

KEEHOON KIM

Ph.D.
Principal Research Scientist
Center for Robotics Research
Korea Institute of Science and Technology
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Research Interests

- Robotics
 - Bio-Medical Robotics (Bionics, Rehabilitation, Surgical Robots)
 - Power Assistant Robotics
 - Haptics & Teleoperation
 - Design of Haptic Devices & Medical Instruments
- System & Control Theory
 - Kinematics (Parallel Mechanism)
 - Advanced Control Theory (H-infinity, mu-synthesis)

Education

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|--------------|--------------------------|---|
| B.S. | Mar. 1996 – Aug. 1999 | - Pohang University of Science and Technology, Pohang, Korea |
| | | - Mechanical Engineering |
| | | - GPA 3.72/4.3 |
| | | - Diploma of Honors for 7 semesters |
| | | - Honor Graduation with Magna Cum Laude |
| M.S. | Sep. 1999 – Aug. 2001 | - Pohang University of Science and Technology, Pohang, Korea |
| | | - Mechanical Engineering |
| | | - Advisor: Prof. Wan Kyun Chung |
| | | - Thesis: Design and Control of 6 DOF Parallel Manipulator for Haptic Display |
| Ph.D. | Sep. 2001 – May 2006 | - Pohang University of Science and Technology, Pohang, Korea |
| | | - Mechanical Engineering |
| | | - Advisor: Prof. Wan Kyun Chung |
| | | - Thesis : Quantitative Comparison Framework of Bilateral Teleoperation Systems |

Research Experience

- Mar. 2015
-Present
Korea Institute of Science and Technology (KIST), Seoul, Korea
Principal Research Scientist, Center for Robotics Research
- Sep. 2014
-Present
University of Science and Technology (UST), Korea
Associate Professor, Dept. of HCI & Robotics
- Jun. 2015
-Present
Ministry of Food and Drug Safety
Expert Adviser, Dept. of Medical Devices
- May 2009
- Feb. 2015
Korea Institute of Science and Technology (KIST), Seoul, Korea
Senior Research Scientist, Center for Cognitive Robotics Research
- Sep. 2010
- Aug. 2014
University of Science and Technology (UST), Korea
Assistant Professor, Dept. of HCI & Robotics
- July 2006
- April 2009
Northwestern University, Illinois, USA
Post-Doctoral Researcher
Director: J. Edward Colgate
 - Developed haptic feedback interface for upper extremity prosthesis to restore sense of touch, pressure, vibration, shear, and temperature by a grant of DARPA Revolutionizing Prosthetics 2009.
- Sep. 2003
- May 2004
Case Western Reserve University, Ohio, USA
Visiting Student
Advisor: M. Cenk Cavusoglu
 - Developed a systematic performance evaluation method for bilateral teleoperation systems using μ -synthesis.
- Feb. 1999
- May 2006
Pohang University of Science and Technology (POSTECH), Pohang, Korea
Research Assistant in Robotics & Bio-Mechatronics Laboratory
Advisor: Wan Kyun Chung
 - Developed a human guided spine bone fusion surgical robot interface using bilateral teleoperation scheme by a grant of Korean Ministry of Health and Welfare.
 - Developed a haptic interface for extreme industrial environments by a grant of POSCO.
 - Developed a 7-DOF parallel type haptic device by grant of Korean Ministry of Science and Technology.
- Sep. 1999
- Aug. 2002
Pohang University of Science and Technology (POSTECH), Pohang, Korea
Teaching Assistant in Robotics & Bio-Mechatronics Laboratory
 - Graded tests and homework for an undergraduate course on System Control (MECH322).
 - Graded tests and homework, and developed experimental setup for graduate courses, Advanced Robotics (MEIE639) and Advanced Automatic Control (MEIE525).

Honors and Awards

- Aug. 1999 - **Diploma of Honors for 7 semesters**
 - **Honor Graduation with Magna Cum Laude**
- Dec. 2005 **Grand Prize Winner of 11th POSCO Thesis Competition by POSCO** "Development of a Haptic Interface for O₂ Lance Manipulator in Electric Furnace." (Award: \$7,000 & Japan-China Observation Tour)
- Nov. 2013 **Commendation awarded by Minister of Science, ICT and Future Planning**
* 미래창조과학부 장관 표창
- Dec. 2013 **Unsung Hero Award, Korea Institute of Science and Technology**
- Oct. 2014 **2014 Top 10 Mechanic Technology of the Year Award, The Korean Federation of Mechanical Engineering Societies**
* 올해의 10대 기계기술
- Nov. 2014 **KIST Outstanding Research Award**
* 이달의 KIST인 상
- Dec. 2014 **Assistive Robot Technology (ART) Award, Korean Robotics Society**
- Feb. 2015 **Commendation awarded by Chairman of National Research Council of Science and Technology**
* 국가과학기술연구회 이사장상
- Nov. 2015 **Bronze Medal, 2016 Korea Invention Promotion Association**
* 대한민국지식재산대전 동상, 한국발명진흥회
- Mar. 2016 **KIST Outstanding Laboratory Award**
* KIST 우수개발탑상
- July 2016 **2016 Outstanding Research Award, Minister of Science, ICT and Future Planning**
* 2016년 국가연구개발 우수성과

