

# DAL HYUNG KIM

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## RESEARCH INTERESTS

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Robotics, Brain imaging, Optical Microscopy, Fluorescence Imaging, Automated Control for Biological System, Optimized Control, Model predictive control, Motion tracking, Microrobotics, Nonholonomic motion planning, Optogenetics, Neuroscience

## EDUCATION

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<b>Ph.D. in Mechanical Engineering and Mechanics</b> <i>Drexel University, Philadelphia, PA, United States</i>	Mar. 2013
<b>M.S. in Mechanical Engineering</b> <i>Korea University, Seoul, South Korea</i>	Aug. 2008
<b>B.S. in Mechanical Engineering</b> <i>Korea University, Seoul, South Korea</i>	Aug. 2005

## RESEARCH EXPERIENCE

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**Assistant Professor** Aug. 16. 2017– present  
The Department of Mechanical Engineering and Energy Processes at Southern Illinois University Carbondale, Carbondale, IL, USA

**Postdoctoral Associate** Advisor: Dr. Drew Robson Sep. 2014 – Jul. 2017  
*Microscope Design & Optogenetics Lab, Rowland Institute at Harvard, Cambridge, MA*

- Developed optimized control for the motion cancellation system for a freely swimming larval zebrafish based on fish motion model.
- Implemented a modified structure illumination (Differential Illumination Focal Filtering) for Pan-neuronal calcium imaging in larval zebrafish brain
- Developed GPU-based 6 degree of freedom registration pipeline for brain images in a freely moving larval zebrafish.

**Postdoctoral Fellow** Advisor: Dr. Elizabeth Kane Jun. 2013 – Aug. 2014  
*The Circuits and Behavior Group, Rowland Institute at Harvard, Cambridge, MA*

- Developed real-time motion cancellation system for free-moving *Drosophila* larva.
- Developed custom-built two-photon microscopic system for brain imaging in *Drosophila* larva.

**Research Assistant**                      Advisor: Prof. MinJun Kim                      Sep. 2008 – May. 2013  
*Biological Actuation, Sensing, & Transport Laboratory, Drexel University, Philadelphia, PA*

- Synthesis, characterization, and control of microorganism-based microrobots
- Developed the MicroBioRobot using bacteria (*Serratia marcescens*) and demonstrated micro-manipulation and micro-assembly.
- Developed feature-based tracking algorithm of MicroBioRobot.
- Developed the cellular MicroBioRobot using eukaryotes (*Tetrahymena pyriformis*) and characterized its motion model in low Reynolds number.
- Implemented optimized control and motion planning for MicroBioRobots
- Studied on flow motion generated by swarm bacteria.

**Research Scientist**                      Advisor: Prof. Woojin Chung                      Sep. 2007 – Aug. 2008  
*Intelligent system and Robotics Laboratory, Korea University, Seoul, Korea*

- Optimized motion planning in the nonholonomic system for autonomous parking application.

**Research Assistant**                      Advisor: Prof. Woojin Chung                      Sep. 2005 – Aug. 2007  
*Intelligent system and Robotics Laboratory, Korea University, Seoul, Korea*

- Develop a path planning algorithm and control for the car-like robot.
- Studied on mobile robot collision avoidance.

## PUBLICATION

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### Journal papers

- J1. Dal Hyung Kim, Jungsoo Kim, Joao C Marques, Abhinav Grama, David G C Hildebrand, Wenchao Gu, Jenifer Li, Drew Robson, “Pan-neuronal calcium imaging with cellular resolution in freely swimming zebrafish”, *Nature Method* (2017) [[Link](#)]
- J2. Hoyeon Kim, U Kei Cheang, Dal Hyung Kim, J. Ali, Min Jun Kim, “Hydrodynamics of self-actuated bacterial carpet near boundary using micro-scale particle image velocimetry”, *Biomicrofluidics*, Vol. 9, 024121, 2015 [[Link](#)]
- J3. U Kei Cheang, Farshad Meshkai, Dal Hyung Kim, Henry Fu, Min Jun Kim, “Minimal geometric requirements for micropropulsion via magnetic rotation”, *Phys. Rev. E*, Vol. 90, 033007, 2014. [[Link](#)]
- J4. Dal Hyung Kim, Paul Seoungsoo Kim, Kyungwoo Lee, JinSeok Kim, Min Jun Kim, “Galvanotactic behavior of *Tetrahymena pyriformis* under electric fields”, *Journal of Micromechanics and Microengineering*, Vol. 23(12), p. 125004, 2013. [[Link](#)]
- J5. Jihoon Kim, Yonghee Jang, Doyoung Byun, Dal Hyung Kim and Min Jun Kim “Mixing Enhancement by Biologically-Inspired Convection in a Micro-Chamber Using Alternating Current Galvanotactic Control of the *Tetrahymena pyriformis*”, *Applied Physics Letters* Vol. 103, p. 103703, 2013. [[Link](#)]
- J6. O. Yan, Dal Hyung Kim, P.S.S. Kim, Min Jun Kim, A.A. Julius, "Motion control of magnetized *Tetrahymena pyriformis* cells by magnetic field with model predictive control (MPC)," *International Journal of Robotics Research*, Vol. 32 (1), p. 129-139, 2012. [[Link](#)]

