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Patents Issued

1. Systems and Methods for Controlling a Legged Robot Based on Rate of Change of Angular Momentum
Ambarish Goswami and Vinutha Kallem
US Patent No. 78,060,253, Issued November 15, 2011
2. Determination of Foot Placement for Humanoid Push Recovery
Jerry Pratt, **Ambarish Goswami**
US Patent No. 7,949,430, Issued May 24, 2011
3. Systems and methods for controlling a legged robot using a two-phase disturbance response strategy
Ambarish Goswami and Muhammad E. Abdallah
US Patent No. 7,835,822, Issued November 16, 2010
4. Controller for an assistive exoskeleton based on active impedance
Gabriel Aguirre-Ollinger, **Ambarish Goswami**, J. Edward Colgate, Michael A. Peshkin
US Patent No. 7,731,670, Issued June 8, 2010
5. Characterization and classification of pose in low dimension
Ambarish Goswami
US Patent No. 7,580,774, Issued August 25, 2009
6. Kinematic quantification of gait asymmetry based on bilateral cyclograms
Ambarish Goswami
US Patent No. 7,503,900, Issued March 17, 2009

Patents Filed

1. Machine Learning Approach for Predicting Humanoid Robot Fall
Ambarish Goswami and Shivaram Kalyanakrishnan
Filed January 29, 2010
2. Humanoid Fall Direction Change Among Multiple Objects
Ambarish Goswami, Yoshiaki Sakagami and Umashankar Nagarajan
Filed December 17, 2009
3. Inertia Shaping For Humanoid Fall Direction Change
Ambarish Goswami, Seung-kook Yun, Yoshiaki Sakagami and Kangkang Yin
Filed November 2, 2009
4. Intelligent Stepping For Humanoid Fall Direction Change
Ambarish Goswami, Seung-kook Yun and Yoshiaki Sakagami
Filed November 2, 2009
5. Learning Capture Points for Humanoid Push Recovery
Jerry Pratt, **Ambarish Goswami**, John Rebula and Fabian Canas
Filed November 18, 2008

Scientific Publications

Notes: Most of these articles can be downloaded from <http://www.ambarish.com>. All Google Scholar citations (only >20 are indicated here) are from January, 2012.

Journal Articles

1. S.-H Lee and **A. Goswami**
Fall on Backpack: Damage Minimizing Humanoid Fall on Targeted Body Segment Using Momentum Control
Journal of Computational and Nonlinear Dynamics. (Conditionally Accepted).
2. G. Aguirre-Ollinger, J. E. Colgate, M. A. Peshkin, and **A. Goswami**
Inertia Compensation Control of a One-Degree-of-Freedom Exoskeleton for Lower-Limb Assistance: Initial Experiments
IEEE Transactions on Neural Systems & Rehabilitation Engineering Accepted (expected pub., March 2012).
3. S. Kalyanakrishnan and **A. Goswami**
Learning to Predict Humanoid Fall
The International Journal of Humanoid Robotics Vol. 8, No. 2, June 2011.
4. G. Aguirre-Ollinger, J. E. Colgate, M. A. Peshkin, and **A. Goswami**
Design of an Active 1-DOF Lower-Limb Exoskeleton with Inertia Compensation
The International Journal of Robotics Research Vol. 30, No. 4, April 2011.
5. G. Aguirre-Ollinger, J. E. Colgate, M. A. Peshkin, and **A. Goswami**
A 1-DOF Assistive Exoskeleton with Inertia Compensation: Effects on the Agility of Leg Swing Motion
Proceedings of the Institution of Mechanical Engineers, Part H, Journal of Engineering in Medicine Vol. 225, No. 3, 2011.
6. R. C. Browning, J. R. Modica, R. Kram and **A. Goswami**
The effects of adding mass to the legs on the energetics and biomechanics of walking
Medicine and Science in Sports and Exercise, March, 2007.
Google Scholar citation: **56**
7. M. B. Popovic, **A. Goswami**, and H. Herr
Ground Reference Points in Legged Locomotion: Definitions, Biological Trajectories and Control Implications
International Journal of Robotics Research Vol. 24, No. 12, 2005.
Google Scholar citation: **91**
8. S. Goldenstein, M. Karavelas, D. Metaxas, L. Guibas, E. Aaron, and **A. Goswami**
Scalable Nonlinear Dynamical Systems for Agent Steering and Crowd Simulation
Computer and Graphics Vol. 25, No. 6, 2001.
Google Scholar citation: **50**
9. D. Tolani, **A. Goswami** and N. I. Badler
Real-Time Inverse Kinematics Techniques for Anthropomorphic Limbs
Graphical Models Vol. 62, No. 5, 2000.
Google Scholar citation: **390**