Publications

Journal Articles

1. Youngsu Cha, Jin Hong, Jaemin Lee, Jung-Min Park, Keehoon Kim, "Flexible piezoelectric energy harvesting from mouse click motions," *Sensors*, 2016, Accepted.
 2. Young Eun Hun, Seonhong Hwang, Keehoon Kim, Won-Ho Chung, Jinyoung Youn, Jin Whan Cho, "The Association of Postural Sensory Deficit with Freezing of Gait in Parkinson's Disease," *Parkinsonism & Related Disorders*, vol. 25, pp. 72-77, April 2016.
 3. Maria Florencia Deslivia, Hyun-joo Lee, Rizki Fajar Zulkamain, Zhu Bin, Arnold Adikrishna, In-ho Jeon, Keehoon Kim, "Reinnervated Split-muscle Technique for Creating Additional Myoelectric Sites in Animal Mode," *Plastic and Reconstructive Surgery*, 2016, Accepted.
 4. Keehoon Kim, J. Edward Colgate, "Haptic Feedback Enhances Grip Force Control of sEMG-Controlled Prosthetic Hands in Targeted Reinnervation Amputees," *IEEE transactions on Neural Systems and Rehabilitation Engineering*, vol. 20, no.6, pp. 798-805, Nov. 2012.
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5. Paul D. Marasco, Keehoon Kim, J. Edward Colgate, Michael A. Peshkin, Todd A. Kuiken, "Robotic Touch Shifts Perception of Embodiment to a Prosthesis in Targeted Reinnervation Amputees," *Brain*, vol. 134, no. 3, pp. 747-758, Mar. 2011. (**IF 9.49**)
6. Keehoon Kim, J. Edward Colgate, Julio J. Santos-Munne, Alex Makhlin, Michael A. Peshkin, "On the Design of Miniature Haptic Devices for Upper Extremity Prosthetics," *IEEE-ASME transactions on Mechatronics*, vol. 15, no. 1, pp. 27-39, Feb. 2010.
7. Keehoon Kim, Wan Kyun Chung, M. Cenk Cavusoglu, "Description of Restriction Space in Position Sensor Based Multi-DOF Bilateral Teleoperation Systems," *IEEE transactions on Robotics*, vol. 25, no. 5, pp. 1150-1158, Oct. 2009.
8. Jongwon Lee, Inwook Hwang, Keehoon Kim, Seungmoon Choi, Wan Kyun Chung, Young Soo Kim, "Cooperative robotic assistant with drill-by-wire end-effector for spinal fusion surgery," *Industrial Robot: An International Journal*, vol. 36, no. 1, pp. 60-72, Jan. 2009.
9. Keehoon Kim, M. Cenk Cavusoglu, and Wan Kyun Chung, "Quantitative Comparison of Bilateral Teleoperation Systems Using μ -Synthesis," *IEEE Transactions on Robotics*, vol. 23, no. 4, pp. 776-789, Aug. 2007.
10. Keehoon Kim, and Wan Kyun Chung, Sang Yep Nam, "Accurate Force Reflection Method for Multi-DOF Haptic Interface Using Instantaneous Restriction Space without Force Sensor at Unstructured Environment," *Advanced Robotics*, vol. 21, no. 1, pp.87-104, Jan. 2007.

Journal Articles (Under Reivew)

1. Man Bok Hong, Sin Jung Kim, and Keehoon Kim, "KULEX-Wrist: A Novel Parallel-Type Exoskeleton Mechanism for Wrist Power Assistance," *IEEE-ASME transactions on Mechatronics* (Under Review).
2. Man Bok Hong, Sin Jung Kim, and Keehoon Kim, "KULEX-Hand: An Underactuated Wearable Hand for Grasping Power Assistance," *IEEE transactions on Robotics* (Under Review)
3. Jaemin Lee, Minkyu Kim, and Keehoon Kim, "A Control Method to Minimize Muscle Energy for Power Assistant Robotic Systems under Unknown External Perturbation," *IEEE transactions on Neural Systems and Rehabilitation Engineering* (Under Review).
4. Seonhong Hwang, Minkyu Kim, Keehoon Kim, "Effects of Short-time Intensive Training for Selected Motions on Consistency and Distinguishability of Surface Electromyogram Patterns", *IEEE transactions on Neural Systems and Rehabilitation Engineering*. (Under Review).

