics Regional Meeting*, 2019.

[13] T. M. Gambon, P. M. Wensing, and J. P. Schmiedeler. Intent changes during locomotion in a robotic exoskeleton. In *Proceedings of the Midwest American Society of Biomechanics Regional Meeting*, 2019.

Books and Chapters in Books

[1] P. M. Wensing and R. Featherstone. Dynamics calculation methods. In M. H. Ang, O. Khatib, and B. Siciliano, editors, *Encyclopedia of Robotics*, pages 1–8. Springer Berlin Heidelberg, 2022. doi: 10.1007/978-3-642-41610-1_224-1.

[2] P. M. Wensing and D. E. Orin. Dynamic models of robots. In M. H. Ang, O. Khatib, and B. Siciliano, editors, *Encyclopedia of Robotics*, pages 1–6. Springer Berlin Heidelberg, 2019. doi: 10.1007/978-3-642-41610-1_58-1.

[3] D. E. Orin and P. M. Wensing. Dynamics. In M. H. Ang, O. Khatib, and B. Siciliano, editors, *Encyclopedia of Robotics*, pages 1–6. Springer Berlin Heidelberg, Berlin, Heidelberg, 2019. doi: 10.1007/978-3-642-41610-1_57-1.

[4] P. M. Wensing and S. Revzen. Template models for control. In *Bio-inspired legged locomotion concepts, control and implementation*, pages 240–266. Elsevier, 2017. doi: 10.1016/B978-0-12-803766-9.00006-3.

[5] P. M. Wensing and D. E. Orin. Control of humanoid hopping based on a SLIP model. In V. Kumar, J. Schmiedeler, S. V. Sreenivasan, and H.-J. Su, editors, *Advances in Mechanisms, Robotics and Design Education and Research*, pages 265—274. Springer International, 2013. doi: 10.1007/978-3-319-00398-6_21.

Doctoral Students Supervised

Completed

- 2022: Taylor Gambon, *Characterization, Estimation, and Realization of Human Intent for Exoskeleton-Assisted Walking* (Co-Advised with Jim Schmiedeler) **Placement:** Post-Doc at UT Austin with Assistant Professor appointment at FSU to follow
- 2022: Roopak Karulkar, *Predicting Changes in the Desired Gait Speed of Lower-limb Exoskeleton Users Via Intuitive Physical Human-Robot Interaction*, **Placement:** Agility Robotics
- 2023: Gabriel Bravo, *Engineering Mechanical Intelligence in Legged Robots* **Placement:** GM Research

In Progress

- John Nganga, *Advancing the Robustness of Differential Dynamic Programming*, (In Progress, 5th Year, Post-Candidacy), ***Dean's Fellow*** & ***NASA NSTGRO Fellow***
- He Li, *Model-Hierarchical Predictive Control of Legged Locomotion*, (In Progress, 4th Year, Post-Candidacy)
- Ryan Posh, *Hybrid Volitional Control of Transtibial Prostheses*, (In Progress, 4th Year, Post-Candidacy, Co-Advised with Jim Schmiedeler), ***NSF Graduate Research Fellow*** & ***Notebaert Fellow***
- Shenggao Li, *Control of Underactuated Hopping*, (In Progress, 4th Year, Post-Candidacy)
- David Kelly, *Task-Level Motor Coordination for Transfemoral Prostheses*, (In Progress, 3rd Year, Post-Quals)

- Nicholas Adrian, *Simulation, Identification, and Control for Highly-Dynamic Humanoids with Electric Motors*, (In Progress, 1st Year)

Masters Students Supervised (Non-Thesis)

- Rojitha Goonesekere, *Sensorless Contact Detection for Quadruped Robots*, (2019-2020)

Undergraduate Researchers Supervised

Current

- Grace Henderson, *Calibrating Phase Variables for Knee/Ankle Prostheses*, (2023-Present)
- Zach Deal, *Variable Impedance Control for Knee/Ankle Prostheses*, (2023-Present)