10. N. I. Badler, D. N. Metaxas, G. Huang, **A. Goswami** and S. Huh
Dynamic Simulation for Zero-Gravity Activities
Aviation, Space, and Environment Medicine Journal, 2000.
11. **A. Goswami** and M. A. Peshkin
Mechanically implementable accommodation matrices for passive force control
International Journal of Robotics Research Vol. 18, No. 8 (August), 1999.
12. **A. Goswami**
Postural stability of biped robots and the foot rotation indicator (FRI) point
International Journal of Robotics Research Vol. 18, No. 6 (June) 1999.
Google Scholar citation: **335**
13. **A. Goswami**, B. Thuilot, and B. Espiau
A study of the passive gait of a compass-like biped robot: symmetry and chaos
International Journal of Robotics Research Vol. 17, No. 12 (December) 1998.
Google Scholar citation: **264**
14. **A. Goswami**
A new gait parameterization technique by means of cyclogram moments:
Application to human slope walking
Gait & Posture, Vol. 8, No. 1 (August), 1998.
Google Scholar citation: **52**
15. **A. Goswami**, B. Espiau, and A. Keramane
Limit cycles in a passive compass gait biped and passivity-mimicking control laws
Journal of Autonomous Robots, Vol. 4, No. 3, 1997.
Google Scholar citation: **226**
16. T. C. Kienzle III, S. D. Stulberg, M. A. Peshkin, A. Quaid, J. Lea, **A. Goswami**, and C-H Wu
Total Knee Replacement
IEEE Engineering in Medicine and Biology, May/June, 1995.
Google Scholar citation: **42**
17. **A. Goswami** and J. R. Bosnik
On a relationship between the physical features of robotic manipulators and the kinematic parameters
produced by numerical calibration
ASME Journal of Mechanical Design, December 1993.
18. **A. Goswami**, A. Quaid, and M. A. Peshkin
Identifying robot parameters using partial pose information
IEEE Control Systems (**invited article**), October 1993.
Google Scholar citation: **22**

Book Sections and Reports

1. S-H. Lee and **A. Goswami**
The reaction mass pendulum (RMP) model for humanoid robot gait and balance control
Humanoid Robots (Editor: Ben Choi)
In-Tech, Austria, February 2009.
2. **A. Goswami** and E. Cordier
Moment-based parameterization of evolving cyclograms on gradually changing slopes
Computer Methods in Biomechanics & Biomedical Engineering - v.2
Middleton J., Jones M.L. and Pande G.N. Eds.
Gordon and Breach Science Publishers 1998.
3. **A. Goswami**, B. Thuilot, and B. Espiau
Compass-like biped robot Part I: Stability and bifurcation of passive gaits
INRIA Research Report No. 2996, October 1996.
Google Scholar citation (October 1, 2010): **176**
4. T. C. Kienzle III, S. D. Stulberg, M. A. Peshkin, A. Quaid, J. Lea, **A. Goswami**, and C-H Wu
A computer-assisted total knee replacement surgical system using a calibrated robot
Computer Assisted Surgery, Ed. R. H. Taylor et al. MIT Press. 1995.
Google Scholar citation: **41**