Refereed Conference Papers

1. Jinwoo Jeong, Woohyun Jung, Ockchul Kim, Jun-Uk Chu, Inchan Youn, Keehoon Kim, Sang Rok Oh, Jong Woong Park, Jinseok Kim, "64-channel double-layered sieve electrode with increased porosity for improved axon regeneration and high spatial resolution," 2016 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob), pp. 1148 - 1153, Singapore, June 26-29, 2016.
2. Donghyun Hwang, Yong Seok Ihn, Seonhong Hwang, Sang-Rok Oh, Keehoon Kim, "A preliminary study on the method for stable and reliable implantation of neural interfaces into peripheral nervous system," 2016 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob), pp. 561 - 566, Singapore, June 26-29, 2016.
3. Minkyu Kim, Jaemin Lee, Keehoon Kim, "Enhancement of sEMG-based gesture classification using mahalanobis distance metric, 2016 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob), pp. 1117 - 1122, Singapore, June 26-29, 2016.
4. Jaemin Lee, Donghyun Hwang, Minkyu Kim, Keehoon Kim, "A feasibility test of underactuated robotic prosthetic fingers actuated by shape memory alloy," 2016 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob), pp. 554 - 560, Singapore, June 26-29, 2016

5. MinKyu Kim; Jaemin Lee; Keehoon Kim, "Tele-operation system with reliable grasping force estimation to compensate for the time-varying sEMG feature," 2016 IEEE International Conference on Robotics and Automation (ICRA), pp. 5561 - 5567, Stockholm, Sweden, May 16-21, 2016.
6. Jaemin Lee, MinKyu Kim, and Keehoon Kim, "A Robust Control Method of Multi-DOF Power-Assistant Robots for Unknown External Perturbation Using sEMG Signals," IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), September 28-October 2, 2015, Hamburg, Germany.
7. Joohyun Kim; Kwon Joong Son; Keehoon Kim, "An empirical study of rendering sinusoidal textures on a ultrasonic variable-friction haptic surface," 12th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), pp. 593 - 596, KINTEX, Goyang, Korea, 2015.
8. Jonghoon Park; Keehoon Kim, "Tracking on lie group for robot manipulators," 11th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), pp. 579 - 584, Kuala Lumpur, Malaysia, Nov. 12-15, 2014.
9. Jaemin Lee, Minkyu Kim, Hyunkyu Ko and Keehoon Kim, "A Control Method for a Power-Assisted Robot for Upper Limbs considering Intention-based Motion Using sEMG Signal," International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Kuala Lumpur, Malaysia, Nov. 12-15, 2014.
10. Minkyu Kim, Jaemin Lee, Hyunkyu Ko and Keehoon Kim, "A preliminary analysis of window size and voting size with a time delay for a robust real-time sEMG pattern recognition," International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Kuala Lumpur, Malaysia, Nov. 12-15, 2014.
11. Kwon Joong Son and Keehoon Kim, "The use of degenerate mode shapes in piezoelectric variable-friction tactile displays," The 12th International Conference on Motion and Vibration (MOVIC), Sapporo, Japan, August 3-7, 2014.
12. Jaemin Lee, Minkyu Kim, Sang-Rok Oh, Keehoon Kim, "Integrated Control Method for Power-Assisted Rehabilitation: Ellipsoid Regression and Impedance Control," IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), September 14-18, 2014. Chicago, IL, USA.
13. Kwon Joong Son and Keehoon Kim, "The use of degenerate mode shapes in piezoelectric variable-friction tactile displays," The 12th International Conference on Motion and Vibration (MOVIC), August 3-7, Sapporo, Japan, 2014.
14. MinKyu Kim, Kwanghyun Ryu, Yonghwan Oh, Sang-Rok Oh, and Keehoon Kim, "Implementation of Real-Time Motion and Force Capturing System for Tele-manipulation based on sEMG Signals and IMU Motion Data," IEEE International Conference on Robotics and Automation (ICRA), Hong Kong, 2014
15. Man Bok Hong, Sin Jung Kim, Keehoon Kim, "KULEX: An ADL Power-Assistance Demonstration," International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Jeju, 2013.
16. Man Bok Hong, Sin Jung Kim, Keehoon Kim, "KULEX: ADL Power Assistant Robotic System for the Elderly and the Disabled (Abstract for VIDEO)," International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Jeju, 2013.
17. Min Kyu Kim, Keehoon Kim, "Increasing performance of a pattern recognition system using a sEMG signal by setting multi-reference," International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Jeju, 2013.
18. Min Kyu Kim, Keehoon Kim, "Pilot Study on Prediction of Human Hand Configuration Using Transient State of Surface-Electromyography Signals," 13th International Conference on Control, Automation and Systems (ICCAS 2013), 2013
19. Kwon Joong Son, Minkyu Kim and Keehoon Kim, "Analytical Modeling of Disk-Type Piezoelectric Variable Friction Tactile Displays," *IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, Wollongong, Australia, pp. 1725-1730, July 9-12, 2013.
20. Hanjin LEE, Keehoon Kim, Sang Rok Oh, "Development of a Wearable and Dry sEMG Electrode