Past

- Nolan Fey, *Adapting the Planning and Control of Legged Robots to Extreme Environments* (2021-2023), **Placement:** PhD Program at MIT, ***NSF Graduate Research Fellowship***
- Kevin Gabriel Alvarez, *Leg Design for Energy Efficient Locomotion* (2021-2022), **Placement:** MS Program at ETH Zurich
- Robbie Frei, *Model Predictive Control of Mini Cheetah* (2019-2022), **Placement:** PhD Program at Michigan, ***NSF Graduate Research Fellowship***
- Giana Fallara, *Centroidal Angular Momentum in Human Locomotion* (2021)
- Erin Archibeck, *Analysis of Gait Variations in Over-ground Walking*, (2017-2020), **Placement:** PhD Program at UC Berkeley, ***NSF Graduate Research Fellowship***
- Jeffrey Berning, *Capturing Start/Stop Transitions with Complaint-Leg Models of Locomotion* (2019-2020), **Placement:** PhD Program at Rice University, ***NSF Graduate Research Fellowship***
- Sebastian Echeandia, *Modeling and Computation of Dynamic Effects from Proprioceptive Force-Control Actuators* (2019-2020), *BS Thesis*, ***Grand Challenge Scholars Program***, **Placement:** MS Program at Georgia Tech
- John Craig, *Fabrication of a Dynamic Quadruped Robot: ND Cheetah* (2018-2019)
- Matt Chignoli, *Variational-Based Optimal Control of Underactuated Balancing for Dynamic Quadrupeds*, (2018-2019), *BS Thesis*, **Placement:** PhD Program at MIT, ***NSF Graduate Research Fellowship***
- Bianca Jurewicz, *Analysis of Gait Variations in Over-ground Walking*, (2017-2019), **Placement:** MS Program at Stanford
- Kevin Best, *Design and Control of a Single-Leg Hopping Robot Platform*, (2017-2018), **Placement:** PhD Program at University of Michigan.
- Ben Beiter, *Simulation and Control of a Single-Leg Hopping Robot*, (2017-2018), **Placement:** PhD Program at Virginia Tech

Invited Seminars at Universities and Research Institutes

[1] Advancing the Versatility of Legged Robots and Assistive Devices, *University of Illinois Urbana Champaign*. February 2023.

[2] Advancing the Versatility of Legged Robots and Assistive Devices, *University of Illinois Chicago*. February 2023.

[3] Advancing the Versatility of Legged Robots and Assistive Devices, *Frontiers in Mechanical Engineering and Sciences Multi-University Webinar Series*. Virtual. March 2022.

[4] Advancing the Versatility of Legged Robots and Assistive Devices, *Ohio State University*. Columbus, OH. October 2021.

[5] Toward Online Model Predictive Control and Robot Designs that Make it Easier, *LAAS-CNRS*. Toulouse, France (Virtual). April 2021.

[6] Assistive Robotics at Notre Dame: Toward Fluent Control of Lower-Limb Prostheses, *Indiana University, Indiana Center for Regenerative Medicine and Engineering (ICRME)*, Indianapolis, IN. February 2020. (with Jim Schmiedeler)

[7] Predictive Models for Managing Physical Interaction, *Northwestern University*, Evanston, Illinois. May 2019.

[8] Structured Prediction for Sensorimotor Control, *Seoul National University (SNU)*, Seoul, South Korea. January 2019.

[9] Structured Prediction for Sensorimotor Control, *Korean Institute of Science and Technology (KIST)*, Seoul, South Korea. January 2019.

[10] Structured Prediction for Sensorimotor Control, *Southern University of Science and Technology (SUSTech)*, Shenzhen, China. January 2019.

[11] Structured Prediction for Sensorimotor Control, *University of California Santa Barbara*, Santa Barbara, CA. October 2018.

[12] Structured Prediction for Sensorimotor Control, *EPFL*. Lausanne, Switzerland. July 2018.

[13] Actuator Design and Predictive Control for Legged Robots, *LIRMM-CNRS*. Montpellier, France. July 2017.

[14] Actuator Design and Predictive Control for Legged Robots, *LAAS-CNRS*. Toulouse, France. July 2017.

[15] Structured Prediction for Sensorimotor Control, *Italian Institute of Technology (IIT)*. Genova, Italy. July 2017.

[16] Control Design for Legged Robots: Physical Principles Enabling Dynamic Mobility, *University of Notre Dame*. South Bend, Indiana. March 2016.

[17] Control Design for Legged Robots: Physical Principles Enabling Dynamic Mobility, *Stanford University*. Palo Alto, California. March 2016.

[18] Control Design for Legged Robots: Physical Principles Enabling Dynamic Mobility, *MIT Robotics Seminar*. Cambridge, Massachusetts. February 2016.

[19] Control Design for Legged Robots: Physical Principles Enabling Dynamic Mobility, *University of Utah*. Salt Lake City, Utah. February 2016.