- J7. Dal Hyung Kim, P.S.S. Kim, A.A. Julius, Min Jun Kim, "Three-dimensional control of *Tetrahymena pyriformis* using artificial magnetotaxis" Applied Physics Letters, Vol. 100(5), p. 053702, 2012. [[Link](#)]
- J8. Dal Hyung Kim, Sean E. Brigandi, Paul Kim, Doyoung Byun, and Min Jun Kim, "Characterization of deciliation-regeneration process of *Tetrahymena pyriformis* for cellular robot fabrication", Journal of Bionic Engineering. Vol. 8 (3), p. 273-279, 2011. [[Link](#)]
- J9. Trung-Hieu Tran, Dal Hyung Kim, Jihoon Kim, Min Jun Kim, and Doyoung Byun. "Use of an Ac Electric Field in Galvanotactic on/off Switching of the Motion of a Microstructure Blotted by *Serratia Marcescens*." Applied Physics Letters, Vol. 99(6), p. 063702, 2011. [[Link](#)]
- J10. E.B. Steager, M.S. Sakar, Dal Hyung Kim, V. Kumar, G. Pappas, Min Jun Kim, "Electrokinetic and optical control of bacterial microrobots," Journal of Micromechanics and Microengineering Vol. 21(3), p. 035001, 2011. [[Link](#)]
- J11. M.S. Sakar, E.B. Steager, Dal Hyung Kim, A.A. Julius, Min Jun Kim, V. Kumar, G. Pappas, "Modeling, control and experimental characterization of microbiorobots," International Journal of Robotics Research, Vol. 30(6), p. 647-658, 2011. [[Link](#)]
- J12. Dal Hyung Kim, U.K. Cheang, L. Kohidai, D.Y. Byun, Min Jun Kim, "Artificial magnetotactic motion control of *Tetrahymena pyriformis* using ferromagnetic nanoparticles: A tool to fabricate new class of microbiorobots," Applied Physics Letters, Vol. 97(17), p. 173702, 2010. [[Link](#)]
- J13. Dal Hyung Kim, E.B. Steager, U.K. Cheang, D.Y. Byun, Min Jun Kim, "A comparison of vision-based tracking schemes for control of microbiorobots," Journal of Micromechanics and Microengineering. Vol. 20(6), p. 065006, 2010. [[Link](#)]
- J14. M.S. Sakar, E.B. Steager, Dal Hyung Kim, Min Jun Kim, G.J. Pappas, V. Kumar, "Single cell manipulation using ferromagnetic composite microtransporters," Applied Physics Letters, Vol. 96(4), p.043705, 2010. [[Link](#)] \* This paper has been selected for the Feb. 22, 2010 issue of Virtual Journal of Nanoscale Science & Technology. You can access the Virtual Journal at <http://scitation.aip.org/nano/>.
- J15. Dal Hyung Kim, Woojin Chung, Shinsuk Park, "Practical Motion Planning for Car-Parking Control in Narrow Environment" IET Control Theory & Applications, Vol. 4(1), p. 129-139, 2010. [[Link](#)]
- J16. Dal Hyung Kim, D. Casale, L. Kohidai, Min Jun Kim, "Galvanotactic and Phototactic Control of *Tetrahymena Pyriformis* as a Microfluidic Workhorse," Applied Physics Letters, Vol. 94(16), p. 163901, 2009. [[Link](#)] \* This paper has been selected for the May 1, 2009 issue of Virtual Journal of Biological Physics Research. You can access the Virtual Journal at <http://www.vjbio.org>.
- J17. Dal Hyung Kim and Woojin Chung, "Motion planning of the car-like vehicle in the parking space by the motion space" The Journal of Korea Robotics Society, Vol.3 (1), p. 1-8, 2008. (In Korean) [[Link](#)].

### Conference Paper

- C1. Dal Hyung Kim, Seung Soo Kim, Agung Anak Julius, Min Jun Kim, "Three-dimensional control of engineered motile cellular microrobots" The 2012 IEEE International Conference on Robotics and Automation (ICRA 2012), p.721-726, Saint Paul, MN, USA, May 2012.