- System for Decoding of Human Hand Configurations,” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 746-750, Oct. 7-12, Vilamoura, Portugal, 2012.
21. Jiyeon Kang, Keehoon Kim, Sin Jung Kim, Sang Rok Oh, “On the Comfortableness of Muscle Power Assistive Robotic System,” *IEEE International Conference on Biomedical Robotics and Biomechanics (BioRob)*, Rome, Italy, pp. 1759-1764, June 24-27, 2012.
 22. HanJin LEE, Keehoon Kim, Myoung Soo Park, Jong Hyeon Park and Sang-Rok Oh, “Verification of A Fast Training Algorithm for Multi-channel sEMG Classification Systems to Decode Human Configuration,” *IEEE International Conference on Robotics and Automation (ICRA)*, St. Paul, USA, pp. 3167-3172, May 14-18, 2012.
 23. HanJin LEE, Sin-Jung Kim, Keehoon Kim, Myoung Soo Park, Sung-Kyun Kim, Jong Hyeon Park and Sang-Rok Oh, “Online Remote Control of a Robotic Hand Configurations using sEMG Signals on a Forearm,” *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, Phuket, Thailand, pp. 2243-2244, Dec 8-10 2011.
 24. Myoung Soo Park, Keehoon Kim, Sang-Rok Oh, “A Fast Classification System for Decoding of Human Hand Configurations Using Multi-Channel sEMG Signals,” *International Conference on Intelligent Robots and Systems (IROS)*, San Francisco, USA, Sep. 25-30, 2011.
 25. Sin-Jung Kim, Keehoon Kim, Sungon Lee, Bum-Jae You, Sang-Rok Oh, “3-D Reconstruction Using a Touch Sensor for Mouse Stereotactic Surgery in Unstructured Environment,” *The 7th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI)*, Busan, Korea, Nov. 24-27, 2010. BEST PAPER AWARD
 26. Keehoon Kim, Wan Kyun Chung, M. Cenk Cavusoglu, “Restriction Space Projection Method for Position Sensor Based Force Reflection of Multi Degrees-of-Freedom Bilateral Teleoperation Systems in Unstructured Environments,” *International Conference on Robotics and Automation (ICRA)*, Alaska, USA, May 3-8, 2010.
 27. Jongwon Lee, Keehoon Kim, Wan Kyun Chung, Seungmoon Choi, Young Soo Kim, “Development of Human Guided Surgical Robot System for Spinal Fusion, CMSS-1,” *International Conference on Robotics and Automation (ICRA)*, California, USA, May 19-23, 2008.
 28. Keehoon Kim, J. Edward Colgate, Michael A. Peshkin, “On the Design of a Thermal Display for Upper Extremity Prosthetics,” *16th Symposium on Haptic Interfaces for Virtual Environments and Teleoperator Systems*, Reno, Nevada, USA, March 13-14, 2008.
 29. Keehoon Kim, J. Edward Colgate, Michael Peshkin, Julio Santos-Munne, Alex Makhlin, “A Miniature Tactor Design for Upper Extremity Prosthesis,” *Special Sessions on Haptics, Proc. Of the Frontiers in the Convergence of Bioscience and Information Technologies*, Jeju, Korea, Oct. 11-13, 2007.
 30. Keehoon Kim, J. Edward Colgate, Michael Peshkin, “Pilot Study of a Thermal Display Using a Miniature Tactor for Upper Extremity Prosthesis,” *Special Sessions on Haptics, Proc. Of the Frontiers in the Convergence of Bioscience and Information Technologies*, Jeju, Korea, Oct. 11-13, 2007.
 31. Keehoon Kim, Jongwon Lee, Wan Kyun Chung, and Young Soo Kim, “A Noble Bilateral Teleoperation System for Human Guided Spinal Fusion,” *International Conference on Robotics and Automation (ICRA)*, Rome, Italy, April 10-14, 2007.
 32. Keehoon Kim, M. Cenk Cavusoglu, Wan Kyun Chung, “A Framework for Quantitative Comparison of Bilateral Teleoperation Systems Using μ -Synthesis,” *International Conference on Robotics and Automation (ICRA)*, Rome, Italy, April 10-14, 2007.
 33. Keehoon Kim, M. Cenk Cavusoglu, Wan Kyun Chung, “Quantitative Comparison of Bilateral Teleoperation Systems with Various Drive Mechanisms and Sensory Configurations,” *Proc. of International Conference on Control, Automation, and Systems (SICE-ICCAS)*, Busan, Korea, Oct. 18-21, 2006.
 34. Keehoon Kim, Jongwon Lee, Wan Kyun Chung, and Young Soo Kim, “Development of a Bilateral Teleoperation System for Human Guided Spine Bone Fusion Surgery: BiTESS II,” *World Congress on Medical Physics and Biomedical Engineering*, Seoul, Korea, Aug. 27-Sep. 1, 2006.

