## Bibliography

- [1] Pieter Abbeel, Adam Coates, Morgan Quigley, and Andrew Y. Ng. An application of reinforcement learning to aerobatic helicopter flight. In *Proceedings of the Neural Information Processing Systems (NIPS '07)*, volume 19, December 2006.
- [2] Yeuhi Abe and Jovan Popovic. Interactive animation of dynamic manipulation. Technical report, MIT CSAIL, feb 2006.
- [3] R. McNeill Alexander. *Optima for Animals*. Princeton University Press, revised edition, 1996.
- [4] N.M. Amato and Y. Wu. A randomized roadmap method for path and manipulation planning. In *Proceedings of the IEEE International Conference on Robotics and Automation*, volume 1, pages 113 120. IEEE, 1996.
- [5] Araki, N.; Okada, M.; Konishi, Y.; Ishigaki, and H.;. Parameter identification and swing-up control of an acrobot system. *International Conference on International Technology*, 2005.
- [6] J.P.Y. Arnould, D.R. Briggs, J.P. Croxall, P.A. Prince, and A.G. Wood. The foraging behaviour and energetics of wandering albatrosses brooding chicks. *Antarctic Science*, 8(3):229–236, 1996.
- [7] H. Asada and J.E. Slotine. Robot analysis and control. pages 93–131, 1986.
- [8] CG Atkeson and Stefan Schaal. Learning tasks from a single demonstration. *IEEE International Conference on Robotics and Automation (ICRA)*, 2:1706–1712, 1997.
- [9] Christopher G. Atkeson and Juan Carlos Santamaria. A comparison of direct and model-based reinforcement learning. International Conference on Robotics and Automation, 1997.
- [10] D.N. Beal, F.S. Hover, M.S. Triantafyllou, J.C. Liao, and G. V. Lauder. Passive propulsion in vortex wakes. *Journal of Fluid Mechanics*, 549:385402, 2006.
- [11] Hamid Benbrahim and Judy A. Franklin. Biped dynamic walking using reinforcement learning. *Robotics and Autonomous Systems*, 22:283–302, 1997.
- [12] Berkemeier, M.D., Fearing, and R.S. Tracking fast inverted trajectories of the underactuated acrobot. *Robotics and Automation*, *IEEE Transactions on*, 15(4):740–750, Aug 1999.
- [13] Dimitri P. Bertsekas. *Dynamic Programming and Optimal Control*. Athena Scientific, 2nd edition, 2000.
- [14] Dimitri P. Bertsekas and John N. Tsitsiklis. *Neuro-Dynamic Programming*. Optimization and Neural Computation Series. Athena Scientific, October 1996.

- [15] Dimitri P. Bertsekas and John N. Tsitsiklis. *Introduction to Probability*. Unpublished class notes edition, 2000.
- [16] John T. Betts. Practical Methods for Optimal Control Using Nonlinear Programming. SIAM Advances in Design and Control. Society for Industrial and Applied Mathematics, 2001.
- [17] A. Bicchi. Hands for dextrous manipulation and robust grasping: a difficult road towards simplicity. *IEEE Transactions on Robotics and Automation*, 16(6):652–662, December 2000.
- [18] Antonio Bicchi. On the closure properties of robotic grasping. *International Journal of Robotics Research*, 14(4):319–334, 1995.
- [19] Alec Brooks and Paul MacCready. Development of a wing-flapping flying replica of the largest pterosaur. In *AIAA/SAE/ASME/ASEE 21st Joint Propulsion Conference*. AIAA, July 1985.
- [20] R. R. Burridge, A. A. Rizzi, and D. E. Koditschek. Sequential composition of dynamically dexterous robot behaviors. *International Journal of Robotics Research*, 18(6):534–555, June 1999.
- [21] Chi-Tsong Chen. *Linear System Theory and Design*. Oxford Series in Electrical and Computer Engineering. Oxford University Press, third edition, Sept 10 1998.
- [22] Stephen Childress. *Mechanics of swimming and flying*. Cambridge University Press, 1981.
- [23] Chung Choo Chung and John Hauser. Nonlinear control of a swinging pendulum. *Automatica*, 31(6):851–862, June 1995.
- [24] Michael J. Coleman. A Stability-Study of a Three-Dimensional Passive-Dynamic Model of Human Gait. PhD thesis, Cornell University, 1998.
- [25] Steven H. Collins, Andy Ruina, Russ Tedrake, and Martijn Wisse. Efficient bipedal robots based on passive-dynamic walkers. *Science*, 307:1082–1085, February 18 2005.
- [26] Steven H. Collins, Martijn Wisse, and Andy Ruina. A three-dimensional passive-dynamic walking robot with two legs and knees. *International Journal of Robotics Research*, 20(7):607–615, July 2001.
- [27] John Craig. *Introduction to Robotics: Mechanics and Control*. Addison Wesley, 2nd edition, January 1989.
- [28] Michael H. Dickinson, Fritz-Olaf Lehmann, and Sanjay P. Sane. Wing rotation and the aerodynamic basis of insect flight. *Science*, 284(5422):1954–60, June 1999.
- [29] Charles P. Ellington, Coen van den Berg, Alexander P. Willmott, and Adrian L. R. Thomas. Leading-edge vortices in insect flight. *Nature*, 384(19):626–630, December 1996.