[20] Control Design for Legged Robots: Physical Principles Enabling Dynamic Mobility, *Ohio State University*. Columbus, Ohio. January 2016.

[21] Whole-Body Control of Dynamic Humanoid Movements, *LIRMM-CNRS*. Montpellier, France. October 2014.

[22] Whole-Body Control of Dynamic Humanoid Movements, *LAAS-CNRS*. Toulouse, France. October 2014.

Lectures at Workshops

[1] It All Matters: Considerations Across Design and Control for Contact-Savvy Robots, *ICRA 2021 Workshop: Highly Dynamic Motion Generation for Underactuated Robots*, Xi'an, China (virtual), June 2021. *recording:* https://www.youtube.com/watch?v=Gek678upj_0

[2] Tailoring Model Complexity in MPC of Legged Locomotion, *ICRA 2021 Workshop: Recent Advances in MPC and RL for Legged Robots*. Xi'an, China (virtual), May 2021. *recording:* https://www.youtube.com/watch?v=4EpH2fsXl88

[3] Whole Body Model Predictive Control Using Reduced-Order Models, *ACC 2021 Workshop: Fielding Legged Robotics off the Beaten Path*, Philadelphia, PA (virtual), May 2021.

[4] Unifying Whole-Body Model Predictive Control with Reduced-Order Control Designs, *IROS 2020 Workshop: Mini Cheetah Workshop*, Las Vegas, NV (virtual), October 2020.

[5] Spatial Vector Algorithms in the Identification and Control of Legged Robots, *IROS 2020 Tutorial: Review on Screw Theory and Geometric Robot Dynamics*, Las Vegas, NV (virtual), October 2020. *recording:* https://www.youtube.com/watch?v=PfTJy5SU7bg

[6] Identification and Control of Highly Dynamic Quadrupeds, *ICRA 2019 Workshop: Toward Online Optimal Control of Dynamic Robots*, Montreal, Canada. May 2019.

[7] Predictive Models For Managing Physical Interaction: From Dynamic Robots to Assistive Exoskeletons, *NSF M3X Workshop on the Dynamic Interaction Between Embodied Human and Machine Intelligence*, Point Reyes, Marshall, CA. August 2018.

[8] Predictive Models of Locomotion: From Dynamic Robots to Assistive Exoskeletons, *2018 Midwest Robotics Workshop*. Chicago, IL. June 2018.

[9] Structured Prediction for Sensorimotor Control, *Humanoids 2017 Workshop: Locomotion and Manipulation: Unifying Solutions Across Aerial and Terrestrial Regimes*. Birmingham, UK. November 2017.

[10] Online Planning and Control for the MIT Cheetah Robots, *ICRA 2017 Workshop: Robust Perception, Planning, and Control for Legged Robot Locomotion in Challenging Domains*. Singapore. May 2017.

[11] Leveraging Simple Models for Hyper-Dynamic Mobility, *Symposium on Adaptive Motion in Animals and Machines (AMAM 2015)*. Cambridge, Massachusetts. June 2015.

[12] Exploiting SLIP-Based Models to Maintain Dynamic Balance, *ICRA 2015 Workshop on Dynamic Locomotion and Balancing of Humanoids: State of the Art and Challenges*. Seattle, Washington. May 2015.

[13] Centroidal Momentum for Whole-Body Humanoid Control, *IROS 2014 Workshop on Whole-Body Control for Humanoids in the Real World*. Chicago, IL. Sept. 2014. (With Dr. David E. Orin)

Invited Lectures at Companies

[1] Toward a Next Generation Quadruped For Unstructured 3D Environments, *Rethink Robotics*. Boston, Massachusetts. May 2017.

Professional Membership and Service

Professional Membership

- Member, IEEE, IEEE Robotics and Automation Society (2009-present)
- Member, ASME (2018-present)