Refereed Conference Proceedings

1. S.-K. Yun and **A. Goswami**
Humanoid Robot Safe Fall Experiments using Aldebaran NAO
International Conference on Robotics and Automation (ICRA), 2012
(Accepted)
2. A. K. Sanyal and **A. Goswami**
Dynamics and Control of the Reaction Mass Pendulum (RMP) as a 3D Multibody System:
Application to Humanoid Modeling
2011 ASME Dynamic Systems and Control Conference (DSCC)
Arlington, VA, October 2011.
3. S.-K. Yun and **A. Goswami**
Momentum-Based Reactive Stepping Controller on Level and Non-level Ground for Humanoid Robot
Push Recovery
IROS 2011, San Francisco, California, September 2011.
4. S.-H. Lee and **A. Goswami**
Fall on Backpack: Damage Minimizing Humanoid Fall on Targeted Body Segment Using Momentum
Control
ASME 2011 International Design Engineering Technical Conferences (IDETC)
Washington D.C., August 2011.
5. S.-H. Lee and **A. Goswami**
Ground reaction force control at each foot: A momentum-based humanoid balance controller for non-
level
and non-stationary ground
IROS 2010, Taipei, Taiwan, October 2010.
6. A. Dutta and **A. Goswami**
Human postural model that captures rotational inertia
*The 33rd Annual Meeting of the American Society of Biomechanics , ASB 2010, Providence, Rhode
Island, USA, August, 2010.*
7. S. Kalyanakrishnan and **A. Goswami**
Predicting falls of a humanoid robot through machine learning
Innovative Applications of Artificial Intelligence, IAAI-10, Atlanta, Georgia, USA, July, 2010.
8. U. Nagarajan and **A. Goswami**
Generalized Direction Changing Fall Control of Humanoid Robots Among Multiple Objects
ICRA 2010, Anchorage, Alaska, USA, May 2010.
9. S.-K. Yun, **A. Goswami** and Y. Sakagami
Safe Fall: Humanoid robot fall direction change through intelligent stepping and inertia shaping
ICRA 2009, Kobe, Japan, May 2009.
10. S. Stramigioli, V. Duindam, G. van Oort and **A. Goswami**
Compact Analysis of 3D Bipedal Gait Using Geometric Dynamics of Simplified Models
ICRA 2009, Kobe, Japan, May 2009.
11. **A. Goswami**
Kinematic and dynamic analogies between planar biped robots and the reaction mass pendulum (RMP)
model
Humanoids 2008, Daejeon, Korea, December 2008.

12. D. Orin and **A. Goswami**
Centroidal Momentum Matrix of a Humanoid Robot: Structure and Properties
IROS 2008, Nice, France, September 2008.
13. J. Rebula, J. Pratt and **A. Goswami**
Learning Capture Point for Improved Humanoid Push Recovery
Humanoids07, Pittsburgh, PA, U.S.A., November 2007.
Google Scholar citation: **22**
14. G. Aguirre-Ollinger, J. E. Colgate, M. A. Peshkin, and **A. Goswami**
A 1-DOF Assistive Exoskeleton with Virtual Negative Damping: Effects on the Kinematic Response of the Lower Limbs
IROS 2007, San Diego, CA, U.S.A., 2007.
15. G. Aguirre-Ollinger, J. E. Colgate, M. A. Peshkin, and **A. Goswami**
Active impedance control of a lower-limb assistive exoskeleton
10th Int. Conf. on Rehabilitation Robotics (ICORR'07), Noordwijk, the Netherlands, Jun 13-15 2007, 2007.
16. S-H. Lee and **A. Goswami**
Reaction Mass Pendulum (RMP): An explicit model for centroidal angular momentum of humanoid robots,
IEEE Int. Conf. on Robotics and Automation, Rome, Italy, April 2007.
17. J. Pratt, J. Carff, S. Drakunov and **A. Goswami**
Capture Point: A Step toward Humanoid Push Recovery
Humanoids06, Genoa, Italy, December 2006.
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18. M. Abdallah and **A. Goswami**
A biomechanically motivated two-phase strategy for biped upright balance control
IEEE Int. Conf. on Robotics and Automation, Barcelona, Spain, April 2005.
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19. R. C. Browning, J. Modica, R. Kram and **A. Goswami**
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20. **A. Goswami** and V. Kalleem
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21. **A. Goswami**
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22. S. Goldenstein, M. Kavelas, D. Metaxas, L. Guibas, and **A. Goswami**
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23. H. Sun, **A. Goswami** and D. Metaxas
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Calgary, Canada, August 1999.