35. Keehoon Kim and Wan Kyun Chung, "Accurate Force Reflection for Kinematically Dissimilar Bilateral Teleoperation Systems Using Instantaneous Restriction Space," *International Conference on Robotics and Automation (ICRA)*, Orlando, USA, May 15-19, 2006.
36. Keehoon Kim, Wan Kyun Chung, and Youngil Youm, "Accurate Multi-DOF Kinesthetic Haptic Display Using Instantaneous Restriction Space," *International Conference on Intelligent Robots and Systems (IROS)*, Edmonton, Canada, Aug.3-5, 2005.
37. Keehoon Kim, M. Cenk Cavusoglu, Wan Kyun Chung, "Quantitative Comparison of Bilateral Teleoperation Systems using H_{∞} Framework," *International Conference on Intelligent Robots and Systems (IROS)*, Sendai, Japan, Sep. 28- Oct. 2, 2004.
38. Keehoon Kim, W.K. Chung, "Design and Analysis of a New 7-DOF Parallel Type Haptic Device PATHOS-II," *International Conference on Intelligent Robots and Systems (IROS)*, Bally's Las Vegas Hotel, October 27 - 31, 2003.
39. Keehoon Kim, W.K. Chung, "Design and Analysis of a New 7-DOF Parallel Type Haptic Device: PATHOS-II," *20th International Symposium on Automation & Robotics in Construction*, September 21-25, 2003.
40. Keehoon Kim, Y. Youm, W.K. Chung, "Human Kinematic Factor for Haptic Manipulation: The Wrist to Thumb," *10th International Symposium on Haptic Interfaces for Virtual Environment and Teleoperator System, Florida*, pp. 319-326, March 24-25, 2002.
41. Keehoon Kim, Doik Kim, Wan Kyun Chung, and Youngil Youm, "Human Factor for Kinematic Design of a Haptic Device," *Proc. of the 32nd International Symposium on Robotics*, Seoul, Korea, pp. 135-140, April 19-21, 2001.
42. Keehoon Kim, W.K. Chung, and Y. Youm, "On the Design Method of Haptic Interface Controller with Virtual Coupling," *Proc. of International Conference on Control, Automation, and Systems (SICE-ICCAS)*, Jeju, Korea, pp. 71-74, Oct., 2001.

Technology Transfers

1. Power Assistant Robotic Systems, Gemtech Co. LTD, 2014. (\$150,000, 5% Royalty)
2. Stereotactic Surgical Robotic System, Neuromeka Co., 2015 (\$100,000, 5% Royalty)
3. Motion Capturing Algorithm based on sEMG, Hyoil CTA, 2015 (\$100,000, 3% Royalty)
4. Logon.U Co., a start-up company, 2015