Professional Service

- Parliamentarian (AdCom Member, ex officio), IEEE Robotics and Automation Society (2022-Present)
- Co-Chair, IEEE Robotics and Automation Society Technical Committee on Model-Based Optimization for Robotics (2019-Present) ***Award:*** IEEE Robotics and Automation Society, Most Active Technical Committee Award 2022
- Conference Activities
  - Finance Co-Chair, Humanoids 2023
  - Workshops and Tutorials Chair, IROS 2023
  - Workshops and Tutorials Co-Chair, Humanoids 2022
- Associate Editor
  - International Journal of Robotics Research (2023-present)
  - IEEE Robotics and Automation Letters (2021-present)
  - IEEE Transactions on Robotics (2018-2021)
  - IEEE International Conference on Robotics and Automation (ICRA) (2019-2022)
  - IEEE/RSJ International Conference Intelligent Robots and Systems (IROS) (2019-2021)
- Workshop Co-Organizer
  - *MIT Mini Cheetah Workshop*, at IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020
  - *Toward Online Optimal Control of Dynamic Robots: From Algorithmic Advances to Field Applications*, at IEEE International Conference on Robotics and Automation (ICRA), 2019.
  - *Which Torque Controlled Actuator Do I need? - On Criteria, Metrics and Experiments for Design, Selection and Comparison*, at the IEEE International Conference on Robotics and Automation (ICRA), 2018.
  - *Locomotion and Manipulation: Unifying Solutions Across Aerial and Terrestrial Regimes*, at IEEE RAS International Conference on Humanoid Robots, 2017.

- Proposal Review: NASA NSTGRO Ad-Hoc Reviewer (2021), NSF ENG Panel Review (2017, 2018, 2019, 2021), NSF ENG Ad-Hoc Reviewer (2020)
- Journal and Conference Review: Average of 19 reviews per year. Service primarily dedicated to the following top journals and conferences: *IEEE Transactions on Robotics, International Journal of Robotics Research, IEEE Robotics and Automation Letters, IEEE Transactions on Neurorehabilitation & Engineering, IEEE International Conference on Robotics and Automation, IEEE/RSJ International Conference on Intelligent Robots and Systems, IEEE-RAS International Conference on Humanoid Robots*
- Conference Session Chair: Dynamic Walking 2021; IROS 2017, 2020; ICRA 2015, 2017, 2022
- Student Activities Co-Chair, IEEE Robotics and Automation Society (2012-2014)

External Graduate Examination Committee Service

- Qualifying Exam Reviewer, James Foster (IHMC), 2023
- Dissertation Reviewer and PhD Defense Committee, Juan Gamba (Italian Inst. of Tech. (IIT), Genova, Italy), 2022
- PhD Defense Committee, Roberto Shu (Carnegie Mellon, Pittsburgh, PA), 2022
- Dissertation Reviewer, Romeo Orsolino (Italian Inst. of Tech. (IIT), Genova, Italy), 2019
- PhD Defense Committee, Taeyoon Lee (Seoul National University, South Korea), 2018
- PhD Defense Committee, Dinesh Atchuthan (LAAS-CNRS, Toulouse, France), 2018
- PhD Defense Committee, Tomislav Horvat (EPFL, Lausanne, Switzerland), 2018
- MS Thesis Co-Advisor, Chiheb Boussema (EPFL, Lausanne, Switzerland), 2018

Community Outreach

- 2018-present - Bi-annual outreach presentations to DoD STARBASE programs
- 2018-2022 - Coordinator of the St. Joseph Valley MATHCOUNTS competition
- Local Media
  - Notre Dame Stories: *Mobile Assist: ROAM engineering lab developing powered prosthesis to aid natural movement* (link), 2022
  - WSBT 22 Local News: *Notre Dame engineers developing artificial intelligence for prosthetic limbs* (link), 2021
  - Notre Dame Observer Cover Article: *Notre Dame engineers research exoskeleton technology* (link), 2018
  - Notre Dame Alumni Association, Interview on Behind the Headlines, 2018
  - Notre Dame News, Featured Article: *Collaboration focuses on restoring dignity, mobility through robotics* (link), 2018

Courses Taught at the University of Notre Dame

AME 30315: Differential Equations, Vibrations, and Controls II (link)

Term	*Rating*	*Enrollment*
Spring 2023	5.0/5	74

AME 50551: Introduction to Robotics (link)

Term	*Rating*	*Enrollment*
Fall 2017	4.9/5	28
Fall 2018	5.0/5	35
Spring 2020	5.0/5	57
Spring 2021	5.0/5	36

AME 40623/60623: Analytical Dynamics (significant redesign, link)

Term	*Rating*	*Enrollment*
Fall 2019	5.0/5	37
Spring 2022	5.0/5	28

AME 60621: Optimization-Based Robotics (new course, link)

Term	*Rating*	*Enrollment*
Spring 2019	5.0/5	17
Fall 2021	5.0/5	12
Fall 2023		TBD