24. **A. Goswami**
Foot rotation indicator (FRI) point: A new gait planning tool to evaluate postural stability of biped robots
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25. L. Roussel, C. Canudas de Wit, and **A. Goswami**
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IEEE Int. Conf. on Robotics and Automation, Leuven, Belgium, May 1998.
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26. M. Mata-Jimenez, B. Brogliato, and **A. Goswami**
On the control of mechanical systems with dynamic backlash
CDC Conf., San Diego, CA, December 1997.
27. M. Mata-Jimenez, B. Brogliato, and **A. Goswami**
Analysis of PD control of mechanical systems with dynamic backlash
2nd Int. Symp. MV2 on Active Control in Mechanical Engineering, Lyon, France, October 1997.
28. C. Canudas de Wit, L. Roussel, and **A. Goswami**
Periodic stabilization of a 1-dof hopping robot over nonlinear compliant surface
IFAC Symp. on Robot Control (SyRoCo), Nantes, France, September 1997.
29. **A. Goswami** and E. Cordier
Moment-based parameterization of cyclograms of slope-walking
XVIIth Congress of the Int. Society of Biomechanics, Tokyo, Japan, August 1997
(**finalist for the Best Young Investigator award**).
30. B. Espiau and the BIP team
BIP: A joint project for the development of an anthropomorphic biped robot
8th Int. Conf. on Advanced Robotics (ICAR), Monterey, CA, July 1997.
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Comparative study of methods for energy-optimal gait generation for biped robots
Int. Conf. on Informatics and Control, St. Petersburg, Russia, June 1997.
32. E. Cordier, **A. Goswami**, and M. Bourlier
Kinematic parameterization of natural slope walking
13th Int. Symp. on "Posture and Gait", Paris, France, June 1997.
33. **A. Goswami** and E. Cordier
Moment-based parameterization of evolving cyclograms on gradually changing slopes
3rd Int. Symp. on Computer Methods in Biomechanics & Biomedical Engr, Barcelona, May, 1997.
34. B. Thuilot, **A. Goswami**, and B. Espiau
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35. K. Kedzior, A. Morecki, M. Wojtyra, T. Zagrajek, T. Zielinska, **A. Goswami**, M. Waldron, and K. Waldron
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ROMANSY, Udine, Italy, July 1996.
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37. **A. Goswami**, J. T. Lea, A. Quaid, M. A. Peshkin, T. C. Kienzle III, and S. D. Stulberg
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First Medical Robotics and Computer Assisted Surgery (MRACS) Symposium, Pittsburgh, PA, 1994.
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39. M. A. Peshkin, **A. Goswami**, and J. M. Schimmels
Force-guided assembly
31st Annual Allerton Conf. on Communication, Control, and Computing,
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40. **A. Goswami** and M. A. Peshkin
Task-space/joint-space damping transformations for passive redundant manipulators
IEEE Int. Conf. on Robotics and Automation (invited session), Atlanta, GA, April 1993.
41. **A. Goswami** and M. A. Peshkin
Mechanical computation for passive force control
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42. **A. Goswami**, A. Quaid, and M. A. Peshkin
Complete parameter identification of a robot using partial pose information (**20**)
IEEE Int. Conf. on Robotics and Automation, Atlanta, GA, April 1993.
Google Scholar citation: **33**
43. **A. Goswami**, A. Quaid, and M. A. Peshkin
Calibration and parameter identification of a 6-DOF robot using a ball-bar system
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44. **A. Goswami** and M. A. Peshkin
Implementation of passive force control with redundant manipulators
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A task-space formulation of passive force control
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46. **A. Goswami**, M. A. Peshkin, and J. E. Colgate
Passive robotics: An exploration of mechanical computation
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47. **A. Goswami** and J. R. Bosnik
Interpretation of redundant kinematic parameters in robotic manipulator calibration algorithms
ASME Biennial Mechanisms Conference, Orlando, FL, September 1988.