- C2. Dal Hyung Kim, Min Jun Kim, "Effects of bacterial surface morphology on hybrid microrobots" The International Bionic Engineering Conference, Boston, USA, Sept. 2011. Oral Presentation by Dal Hyung Kim
- C3. Dal Hyung Kim, Sean Brigandi, Agung Anak Julius, Min Jun Kim, "Real-time feedback control using artificial magnetotaxis with rapidly-exploring random tree (RRT) for *Tetrahymena pyriformis* as a microbiorobot" The 2011 IEEE International Conference on Robotics and Automation (ICRA 2011), p. 3183-3188, Shanghai, China, May 2011. Oral Presentation by Dal Hyung Kim
- C4. Dal Hyung Kim, E.B. Steager, Min Jun Kim, "Comparison of contour based and feature based tracking methods for control of microbiorobotics," 2009 ASME IMECE, Lake Buena Vista, FL, USA, IMECE2009-10564, Nov. 2009. Oral Presentation by Dal Hyung Kim
- C5. E.B. Steager, M.S. Sakar, Dal Hyung Kim, V. Kumar, G.J. Pappas, Min Jun Kim, "Hybrid control and transport using bacteria-driven microbiorobots," 2009 ASME IMECE, Lake Buena Vista, FL, USA, IMECE2009-11327, Nov. 2009.
- C6. E. Steager, Dal Hyung Kim, Min Jun Kim, "Control of a microstructure powered by bacteria using electric fields," The US-Korea Conference on Science, Technology, and Entrepreneurship, NST-3.2, Raleigh, NC, USA, 2009.
- C7. Dal Hyung Kim, Kwanghyun Yoo, Woojin Chung, Hyo-Whan Chang, Chikwan Choi and Paljoo Yoon, "The efficient path planning for car-parking using the slice projection method and comparison with the RRT method" The 3rd Korea robot conference," p. 520-521, Changwon, South Korea, June 2008, Oral Presentation by Dal Hyung Kim
- C8. Dal Hyung Kim, and Woojin Chung, "Motion planning for Car-Parking Using the Slice Projection Technique" 2008 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2008), p. 1050-1055, Nice, France, Sept. 2008.
- C9. Dal Hyung Kim, Woojin Chung, "Car-parking Motion Planning by the Motion Space Approach", Proceedings of 13th International Conference on Advanced Robotics, p. 241-246, Jeju, South Korea, 2007, Oral Presentation by Dal Hyung Kim
- C10. Dal Hyung Kim, Woojin Chung, "Motion Planning of the Car-like Vehicle in the Parking Space by the Motion Space", Proceedings of 2nd Korea robot conference, p. 551-558, PyeongChang, South Korea, Jun. 2007. (In Korean)
- C11. Kooktae Lee, Dal Hyung Kim, Woojin Chung, Hyohwan Chang, Paljoo Yoon, "Car Parking control using a trajectory tracking controller", Proceedings of SICE-ICCAS 2006, p. 2058-2063, Busan, South Korea, Oct. 2006.
- C12. Dal Hyung Kim, Woojin Chung, Kooktae Lee, "Collision-free Path Planning for a Car Parking Problem", Proceedings of the 3rd International Conference on Ubiquitous Robots and Ambient Intelligence (URAI 2006), p. 321-326, Seoul, South Korea, Oct. 2006.
- C13. Dal Hyung Kim, Kooktae Lee, Woojin Chung, Hyo Whan Chang, PalJoo Yoon "Parking control of a RC car by using a trajectory tracking controller" Proceedings of 1st Korea robot conference, p. 448-455, Jeju, South Korea, June 2006. (In Korean), Poster Presentation by Dal Hyung Kim.

### Book Chapter

- B1. Paul Seung Soo Kim, Aaron Becker, Yan Ou, Dal Hyung Kim, Anak Agung Julius, and Min Jun Kim “Chapter 11: Magnetic swarm control of microorganisms” in “Microbiorobotics: Biologically Inspired Microscale Robotic Systems,” 2nd edition, Elsevier, 2015
- B2. Dal Hyung Kim, Sean Brigandi, Paul Kim, and Min Jun Kim “Chapter D.5: Control of *Tetrahymena pyriformis* as a Microrobot” in “Microbiorobotics: Biologically Inspired Microscale Robotic Systems,” Elsevier, 2012. [[Link](#)]

### Patents

- P1. Dal Hyung Kim, Jennifer Li and Drew Robson, “DIFF: DIFFERENTIAL ILLUMINATION FOCAL FILTERINGUS”, have been issued a provisional patent (application No. 62/487,793, filed 20 April, 2017)

### HONORS AND AWARD

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Outstanding Promise Doctoral Award, Dept. of Mech. Eng. & Mechanics, Drexel Univ.	2013
Lee Smith Fellowship, Drexel Univ.	2011
International Travel Award, Drexel Univ.	2011
Dean’s Fellowship, Drexel Univ.	2010
Excellent Paper Award from 07’ Korea Robot Conference by Korea Robotics Society	2007
Best Honors Scholarship, Korea Univ.	2005