Patents

Registered

1. END EFFECTOR FOR SPINE BONE FUSION SYSTEMS
뼈 융합 수술 시스템을 위한 엔드 이펙터 (Patent No. 10-0705998, KR)
2. HAPTIC INTERFACE FOR OXYGEN LANCE MANIPULATOR IN ELECTRIC FURNACE
힘 반영 전기로 산소 취입기 조작을 위한 햅틱 인터페이스 장치 (Patent No. 10-0823095, KR)
3. RESTRICTION SPACE CALCULATION METHOD USING POSITION SENSORS OF MULTI DEGREES-OF-FREEDOM MANIPULATOR
다관절 매니퓰레이터의 위치 센서를 이용한 제한공간 산출 방법 (Patent No. 2010-29131, KR)
4. MATERIAL SCREENING APPARATUS
재료 감별 장치 (Application No. PCT/KR2010/004917, Patent No. 1402862 KR, 13/812290 US)
5. APPARATUS FOR SUPPORTING A MUSCULAR STRENGTH OF ARM
상지 근력 보조장치 (Patent No. 1205891 KR, Application No. 13/617,580 US)

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6. **PRECISE PLACEMENT DEVICE FOR PRECISE INSERTION OF INSERT**
뇌정위 수술을 위한 전극 삽입 장치 (Patent No. 1205891 KR, Application No. 13/617,580US)
 7. **EXOSKELETON MECHANISM FOR LIMB POWER ASSISTANCE,**
근력보조를 위한 외골격장치 (Patent No. 1295004 KR, Application No. 13/617,985 US)
 8. **SPHERICAL TRANSMISSION JOINT**
경사 축의 회전동력전달을 위한 구형 조인트 (Patent No. 1283933 KR, PATENT No. 8,763,490 US)
 9. **TACTILE DISPLAY AND ITS CONTROL METHOD USING SQUEEZE FILM EFFECT**
스퀴즈막 효과를 이용한 촉감 디스플레이를 구비한 전자 장치 (PATENT No. 1383012 KR, 13/768,292 US)
 10. **WEARABLE ELECTROMYOGRAM SENSOR SYSTEM**
착용형 근전도 시스템 (PATENT No. 10-1501661 KR, 14/088,859, US)
 11. **APPARATUS FOR SUPPORTING A MUSCULAR STRENGTH OF ARM**
상지 근력 강화 보조 장치 (Application No. 10-2014-0043523 KR, 003550 PCT)
 12. **APPARATUS FOR SUPPORTING A MUSCULAR STRNGTH AND A KIT HAVING THE SAME**
상지 근력 강화 장치 및 이를 구비한 키트 (PATENT No. 10-1523014 KR, 003767 PCT)
 13. **Apparatus for Upper Limb Rehabilitation**
상지재활기(Patent NO. 30-0777253 KR)
 14. **Apparatus for supporting a muscular strength**
상지운동기(Patent NO. 30-0777250, 30-0777251, 30-0777252 KR)

Pending

1. **DETECTOR AND STIMULATOR FOR FEEDBACK IN A PROSTHESIS (Application No. 11/677564, US)**
2. **PLANT STATUS AUTOMATIC ANALYSIS DEVICE AND ANALYSIS METHOD USING THEREOF**
식물상태 자동화 분석장치 및 이를 이용한 식물 분석 방법 (Application No. 10-2014-0030571 KR, 001041 PCT)
3. **ROBOT FINGER STRUCTURE**
로봇손가락 구조체, (Application No. 10-2014-0072747 KR, 005986 PCT)
4. **AUTOMATIC SYSTEM FOR PLANT PHENOTYPE ANALYSIS**
식물분석 자동화 시스템 (Application No. 2015-0012996 KR, 003124 PCT)
5. **POTS FOR PLANT PHENOTYPING**
식물뿌리 표현형 측정을 위한 식물 생육 용기 (Application No. 2015-0012986 KR)
6. **PLANT PHENOTYPE ANALYSIS APPARATUS**
식물 표현체 분석장치 (Application No. 2015-0013024 KR)
7. **WEARABLE DEVICE FOR HAPTIC DISPLAY**
착용형 촉감 전달 장치 (Application No. 2015-0057088 KR)
8. **SENSOR MODULE FOR BIONIC SIGNAL ACQUISITION**
생체 신호 측정용 센서 모듈 (Application No. 2015-0024672 KR)

Grants

1. Principal Investigator, \$1,950,000, 2010~2014
ADL Support System for the Elderly and Disabled, Ministry of Knowledge and Economy
연구책임자, 1,950,000,000원, 2010~2014
노약자/장애인을 위한 근력보조 시스템 개발, 산업원천기술개발사업, 지식경제부
2. Principal Investigator, \$1,600,000, 2010~2012 (Phase I)
Decoding of Human Intention and Restoration of Sensory Perception based on Bionic Interface
연구책임자, 1,600,000,000, 2010~2012 (1단계 2년)
바이옴닉 인터페이스 기반 의도인식 및 감각전달 기술 개발, 글로벌프론티어사업, 교육과학부
3. Principal Investigator, \$2,400,000, 2013~2015 (Phase II)
Prediction of human motion intention based on surface electromyogram and restoration of multi-sensory feedback for sensory-motor skills through remote-controlled avatar
연구책임자, 2,400,000,000원, 2013~2015 (2단계 3년)
원격존재를 통한 감각-운동 작업을 위한 근전도 신호 기반의 동작의도 예측 및 능동 촉감 복원 기술 개발 글로벌프론티어사업, 교육과학부