- [30] Isabelle Fantoni and Rogelio Lozano. Non-linear Control for Underactuated Mechanical Systems. Communications and Control Engineering Series. Springer-Verlag, 2002.
- [31] Ila Rani Fiete. Learning and coding in biological neural networks. PhD thesis, 2003.
- [32] IR Fiete, RH Hahnloser, MS Fee, and HS Seung. Temporal sparseness of the premotor drive is important for rapid learning in a neural network model of birdsong. J Neurophysiol., 92(4):2274-82. Epub 2004 Apr 07., Oct 2004.
- [33] R.J. Full and D.E. Koditschek. Templates and anchors: neuromechanical hypotheses of legged locomotion on land. Journal of Experimental Biology, 202(23):3325–3332,
- [34] Hartmut Geyer. Simple models of legged locomotion based on compliant limb behavior. PhD thesis, University of Jena, 2005.
- [35] Herbert Goldstein. Classical Mechanics. Addison Wesley, 3rd edition, 2002.
- [36] A. Goswami. Postural stability of biped robots and the foot rotation indicator (FRI) point. International Journal of Robotics Research, 18(6), 1999.
- [37] Ambarish Goswami, Benoit Thuilot, and Bernard Espiau. Compass-like biped robot part I: Stability and bifurcation of passive gaits. Technical Report RR-2996, INRIA, October 1996.
- [38] Kenneth C. Hall and Steven A. Pigott. Power requirements for large-amplitude flapping flight. Journal of Aircraft, 35(3), May 1998.
- [39] Philip Holmes, Robert J. Full, Dan Koditschek, and John Guckenheimer. The dynamics of legged locomotion: Models, analyses, and challenges. Society for Industrial and Applied Mathematics (SIAM) Review, 48(2):207-304, 2006.
- [40] David Hsu, Robert Kindel, Jean-Claude Latombe, and Stephen Rock. Randomized kinodynamic motion planning with moving obstacles. The International Journal of Robotics Research, 21(3):233–255, 2002.
- [41] Vanessa Hsu. Passive dynamic walking with knees: A point-foot model. Master's thesis, Massachusetts Institute of Technology, February 2007.
- [42] David H. Jacobson and David Q. Mayne. Differential Dynamic Programming. American Elsevier Publishing Company, Inc., 1970.
- [43] L.E. Kavraki, P. Svestka, JC Latombe, and M.H. Overmars. Probabilistic roadmaps for path planning in high-dimensional configuration spaces. IEEE Transactions on Robotics and Automation, 12(4):566–580, August 1996.
- [44] Daniel E. Koditschek and Martin Buehler. Analysis of a simplified hopping robot. International Journal of Robotics Research, 10(6):587–605, Dec 1991.
- [45] N. Kohl and P. Stone. Machine learning for fast quadrupedal locomotion, July 2004.
- © Russ Tedrake, 2009

- [46] Nate Kohl and Peter Stone. Policy gradient reinforcement learning for fast quadrupedal locomotion. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, 2004.
- [47] V. R. Konda and J. N. Tsitsiklis. Actor-critic algorithms. *SIAM Journal on Control and Optimization*, 42(4):1143–1166, 2003.
- [48] Andrew L. Kun and W. Thomas Miller, III. Adaptive dynamic balance of a biped robot using neural networks. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 240–245, 1996.
- [49] Xu-Zhi Lai, Jin-Hua She, Simon X. Yang, and Min Wu. Stability analysis and control law design for acrobots. In *Proceedings of the 2006 IEEE International Conference on Robotics and Automation*, May 2006.
- [50] S. LaValle and J. Kuffner. Rapidly-exploring random trees: Progress and prospects. In *Proceedings of the Workshop on the Algorithmic Foundations of Robotics*, 2000.
- [51] Steven M. LaValle. Planning Algorithms. Cambridge University Press, 2006.
- [52] Steven M. LaValle, James J. Kuffner, and Jr. Randomized kinodynamic planning. *The International Journal of Robotics Research*, 20(5):378–400, 2001.
- [53] James C. Liao, David N. Beal, George V. Lauder, and Michael S. Triantafyllou. The Kármán gait: novel body kinematics of rainbow trout swimming in a vortex street. *Journal of Experimental Biology*, 206(6):1059–1073, 2003.
- [54] Arun D. Mahindrakar and Ravi N. Banavar. A swing-up of the acrobot based on a simple pendulum strategy. *International Journal of Control*, 78(6):424–429, April 2005.
- [55] Tad McGeer. Passive dynamic walking. *International Journal of Robotics Research*, 9(2):62–82, April 1990.
- [56] Thomas A. McMahon and George C. Cheng. The mechanics of running: How does stiffness couple w/ speed. *Journal of Biomechanics*, 23(Supplement 1):65–78, 1990.
- [57] W. Thomas Miller, III. Real-time neural network control of a biped walking robot. *IEEE Control Systems Magazine*, 14(1):41–48, Feb 1994.
- [58] Simon Mochon and Thomas A. McMahon. Ballistic walking. *Journal of Biomechanics*, 13:49–57, 1980.
- [59] Simon Mochon and Thomas A. McMahon. Ballistic walking: An improved model. *Mathematical Biosciences*, 52(3-4):241–260, December 1980.
- [60] Jun Morimoto and Kenji Doya. Reinforcement learning of dynamic motor sequence: Learning to stand up. pages 1721–1726. IEEE/RSJ International, 1998.
- [61] Richard M. Murray and John Hauser. A case study in approximate linearization: The acrobot example, April 1991.

- [62] Richard M. Murray, Zexiang Li, and S. Shankar Sastry. *A Mathematical Introduction to Robotic Manipulation*. CRC Press, Inc., 1994.
- [63] Eadweard Muybridge and Anita Ventura Mozley. *Muybridge's Complete Human and Animal Locomotion: All 781 Plates from the 1887 Animal Locomotion.* 3 Vols. Dover Publications, Incorporated, May 1979.
- [64] Andrew Y. Ng, H. Jin Kim, Michael I. Jordan, and Shankar Sastry. Autonomous helicopter flight via reinforcement learning. *Advances in Neural Information Processing Systems (NIPS)*, 16, 2003.
- [65] Katsuhiko Ogata. *Modern Control Engineering*. Prentice Hall Incorporated, 3rd edition, August 1996.
- [66] Barak Pearlmutter. Learning state space trajectories in recurrent neural networks. *Neural Computation*, 1:263–9, 1989.
- [67] William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery. *Numerical Recipes in C: The Art of Scientific Computing*. Cambridge University Press, second edition, 1992.
- [68] Marc H. Raibert. Legged Robots That Balance. The MIT Press, 1986.
- [69] Stefan Schaal and Chris Atkeson. Robot juggling: An implementation of memory-based learning. (14):57–71.
- [70] W Schultz. Getting formal with dopamine and reward. *Neuron.*, 36(2):241–63., Oct 10 2002.
- [71] H. Sebastian Seung, Daniel D. Lee, Ben Y. Reis, and David W. Tank. The autapse: a simple illustration of short-term analog memory storage by tuned synaptic feedback. *Journal of Computational Neuroscience*, 9:171–85, 2000.
- [72] Sebastian Seung. The REINFORCE algorithm. 2001.
- [73] Wei Shyy, Yongsheng Lian, Jian Teng, Dragos Viieru, and Hao Liu. Aerodynamics of Low Reynolds Number Flyers. Cambridge Aerospace Series. Cambridge University Press, 2008.
- [74] Athanasios Sideris and James E. Bobrow. A fast sequential linear quadratic algorithm for solving unconstrained nonlinear optimal control problems, February 2005.
- [75] Jean-Jacques E. Slotine and Weiping Li. *Applied Nonlinear Control*. Prentice Hall, October 1990.
- [76] M. W. Spong. Underactuated mechanical systems. In B. Siciliano and K. P. Valavanis, editors, *Control Problems in Robotics and Automation*, Lecture notes in control and information sciences 230. Springer-Verlag, 1997.
- [77] Mark Spong. The swingup control problem for the acrobot. *IEEE Control Systems Magazine*, 15(1):49–55, February 1995.

- [78] Mark W. Spong. Partial feedback linearization of underactuated mechanical systems. In *Proceedings of the IEEE International Conference on Intelligent Robots and Systems*, volume 1, pages 314–321, September 1994.
- [79] Mark W. Spong. Swing up control of the acrobot. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 2356–2361, 1994.
- [80] Mark W. Spong. Energy based control of a class of underactuated mechanical systems. In *Proceedings of the 1996 IFAC World Congress*, 1996.
- [81] Mark W. Spong and Gagandeep Bhatia. Further results on control of the compass gait biped. In *Proc. IEEE International Conference on Intelligent Robots and Systems (IROS)*, pages 1933–1938, 2003.
- [82] Gilbert Strang. *Introduction to Linear Algebra*. Wellesley-Cambridge Press, 2nd edition, October 1998.
- [83] Steven H. Strogatz. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering. Perseus Books, 1994.
- [84] Richard S. Sutton and Andrew G. Barto. *Reinforcement Learning: An Introduction*. MIT Press, 1998.
- [85] Stephen T. Thornton and Jerry B. Marion. *Classical Dynamics of Particles and Systems*. Brooks Cole, 5th edition, 2003.
- [86] Xiaodong Tian, Jose Iriarte-Diaz, Kevin Middleton, Ricardo Galvao, Emily Israeli, Abigail Roemer, Allyce Sullivan, Arnold Song, Sharon Swartz, and Kenneth Breuer. Direct measurements of the kinematics and dynamics of bat flight. *Bioinspiration & Biomimetics*, 1:S10–S18, 2006.
- [87] Michael S. Triantafyllou and George S. Triantafyllou. An efficient swimming machine. *Scientific American*, 272(3):64, March 1995.
- [88] John Tsitsiklis and Ben Van Roy. An analysis of temporal-difference learning with function approximation. *IEEE Transactions on Automatic Control*, 42(5):674–690, May 1997.
- [89] Vance A. Tucker. Gliding flight: Speed and acceleration of ideal falcons during diving and pull out. *Journal of Experimental Biology*, 201:403–414, Nov 1998.
- [90] Eric D. Tytell and George V. Lauder. Hydrodynamics of the escape response in bluegill sunfish, lepomis macrochirus. *The Journal of Experimental Biology*, 211:3359–3369, 2008.
- [91] Nicolas Vandenberghe, Stephen Childress, and Jun Zhang. On unidirectional flight of a free flapping wing. *Physics of Fluids*, 18, 2006.
- [92] Nicolas Vandenberghe, Jun Zhang, and Stephen Childress. Symmetry breaking leads to forward flapping flight. *Journal of Fluid Mechanics*, 506:147–155, 2004.
- [93] R.J. Williams. Simple statistical gradient-following algorithms for connectionist reinforcement learning. *Machine Learning*, 8:229–256, 1992.

- [94] Xin Xin and M. Kaneda. New analytical results of the energy based swinging up control of the acrobot. In *Proceedings of the 43rd IEEE Conference on Decision and Control (CDC)*, volume 1, pages 704 709. IEEE, Dec 2004.
- [95] Jun Zhang, Stephen Childress, Albert Libchaber, and Michael Shelley. Flexible filaments in a flowing soap film as a model for one-dimensional flags in a two-dimensional wind. *Nature*, 408(6814):835–838, December 2000.
- [96] Kemin Zhou and John C. Doyle. Essentials of Robust Control. Prentice Hall, 1997.

MIT OpenCourseWare http://ocw.mit.edu

6.832 Underactuated Robotics Spring 2009

For information about citing these materials or our Terms of Use, visit: http://ocw.mit.edu/terms.