

JI-CHUL RYU

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RESEARCH INTERESTS

Dynamic Nonprehensile Robotic Manipulation, Integrated Planning and Control of Autonomous Mobile Robots and Mobile Manipulators, Intelligent Assistive Technologies with Mobile Robot Systems, Nonlinear Dynamic Systems Modeling and Control.

EDUCATION

- Ph.D.**, Mechanical Engineering August 2009
University of Delaware, Newark, DE
Advisor: Dr. Sunil K. Agrawal
Dissertation: *Integrated Planning and Control of Mobile Manipulators and Robots Using Differential Flatness*
- M.S.**, Mechanical Engineering February 1999
Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea
Advisor: Dr. Young-Ho Cho
Thesis: *Electromagnetic Microactuator with the Electroplated Planar Coils Driven by Radial Magnetic Field*
- B.S.**, Mechanical Engineering with Honors February 1997
KAIST, Daejeon, South Korea

RESEARCH & PROFESSIONAL EXPERIENCE

- Northwestern University**, Evanston, IL September 2010 – Present
Postdoctoral fellow – Laboratory for Intelligent Mechanical Systems
- Conduct research projects on dynamic nonprehensile robotic manipulation using manipulation primitives such as rolling, sliding, catching or throwing in the area of planning and control.
- University of Delaware**, Newark, DE November 2009 – August 2010
Supplemental Professional – Mechanical Systems Laboratory
- Conducted research on the control of inverted pendulum-type multi-link mobile manipulator.
 - Conducted research on data mining to do a quantitative evaluation of the progression of cognitive learning in the “baby robot” project.
- University of Delaware**, Newark, DE June 2005 – August 2009
Research Assistant – Mechanical Systems Laboratory
- Conducted research on planning and control of various autonomous mobile robots and mobile manipulators. This involved kinematic/dynamic modelings, simulations in MATLAB/SIMULINK, and software algorithm implementations (using C/C++ under Linux) on IRobot’s camera-equipped *Magellan Pro* robots and other various robotic vehicles.
 - Developed planning and control algorithms for the NIST (National Institute of Standards and Technology)’s mobility-assist and lift robotic system named HLPR Chair.
 - Conducted research on assistive technologies with mobile robots including an assistive manipulator, a mobility assistive robot, and “baby robot.”
 - In the “baby robot” project, we provide very young infants (as young as 5-6 months) or special needs babies with mobility generated by a mobile robot to help them improve cognitive development as well as physical development. The “baby robot” project has been featured in several newspapers and media video reports

including Discovery Channel, ABC, Comcast, The Washington Post, and The Associated Press.
(http://mechsys4.me.udel.edu/research/baby_robot/)

Samsung Electronics, Suwon, South Korea June 2002 – May 2004

Research Engineer - Institute of Intelligent System, Mechatronics Center

- Developed operating software programs with GUI (Graphical User Interface) for automatic machines using Microsoft Visual C++ on Windows OS.
- Developed motion control interface libraries and programs in C/C++ for X-Y cartesian robot using PMAC & MEI motion controllers.
- Used a software architecture design method using UML.

MeccaTechs (now called **UBprecision**), Yongin, South Korea

April 2000 – May 2002

Research Engineer - Research Center

- Developed software programs for automatic machines, based on Real Time OS (VRTX) in VME environment.
- Developed motion control interface libraries and programs in C/C++ for X-Y cartesian robot using PMAC motion controller.

Daewoo Heavy Industries (now called **Doosan Infracore**), Changwon, South Korea March 1999 – March 2000

Assistant Research Engineer - Factory Automation System Engineering Center

- Designed a special purpose machine using AutoCAD for truck engine manufacturing.

Korea Advanced Institute of Science and Technology (KAIST)

March 1997 – February 1999

Research Assistant – Microsystems Laboratory (now called NanoSensuating Systems Laboratory)

- Designed, fabricated, and tested an electromagnetic microactuator using MEMS technology in Biochip Technology Research.

TEACHING EXPERIENCE

Teaching Assistant (MEEG304 – Machine Design: Elements), University of Delaware Spring 2005

- Graded quizzes & homework and held office hours.

Teaching Assistant (MEEG311 – Vibration and Control), University of Delaware Fall 2004

- Supervised lab experiments, graded lab reports & homework, and held office hours.
- Constructed and maintained the course's webpage.

PUBLICATIONS

REFEREED JOURNAL PAPERS

1. J. Gomez, **J.-C. Ryu**, S. Alonso, and S. K. Agrawal, "Development and Validation of Globally Asymptotically Stable Control Laws for Automatic Tractor Guidance," *Applied Engineering in Agriculture*, in print.
2. **J.-C. Ryu** and S. K. Agrawal, "Differential Flatness-based Robust Control of Mobile Robots in the Presence of Slip," *The International Journal of Robotics Research*, Vol. 30, No. 4, pp. 463-475, 2011.
3. C. P. Tang, P. T. Miller, V. N. Krovi, **J.-C. Ryu** and S. K. Agrawal, "Differential Flatness-based Planning and Control of a Wheeled Mobile Manipulator – Theory and Experiment", *IEEE/ASME Transactions on Mechatronics*, Vol. 16, No. 4, pp. 768-773, 2011.
4. **J.-C. Ryu** and S. K. Agrawal, "Planning and Control of Under-actuated Mobile Manipulators Using Differential Flatness," *Autonomous Robots*, Vol. 29, No. 1, pp. 35-52, 2010.
5. **J.-C. Ryu**, V. Sangwan, and S. K. Agrawal, "Differentially Flat Designs of Under-Actuated Mobile Manipulators," *ASME Transactions, Journal of Dynamic Systems, Measurement, and Control*, Vol. 132, No. 2, 024502, 2010.
6. R. Bostelman, **J.-C. Ryu**, T. Chang, J. Johnson, and S. K. Agrawal, "An Advanced Patient Lift and Transfer Device for the Home," *ASME Transactions, Journal of Medical Devices*, Vol. 4, No. 1, 011004, 2010.

7. A. Lynch, **J.-C. Ryu**, S. K. Agrawal, and J. C. Galloway, "Power mobility training for a 7-month-old infant with spina bifida," *Pediatric Physical Therapy*, Vol. 21, No. 4, pp. 362-368, 2009.
8. **J.-C. Ryu**, S. K. Agrawal and J. Franch, "Motion Planning and Control of a Tractor with a Steerable Trailer Using Differential Flatness," *ASME Transactions, Journal of Computational and Nonlinear Dynamics*, Vol. 3, No. 3, 031003, 2008.
9. **J.-C. Ryu**, K. Pathak, and S. K. Agrawal, "Control of a Passive Mobility Assistive Robot," *ASME Transactions, Journal of Medical Devices*, Vol. 2, No. 1, 011002, 2008.
10. J. C. Galloway, **J.-C. Ryu**, S. K. Agrawal, "Babies driving robots: Self-generated mobility in very young infants," *Journal of Intelligent Service Robotics*, Vol. 1, No. 2, pp. 123-134, 2008.
11. S. K. Agrawal and **J.-C. Ryu**, "Design of Dissipative and Stable Assist Robots," *ASME Transactions, Journal of Mechanical Design*, Vol. 129, No. 12, pp. 1251-1255, 2007.
12. S.-R. Oh, **J.-C. Ryu**, and Sunil K. Agrawal, "Dynamics and Control of Helicopters with a Six-Cables Suspended Robot," *ASME Transactions, Journal of Mechanical Design*, Vol. 128, No. 5, pp. 1113-1121, 2006.
13. **J.-C. Ryu**, T. Kang, and Y.-H. Cho, "Electromagnetic Microactuators with the Electroplated Planar Coils Driven by Radial Magnetic Field," *Journal (A) of the Korean Society of Mechanical Engineers*, Vol. 25, No 1, pp. 16-24, 2001.

REFEREED CONFERENCE PAPERS

1. **J.-C. Ryu** and S. K. Agrawal, "Differentially Flat Mobile Manipulators Mounted with an Under-actuated Vertical Arm," *Proc. IEEE International Conference on Robotics and Automation (ICRA)*, pp. 5201-5206, 2010.
 2. **J.-C. Ryu** and S. K. Agrawal, "Differential Flatness-based Robust Control of a Two-wheeled Mobile Robot in the Presence of Slip," *Proc. ASME Dynamic Systems and Control Conference (DSCC)*, DSCC2008-2228, 2008.
 3. C. P. Tang, P. Miller, V. N. Krovi, **J.-C. Ryu**, and S. K. Agrawal, "Kinematic Control of a Nonholonomic Wheeled Mobile Manipulator with a Differential Flatness Approach," *Proc. ASME Dynamic Systems and Control Conference (DSCC)*, DSCC2008-2253, 2008.
 4. **J.-C. Ryu**, V. Sangwan, and S. K. Agrawal, "Differentially Flat Designs of Mobile Vehicles with Under-actuated Manipulator Arms," *Proc. ASME International Mechanical Engineering Congress and Exposition (IMECE)*, IMECE2007-43526, 2007.
 5. **J.-C. Ryu**, S. K. Agrawal, and J. Franch, "Motion Planning and Control of a Tractor with a Steerable Trailer Using Differential Flatness," *Proc. ASME International Design Engineering Technical Conference (IDETC)*, DETC2007-35288, 2007.
- Received the MSC Simulation Software Award.**
6. R. Bostelman, J. Albus, T. Chang, T. Hong, S. K. Agrawal and **J.-C. Ryu**, "DynaHLPR Chair: A Novel Indoor Mobility-Assist and Lift System," *Proc. ASME International Design Engineering Technical Conference (IDETC)*, DETC2007-35295, 2007.
 7. **J.-C. Ryu**, K. Pathak, and S. K. Agrawal, "Control of a Passive Mobility Assistive Robot," *Proc. ASME International Mechanical Engineering Congress and Exposition (IMECE)*, IMECE2006-14701, 2006.
 8. S. K. Agrawal and **J.-C. Ryu**, "Design of Dissipative and Stable Assist Robots," *Proc. ASME International Design Engineering Technical Conference (IDETC)*, DETC06-99734, 2006.
 9. S.-R. Oh, **J.-C. Ryu**, S. K. Agrawal, "Dynamics and Control of Helicopters with a Six-Cables Suspended Robot," *Proc. ASME International Design Engineering Technical Conference (IDETC)*, DETC2005-85131, 2005.
 10. **J.-C. Ryu**, T. Kang, and Y.-H. Cho, "A New Transverse Electromagnetic Microactuator using the Radial Magnetic Field Guided by Symmetric Twin Magnets," *Proc. ASME International Mechanical Engineering Congress and Exposition (IMECE)*, pp.105-109, 1999.
 11. **J.-C. Ryu**, T. Kang, and Y.-H. Cho, "Electromagnetic Microactuators with the Electroplated Planar Coils Driven by Radial Magnetic Field," *Proc. The 1st Korean MEMS Conference*, pp.29-36, 1999.

(Under Review)

12. **J.-C. Ryu**, F. Ruggiero, and K. M. Lynch, "Control of Nonprehensile Rolling Manipulation: Balancing a Disk on a Disk," submitted to *IEEE International Conference on Robotics and Automation (ICRA)*, 2012.

OTHER PRESENTATIONS AND POSTERS

1. A. Lynch, **J.-C. Ryu**, S. K. Agrawal, and J. C. Galloway, "Power Mobility Training for a 7-month-old Infant with Spina Bifida," *Poster at the PT 2009: Annual Conference & Exhibition of the American Physical Therapy Association (APTA)*, 2009.
2. X. Chen, A. Lynch, **J.-C. Ryu**, S. K. Agrawal, and J. C. Galloway, "Effect of Force Field Joystick to Enhance Early Mobility in Infants," *Poster at the 5th Annual Center for Biomedical Engineering Research Day*, University of Delaware, 2008.
3. J. Katupitiya (Presenter), R. Eaton, **J.-C. Ryu**, and S. K. Agrawal, "A streamlined Approach to Future Autonomous Farming," *In the Half-Day Workshop on Towards Autonomous Agriculture of Tomorrow at the IEEE International Conference on Robotics and Automation (ICRA)*, 2008.
4. J. C. Galloway, **J.-C. Ryu (Presenter)**, and S. K. Agrawal, "First Generation of Mobility Devices in Special Needs Infants," *Presentation at the 4th Annual Center for Biomedical Engineering Research Day*, University of Delaware, 2007.
5. **J.-C. Ryu** and S. K. Agrawal (Presenter), "Differential Flatness Based Planning and Control of Classes of Mobile Vehicles," *In the Full-Day Workshop on Collision-free Motion Planning for Dynamic Systems at the IEEE International Conference on Robotics and Automation (ICRA)*, 2007.

AWARDS & HONORS

ASME-DSCD Student Travel Awards	
– 2008 ASME Dynamic Systems and Control Conference (DSCC), Ann Arbor, MI	October 2008
– 2007 ASME International Mech. Eng. Congress and Exposition (IMECE), Seattle, WA	November 2007
– 2006 ASME International Mech. Eng. Congress and Exposition (IMECE), Chicago, IL	November 2006
MSC Simulation Software Award	September 2007
– 2007 ASME International Design Engineering Technical Conference (IDETC)	
Research Assistant Scholarships (Full tuition waiver + stipend) – U. of Delaware	June 2005 – August 2009
Teaching Assistant Scholarships (Full tuition waiver + stipend) – U. of Delaware	Fall 2004 – Spring 2005
Excellent Attitude Award – Chair of the Department of ME, KAIST	April 1997
<i>Cum Laude</i> Honors – B.S degree, KAIST	February 1997
Merit-based scholarships (5 out of 7 eligible semesters) – KAIST	March 1993 – February 1997

PATENTS

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- Intelligent Powered Mobility for Infants and Special Needs Children (filed in 2008, Application No. 12/245169)

SKILLS

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- Programming Languages: C/C++, Microsoft Visual C++
 - O/S: MS-Windows programming, Linux programming, Real-Time OS (VRTX, QNX)
 - Simulation and Math Tools: Matlab/Simulink, Maple
 - Simulation/Control Tools for Robotics Applications: Player/Stage
 - Vision & Image Processing Libraries: ARToolKit, OpenCV
 - Object-Oriented Analysis: Rational Rose, UML,
 - Mechanical Design Tools: AutoCAD, Pro/E
 - Motion Controllers and CPU Boards: PMAC, MEI, Motorola MVME162 CPU board

TECHNICAL REVIEWS

Journals

1. IEEE Transactions on Robotics
2. ASME Transactions, Journal of Dynamic Systems, Measurement and Control
3. Advances in Human-Computer Interaction
4. International Journal of Systems Science

Conferences

4. IEEE International Conference on Robotics and Automation (ICRA)
5. ASME International Mechanical Engineering Congress and Exposition (IMECE)
6. ASME International Design Engineering Technical Conference (IDETC)

MEMBERSHIP & ACTIVITIES

Member of IEEE, affiliated with Robotics and Automation Society (RAS)	2005 – present
Member of ASME, affiliated with Dynamic Systems & Control Division (DSCD)	2005 – present

Updated as of 11/16/2011