Invited Talks

1. "Assistant Robotic Technologies in Bio-Medical Applications," World Robot Conference, Nov. 24, 2015.
2. "KULEX, KIST Upper Limb Exoskeleton," Korea-Swiss Life Science Symposium, Oct. 22, 2015.
3. "Development of sEMG Sensor Systems and Industrial Applications," Korea Development Bank, Oct. 16, 2015.
4. "Decoding of Human Motion Intention Using Bionic Interface," DGIST, Sep. 16, 2015.
5. "Development of sEMG Sensor Systems and Industrial Applications," Educational Center for Future Technology, Sep. 11, 2015.
6. "Prediction of Human Motion Intention Using Bionic-Interface," Korea-Japan Robotics Workshop, Sep. 4, 2015.
7. "Robotic Technologies in Science Fiction," Seongbuk-Gu, KIST Science Talk, Aug. 4, 2015.
8. "Assistant Robotic Technologies in Bio-Medical Applications," Bionics Forum, July 2, 2015.
9. "Assistant Robotic Technologies in Bio-Medical Applications," Yonsei University, April 3, 2015.
10. "Assistant Robotic Technologies in Bio-Medical Applications," Korea University, Dec. 9, 2014
11. "Robotic Technologies in Science Fiction", Science Talk on Saturday, Dec. 6, 2014.
12. "Assistant Robotic Technologies in Bio-Medical Applications," Kookmin University, Nov. 24, 2014.
13. "Assistant Robotic Technologies in Bio-Medical Applications," Pohang University of Science and Technology (POSTECH), Oct. 29, 2014.
14. "Assistant Robotic Technologies in Bio-Medical Applications," The Institute of Electronics and Information Engineers (IEIE), Oct. 15, 2014.
15. "Assistant Robotic Technologies in Bio-Medical Applications," Seoul Samsung Hospital, Sep. 1, 2014.
16. "Assistant Robotic Technologies in Bio-Medical Applications," Asan Hospital, Annual Symposium of Center for Biomedical Engineering Research Center, Nov. 27, 2013
17. "Robotic Technologies in Science Fiction", Science Touch on Friday, Nov. 8, 2013.
18. "Robotic Technologies in Science Fiction", Center for Women in Science Engineering and Technology, July 30, 2013.
19. "Decoding of Motion Intention & Restoration of Haptic Sensation for Upper Extremity Amputees", Bulgaria-Korea Science and Technology Forum, Jun. 3, 2013

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20. "Decoding of Motion Intention and Restoration of Haptic Sensation for Upper Extremity Amputees", Asan Hospital, Dec. 14, 2012.
 21. "Assistant Robotics in Bio-Medical Applications", Seoul National University, Oct. 31, 2012.
 22. "Assistant Robotics in Bio-Medical Applications", Daegu-Kyungbuk Institute of Science and Technolgy (DGIST), Sep. 12, 2012.
 23. "Assistant Robotics in Bio-Medical Applications", Hanyang University WCU, July 25, 2012.
 24. "Assistant Robotics in Bio-Medical Applications", Bulgaria-Korea Science and Technology Forum, Jun. 28, 2012.
 25. "Restoration of Haptic Sensation for Upper Extremity Amputees", International Workshop on Cognition, Control and Learning, Jan. 6, 2012
 26. "Assistant Robotics in Bio-Medical Applications", Dept. of Orthopedics, Asan Hospital, Oct. 25, 2011.
 27. "Assistant Robotics in Bio-Medical Applications", Dept. of Radiology, Asan Hospital, Aug. 25, 2011.
 28. "Toward Neurocontrolled Upper Extremity Prosthesis: Decoding of Human Motion Intention & Restoration of Haptic Sensation," Technische Universitat Munchen, Germany, May 26, 2011.
 29. "Restoration of Haptic Sensation: Toward Neurocontrolled Upper Extremity Prosthesis," ETH, Switzerland, May 23, 2011.
 30. "Restoration of Haptic Sensation: Toward Neurocontrolled Upper Extremity Prosthesis," Sungkyunkwan University, Apr. 25, 2011.
 31. "Assistant Robotics Technologies in Bio-Medical Application," Robotic Surgery Symposium, Asan Hospital, Feb. 11, 2011.
 32. "Assistant Robotics Technologies in Bio-Medical Application," Robotic Surgery Center, Asan Hospital, Feb. 8, 2011.
 33. "Toward Neurocontrolled Upper Extremity Prosthesis: Trends, Issues, and Perspectives," the Guro Industrials, Dec. 21, 2010.
 34. "Assistant Robotics Technologies in Bio-Medical Application," Asan-KIST Symposium, Asan Hospital, Nov. 16, 2010.
 35. "Toward Neurocontrolled Upper Extremity Prosthesis: Trends, Issues, and Perspectives," Korea University, Nov. 8, 2010.
 36. "Assistant Robotics Technologies in Rehabilitation Applications," Hyundai Rotem, Oct. 21, 2010.
 37. "Toward Neurocontrolled Upper Extremity Prosthesis: Restoration of Haptic Sensation," KAIST, Daejon, June 10, 2010.
 38. "Restoration of Haptic Sensation for Upper Extremity Prosthesis," Seoul National University, Seoul Korea, Dec. 1, 2009.
 39. "Assistant Robotics in Bio-Medical Applications: Restoration of Haptic Sensation for Upper Extremity Prosthesis," Korea Institute of Industrial Technology, Ansan, Korea, July 17, 2009
 40. "Assistant Robot Technologies in Bio-Medical Applications," Korea Institute of Science and Technology (KIST), Seoul, Korea, January 9, 2009.
 41. "Assistant Robot Technologies in Bio-Medical Applications," Kyungpook National University, Daegu, Korea, January 7, 2009.
 42. "Haptic Feedback for Upper Extremity Prosthetics," Rehabilitation Institute of Chicago, Chicago, USA, February 29, 2008
 43. "Assistant Robot Technologies in Bio-Medical Application," Gwangju Institute of Science and Technology (GIST), Gwangju, Korea, February 4, 2008
 44. "Research on Upper Extremity Prosthetics", Pohang Institute of Intelligent Robotics, Pohang, Korea, October 9, 2007.
 45. "Towards Tele-Presence", Korea Institute of Industrial Technology, Ansan, Korea, April 5, 2006.

Professional Service

Served as a committee member for international conference, including:

- 2011 IEEE International Conference on Mechatronics and Automation (ICMA), Program Committee
- 2012 IEEE International Conference on Intelligent Robots and Systems (IROS), Associate Editor
- 2012 Korea Robotics Society Annual Conference (KROC), Local Chair
- 2013 IEEE International Conference on Intelligent Robots and Systems (IROS), Associate Editor
- 2013 Korea Robotics Society Annual Conference (KROC), Financial Chair
- 2013 IEEE International Conference on Intelligent Robots and Systems (IROS), Associate Editor
- 2013 International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Local Chair
- 2014 IEEE International Conference on Robotics and Automation (ICRA), Associate Editor
- 2014 IEEE International Conference on Intelligent Robots and Systems (IROS), Associate Editor
- 2014 International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Finance Chair
- 2015 IEEE International Conference on Robotics and Automation (ICRA), Associate Editor
- 2015 Workshop of IEEE International Conference on Robotics and Automation (ICRA), Co-Organizer
- 2015 IEEE International Conference on Intelligent Robots and Systems (IROS), Editor
- 2016 IEEE International Conference on Intelligent Robots and Systems (IROS), Editor
- 2016 Journal of Korea Robotics Society, Editor.
- 2017 Korea Robotics Society Annual Conference (KROC), Exhibition Chair

Served as a reviewer for international journals, including:

- IEEE Transactions on Robotics
- IEEE Transactions on Neural Systems and Rehabilitation Engineering
- IEEE Transactions on Haptics
- IEEE Transactions on Biomedical Engineering
- IEEE Transactions on Mechatronics
- IEEE Spectrum
- International Journal of Robotics Research
- Advanced Robotics
- Robotica
- ASME Journal of Dynamic Systems Measurement and Control
- International Journal of Control, Automation, and Systems (IJCAS)
- Journal of Mechanical Science and Technology
- Journal of Biomedical and Health Informatics

Served as a reviewer for international conference, including:

- IEEE International Conference on Robotics and Automation
- IEEE/RSJ International Conference on Intelligent Robots and Systems
- Symposium on Haptic Interfaces
- IEEE International Symposium on Robots and Human Interactive Communications
- IEEE International Conference on Mechatronics and Automation.
- IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics