Stephen Baek

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Biography

Stephen Baek is a researcher interested in both theory and application of computational geometry and machine learning. Specifically, he is interested in mathematical representations and algorithms for learning trends and patterns in geometric data, such as images, videos, 3D scans, and medical images. His current and past research spans a variety of interdisciplinary subjects including statistical human body shape analysis and modeling, vision-based human motion tracking and analysis, driver state monitoring in autonomated/autonomous vehicles, data-driven physics simulation, and medical image analysis.

He received his B.S. degree in mechanical engineering from Seoul National University, Seoul, Korea in 2009 and a Ph.D. degree from the same institution in 2013 for his award-winning study on the space of human body shapes on Riemannian manifolds. During his training, he received the National Science and Engineering Scholarship and the Global Ph.D. Fellowship from the Korean Ministry of Education. He was also awarded the Presidential Postdoc Fellowship from the President of the Republic of Korea.

Dr. Baek was a Senior Researcher at the Institute of Advanced Machinery Design (IAMD) at Seoul National University from 2013 to 2015, where he was involved with computer vision based three-dimensional shape acquisition and recognition. In 2014, he visited the University of South Carolina as a Visiting Research Associate, where he was involved with geometric feature recognition for feature-based manufacturing process planning. In 2015, he joined the University of Iowa, Iowa City, IA, United States, where he currently is an Assistant Professor at the Department of Industrial and Systems Engineering. He also holds courtesy appointments in Electrical and Computer Engineering and Radiation Oncology. He directs the Visual Intelligence Laboratory at the Center for Computer-Aided Design at the University of Iowa.

Keywords: Computational geometry; Computer vision; Deep learning on non-Euclidean domains; Data-driven geometry modeling; Digital human modeling; Medical geometry processing; Morphometry; Statistical shape analysis

Education

Ph.D. Mechanical and Aerospace Engineering, Seoul National University, Korea, 2013.
Thesis: Nonlinear Analysis of the Space of Human Body Shapes and Its Application to Parametric Human Modeling System (*Best Thesis Honor, Grand Prize from 'the Society of CAD/CAM Engineers Graduate Thesis Awards'*)

B.S. Mechanical and Aerospace Engineering, Seoul National University, Korea, 2009.
Thesis: A Modeling Method for 3D Face Model Using Single 2D Front-View Image (*Best Thesis Honor*)

Affiliations

Assistant Professor | Industrial and Systems Engineering, The University of Iowa

Assistant Professor | Electrical and Computer Engineering, The University of Iowa (by courtesy)

Adjunct Assistant Professor | Radiation Oncology, The University of Iowa (by courtesy)

Faculty Researcher | Center for Computer-Aided Design, The University of Iowa

Faculty Member | Public Digital Arts Cluster, The University of Iowa

Honors and Awards

Best Paper Award from International Conference on Maintenance and Rehabilitation of Constructed Infrastructure Facilities, 2017.

Most Cited Articles in Computer-Aided Design since 2011, Elsevier, 2016.

Best Paper Award from 2015 Annual Conference of the Society of CAD/CAM Engineers, 2015.

Best Paper Award from 2014 Summer Conference of the Society of CAD/CAM Engineers, 2014.

Bronze Prize from 15th Korea CAD/CAM Software Competition, 2014.

Grand Prize from the 1st Delcam Korea & the Society of CAD/CAM Engineers Best Graduate Thesis Awards, 2014.

Best Paper Award from 2014 Annual Conference of the Society of CAD/CAM Engineers, 2014.

Best Student Paper from 2014 Annual Conference of the Society of CAD/CAM Engineers, 2014.

Best Ph.D. Thesis from the School of Mechanical and Aerospace Engineering at Seoul National University, 2014.

Presidential Postdoc Fellowship from the President of Republic of Korea, 2013–2015.

Top 25 Hottest Articles Published in Computer-Aided Design in 2012, Elsevier, 2012.

Bronze Prize from 13th Korea CAD/CAM Software Competition, 2012.

Global Ph.D. Fellowship from the Korean Ministry of Education, 2011–2013.

Best Paper of the Year from Transactions of the Society of CAD/CAM Engineers, 2011.

Best Paper of the Year from Transactions of the Society of CAD/CAM Engineers, 2010.

Bronze Medal from 2009 Korea Software Awards, 2010.

Best Bachelor's Thesis from the School of Mechanical and Aerospace Engineering at Seoul National University, 2008.

Outstanding Design Award from Seoul National University Robot Competition, 2008.

Best Product Development Award from Seoul National University CAD/CAM Contest, 2007.

Award for Appreciation in 2007 School Retreat Program from the School of Mechanical and Aerospace Engineering at Seoul National University, 2007.

Outstanding Design Award from Seoul National University Mechanical Design Contest, 2005.

National Science and Engineering Scholarship from the Korean Ministry of Education, 2005-2009.

Professional Activities

Editorial Board Membership

Editorial Board Member, International Journal of Digital Human, Inderscience, February 2018–Present.

Program Board Member, 10TH International Conference on Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management, July 2018–Present.

Organizing Committee, Annual CAD Conferences and Exhibitions, December 2016–Present.

Reviewer of Scientific Journals

Computer-Aided Design, Elsevier.

Computer-Aided Design and Analysis, Taylor & Francis.

ASME Journal of Computing and Information Science in Engineering.

IEEE Transactions on Emerging Topics in Computational Intelligence.

IEEE Transactions on Biomedical Engineering.

Computer Methods and Programs in Biomedicine, Elsevier.

Computer Methods in Biomechanics and Biomedical Engineering, Taylor & Francis.

Artificial Intelligence in Medicine, Elsevier.

The Visual Computer, Springer.

IEEE Computer Graphics and Applications.

Computer Animation and Virtual Worlds, Wiley.

Computers & Graphics, Elsevier.

International Journal of Industrial Ergonomics, Elsevier.

Transactions of the Society of CAD/CAM Engineers.

Service

Committee Member, Engineering Technology Committee (ETC), Engineering Faculty Council (EFC), The University of Iowa, September 2018–Present.

Faculty Member, Engineering Initiative for Artificial Intelligence, The University of Iowa, September 2018–Present.

Committee Member, Industrial Engineering Graduate Program Committee, The University of Iowa, August 2017–Present.

President, Korean-American Scientists and Engineers Association (KSEA) Iowa City Chapter, November 2017–Present.

Proposal Review Panelist, National Science Foundation (NSF) Civil, Mechanical and Manufacturing Innovation (CMMI) Division, November 2017–December 2017.

Reviewer, National Aeronautics and Space Administration (NASA) Iowa Space Grant Consortium Scholarship, August 2016.

Academic Advisor, Alpha Pi Mu, The University of Iowa, September 2015–August 2017.

Coordinator, Design and Manufacturing Elective Focus Area (EFA), October 2015–Present.

Department Secretary, The University of Iowa, August 2016–August 2017.

IE Program Secretary, The University of Iowa, August 2015–August 2016.

Professional Memberships

Member, Institute of Electrical and Electronics Engineers (IEEE), 2018–Present.

Member, American Association for the Advancement of Science (AAAS), 2018–Present.

Member, Korean-American Scientists and Engineers Association, 2015–Present.

Member, Society of CAD/CAM Engineers, 2013–2015.

Student Member, Korean Society of Mechanical Engineers, 2013–2014.

Student Member, Society of CAD/CAM Engineers, 2009–2013.

Media Coverage

Featured in **Business Record**: "Event Preview: Artificial intelligence, the 4th industrial revolution," February 2018.

Featured in **The Daily Iowan**: "Downtown mural promotes education on renewable energy," January 2018.

Interview with **Press-Citizen**: "Iowa City students troubleshoot in makerspaces," November 2016.

Opinion column on **Kyosu Shinmun** (KOR), July 2014.

Panel Discussions

Panelist. *Emerging Technology in Business Panel*, EntreFest: The Largest Gathering of Iowa's Entrepreneurial and Innovation Community, Cedar Rapids, IA, May 2018.

Panelist. *The Future of Technology*, Corridor Business Journal, Cedar Rapids, IA, March 2018.

Panelist. *Artificial Intelligence: The 4th Industrial Revolution*, Business Record Magazine, Des Moines, IA, March 2018.

Artworks and Exhibitions

Participating Artist, Live Geometry: a durational performance and gallery event, Dada Futures, Iowa City, IA, April 2018.

Participating Artist, A device for measuring the sonification of everyday things, 2018 National Conference on Education for the Ceramic Arts (NCECA), Pittsburgh, PA, March 2018.

Participating Artist, STEAM Wall Project: Interactive art installation at Robert A. Lee Recreation Center in Iowa City, Funded by The City of Iowa City Public Art Program, 2017.

Participating Artist, Live Geometry: Can Data create an art form?, Funded by Arts and Humanities Initiative (AHI) Award, The University of Iowa, 2017.

Work Experience

Assistant Professor, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, August 2015–Present.

Visiting Research Associate, Ronald E. McN*AIR* Center for Aerospace Innovation and Research, The University of South Carolina, Columbia, SC, October 2014.

Senior Researcher, Institute of Advanced Machinery and Design, Seoul National University, Seoul, Korea, September 2013–July 2015.

Technical Research Personnel, Republic of Korea Army (Alternative Military Duty), October 2011–February 2015.

Graduate Research Assistant, Human-Centered CAD Laboratory, Seoul National University, Seoul, Korea, March 2009–August 2013.

Design Engineer (Part-time), Department for Robot Arm Design, Hurotech Co. Ltd., Seoul, Korea, March 2008–October 2008.

Undergraduate Research Assistant, Human-Centered CAD Laboratory, Seoul National University, Seoul, Korea, September 2007–February 2009.

Research Projects

Ongoing Projects

ATCA02 Role: **Principal Investigator** Amount: **$78,600**

Funding Source:	A gift from Aisin Technical Center of America, Inc.
Project Title:	Modeling Anthropometrically Accurate Avatars for Vehicle Simulations
Funding Period:	April 2019–March 2020
Summary:	(Classified)

HMC Role: **Principal Investigator** Amount: **$221,398**

Funding Source:	Hyundai Motor Company (HMC)
Project Title:	A Study on User Experience in Autonomous Driving Scenarios
Funding Period:	April 2019–January 2020
Summary:	(Classified)

CDC R49 CE002108-05 Role: **Principal Investigator** Amount: **$15,000**

Funding Source:	Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control
Project Title:	In-home Gait and Balance Screening for the Risk Assessment of Falls in Elderly Populations
Funding Period:	July 2018–June 2019
Summary:	The goal of this project is to study elderly gait motions using smart-shoe sensors and develop a predictive model for future risk of fall injury.

69A3551747131 Role: **Principal Investigator** Amount: **$25,933**

Funding Source: U.S. Department of Transportation, Office of the Assistant Secretary for Research and Technology
Project Title: Driver360: A Four-dimensional Scanning System to Better Understand Drivers
Funding Period: May 2018–November 2018
Summary: The objective of this project is to construct a four-dimensional (4D = spatial + temporal) scanning system that can be installed in a driving simulator environment.

U.S. DOT 693JJ31750016 Role: **Co-PI** (PI: Daniel McGehee) Amount: **$1,862,640**

Funding Source: U.S. Department of Transportation (DOT), Federal Highway Administration (FHWA) Exploratory Advanced Research (EAR) Program
Project Title: Developing Connected Simulation to Study Interactions between Drivers, Pedestrians, and Bicyclists
Funding Period: October 2017–September 2019
Summary: The goal of this project is to develop virtual reality technologies for interactive simulation among subjects within different simulation environments in order to study the road user behaviors for enhancing road safety.

ATCA01 Role: **Principal Investigator** Amount: **$250,000**

Funding Source: A gift from Aisin Technical Center of America, Inc.
Project Title: Driver State Detection via Deep Learning
Funding Period: October 2017–March 2019
Summary: (Classified)

Past Projects

Old Gold Summer Fellowship Role: **Principal Investigator** Amount: **$6,000**

Funding Source: Old Gold Summer Fellowship, The University of Iowa
Project Title: Deep Learning on Non-Euclidean Domains
Funding Period: May 2018–August 2018
Summary: The goal of this project is to develop a mathematical foundation for expanding the basic building blocks of deep neural networks to non-Euclidean domains such as manifolds, graphs, and point clouds.

U.S. DOD N00014-16-1-2220 Role: **Co-I** (PI: Karim Abdel-Malek) Amount: **$41,196**

Funding Source: U.S. Department of Defense (DOD) Office of Naval Research (ONR)
Project Title: Malum Terminus: A US Marine Corps Simulation System for Injury Avoidance
Funding Period: January 2016–December 2017 (*Subcontract*)
Summary: The goal of this study is to discover the causal effects of various demographic, anthropometric, physiological, and biomechanical factors on musculoskeletal injury and to develop an artificial intelligence-powered simulation tool for predicting potential injury.

U.S. DOD W911QY-12-C-0009 Role: **Co-I** (PI: Karim Abdel-Malek) Amount: **$30,000**

Funding Source: U.S. Department of Defense (DOD) Department of Army
Project Title: Integrated Human Model for PPE Analysis and Design
Funding Period: June 2016–February 2017 (*Subcontract*)
Summary: The goal of this project was to develop a digital human model for analysis and design of personal protection equipment (PPE) covering a diverse anthropometric population.

Teaching

Teaching Excellence

Recognition from the Graduating Class of 2016, 2018

Courses Taught

Instructor, IE:6380 **Deep Learning**, Graduate Course, The University of Iowa, 2018–Present.

Instructor, IE:4172 **Big Data Analytics**, Undergraduate Elective, The University of Iowa, 2018–Present.

Instructor, IE:6232 **Advanced Computer-Aided Design and Manufacturing**, Graduate Course, The University of Iowa, 2015–Present.

Instructor, ENGR:2760 **Design for Manufacturing**, Core Engineering Course, The University of Iowa, 2016–Present.

Instructor, **Computer-Aided Design**, Graduate Course, Seoul National University, 2014.

Teaching Assistant, **Digital Computer Concept and Practice**, Undergrad Course, Seoul National University, 2011–2012.

Teaching Assistant, **Computer-Aided Design**, Graduate Course, Seoul National University, 2010–2012.

Teaching Assistant, **Computer-Aided Design and Manufacturing**, Undergrad Course, Seoul National University, 2010–2012.

Graduate Students Advised

Samuel S. Mate, M.S. Mechanical Engineering, The University of Iowa, 2016. "Anthropometric Human Modeling based on Nonlinear Statistical Shape Analysis" (Funding: Startup)

Zachary J. Nolte, M.S. Industrial Engineering, The University of Iowa, 2017. "Massive 3D Model Segmentation through Gamification." (Funding: Startup)

Benjamin R. Perlson, M.S. Industrial Engineering, 2019. Non-thesis Track.

Zhiyu Sun, Ph.D. Industrial Engineering, The University of Iowa, 2019. "Convolutional Neural Networks on Manifolds via Zernike Polynomial." (Funding: Startup/ONR)

Yusen He, Ph.D. Industrial Engineering, The University of Iowa, 2020. "Real-time Prediction of the Geometric Accuracy of Additive Manufacturing Processes via Geometric Convolutional Autoencoders." (Funding: TA/U.S. DOT)

Sehyun Eric Chun, Ph.D. Industrial Engineering, The University of Iowa, 2023. "TBD - Vehicle Driver State Detection via Deep Learning." (Funding: Aisin)

Boogun Choi, Ph.D. Industrial Engineering, The University of Iowa, 2023. "TBD - Development of Dynamic Human Avatar for Virtual Reality Simulation." (Funding: U.S. DOT)

Thesis Committee Membership

Zhiyu Sun, M.S. Mechanical Engineering, The University of Iowa, 2015. "Generating Analysis-Ready NURBS Models of Cloth for Isogeometric Analysis."

Anton Akusok, Ph.D. Industrial Engineering, The University of Iowa, 2016. "Extreme Learning Machines: Novel Extensions and Application to Big Data."

Andrey Gritsenko, Ph.D. Industrial Engineering, The University of Iowa, 2017. "Bringing Interpretability and Visualization with Artificial Neural Networks."

Jaemin Powell, M.S. Industrial Engineering, The University of Iowa, 2017. "Hardware Design for an Electro-Mechanical Bicycle Simulator in an Immersive Virtual Reality Environment."

Yuanming Luo, Ph.D. Mechanical Engineering, The University of Iowa, 2018. "Inverse Finite Element and Tissue Property Identification."

Jack L. Rummells, Ph.D. Biomedical Engineering, The University of Iowa, 2021. "Biomechanical Assessment Techniques for Data Analytics to Predict Risk of Sport Injury."

Publications

Journal Articles

25. Yoon, S., Baek, S., & Lee, D. (2019). 4D cardiac motion modeling using pair-wise mesh registration. *Lecture Notes in Computer Science*, 11395: 161–170. DOI: 10.1007/978-3-030-12029-0_18.

24. Liu, T. C., Bhatt, R., Farrell, K. D., Baek, S., Liu, Y. M., Abdel-Malek, K., & Arora, J. (2018). A quantitative assessment of variations in the palm surface area as a percentage of total body surface area within the general population. *International Journal of Human Factors Modelling and Simulation*, 6(1): 81–96.

23. Ouyang, T., He, Y., Li, H., Sun, Z., & Baek, S. (2018). A deep learning framework for short-term power load forecasting. *IEEE Transactions on Emerging Topics in Computational Intelligence*, **Accepted**.

22. Gritsenko, A., Akusok, A., Baek, S., Miche, Y., & Lendasse, A. (2018). Extreme Learning Machines for VISualization+R - mastering visualization with target variables. *Cognitive Computation*, 10(3): 464–477. DOI: 10.1007/s12559-017-9537-6.

21. Shi, Y., Zhang, Y., Baek, S., Backer, W. D., & Harik, R. (2018). Manufacturability analysis for additive manufacturing using a novel feature recognition technique. *Computer-Aided Design and Applications*, 15(6): 941–952. DOI: 10.1080/16864360.2018.1462574.

20. Luo, Y., Fan, Z., Baek, S., & Lu, J. (2018). Machine learning-aided exploration of relationship between strength and elastic properties in ascending thoracic aneurysm. *International Journal for Numerical Methods in Biomedical Engineering*, 34(6): e2977. DOI: 10.1002/cnm.2977.

19. Sun, Z., Harik, R., & Baek, S. (2018). Mesh segmentation via geodesic curvature flow. *Computer-Aided Design and Applications*, 15(5): 677–683. DOI: 10.1080/16864360.2018.1441235.

18. Sun, Z., He, Y., Gritsenko, A., Lendasse, A., & Baek, S. (2017). Deep spectral descriptors: learning the point-wise correspondence metric via Siamese deep neural networks. *ArXiv Preprint: ArXiv:1710.06368*,

17. Harik, R., Shi, Y., & Baek, S. (2017). Shape Terra: mechanical feature recognition based on a persistent heat signature. *Computer-Aided Design and Applications*, 14(2): 206–218. DOI: 10.1080/16864360.2016.1223433.

16. Akusok, A., Baek, S., Miche, Y., Björk, K.-M., Nian, R., Lauren, P., & Lendasse, A. (2016). ELMVIS+: fast nonlinear visualization technique based on cosine distance and extreme learning machines. *Neurocomputing*, 205: 247–263. DOI: 10.1016/j.neucom.2016.04.039.

15. Baek, S.-Y. & Lee, K. (2016). Statistical foot-shape analysis for mass-customisation of footwear. *International Journal of Computer Aided Engineering and Technology*, 8(1/2): 80–98. DOI: 10.1504/IJCAET.2016.073265.

14. Baek, S.-Y., Kam, D.-U., & Lee, K. (2015). Differential operators on a triangular mesh and their applications. *Transactions of the Society of CAD/CAM Engineers*, 20(1): 44–54.

13. Baek, S.-Y., Lim, J., & Lee, K. (2015). Isometric shape interpolation. *Computers & Graphics*, 46(1): 257–263. DOI: 10.1016/j.cag.2014.09.025.

12. Park, J., Kim, T., Baek, S.-Y., & Lee, K. (2015). An algorithm for estimating surface normal from its boundary curves. *Journal of Computational Design and Engineering*, 2(1): 67–72. DOI: 10.1016/j.jcde.2014.11.007.

11. Baek, S.-Y. & Lee, K. (2014). An isometric shape interpolation method on mesh models. *Transactions of the Society of CAD/CAM Engineers*, 19(2): 1–10.

10. Cho, S., Baek, D., Baek, S.-Y., Lee, K., & Bang, H. (2014). 3d volume drawing on a potter's wheel. *IEEE Computer Graphics and Applications*, 34(3): 50–58. DOI: 10.1109/MCG.2014.3.

9. Choi, J.-H., Baek, S.-Y., Kim, Y., Son, T.-G., Park, S., & Lee, K. (2014). Automatic detection of inferior alveolar nerve canal from cone-beam computed tomography images for dental surgery planning. *Studies in Health Technology and Informatics*, 196(1): 61–65. DOI: 10.3233/978-1-61499-375-9-61.

8. Song, J., Cho, S., Baek, S.-Y., Lee, K., & Bang, H. (2014). GaFinC: gaze and finger control interface for 3D model manipulation in CAD application. *Computer-Aided Design*, 46(1): 239–245. DOI: 10.1016/j.cad.2013.08.039.

7. Baek, S.-Y. & Lee, K. (2013). Parametric human body modeling system for virtual garment fitting. *International Journal of Computer Aided Engineering and Technology*, 5(2/3): 242–261. DOI: 10.1504/IJCAET.2013.052932.

6. Baek, S.-Y., Wang, J. H., Song, I., Lee, K., Lee, J., & Koo, S. (2013). Automated bone landmarks prediction on the femur using anatomical deformation technique. *Computer-Aided Design*, 45(2): 505–510. DOI: 10.1016/j.cad.2012.10.033.

5. Lee, S., Baek, S.-Y., Son, J., Kim, D., & Lee, K. (2012). Changes in medio-lateral knee joint reaction force of patients with over-pronation during gait due to insole parameters - a case study. *Transactions of the Society of CAD/CAM Engineers*, 17(3): 149–155.

4. Baek, S.-Y. & Lee, K. (2012). Parametric human body shape modeling framework for human-centered product design. *Computer-Aided Design*, 44(1): 56–67. DOI: 10.1016/j.cad.2010.12.006. **Top 25 Hottest Articles Published in Computer-Aided Design in 2012**.

3. Lee, J., Baek, S.-Y., & Lee, K. (2010). 3d generic vertebra model for computer aided diagnosis. *Transactions of the Society of CAD/CAM Engineers*, 15(4): 297–305. **Best Paper of the Year**.

2. Choi, J.-H., Park, S.-W., Baek, S.-Y., & Lee, K. (2010). Evaluation of handheld products by computing user hand fatigue. *Simulation Modeling Practice and Theory*, 18(2): 230–239. DOI: 10.1016/j.simpat.2009.10.009.

1. Jang, T., Baek, S.-Y., & Lee, K. (2009). Synthesis of human body shape for given body sizes using 3d body scan data. *Transactions of the Society of CAD/CAM Engineers*, 14(6): 364–373. **Best Paper of the Year**.

Conference Proceedings

53. Sun, Z., Lu, J., & Baek, S. (2018). Zernet: convolutional neural networks on arbitrary surfaces via zernike local tangent space estimation. In *ArXiv Preprint: ArXiv:1812.01082*.

52. Baek, S. & Song, S. (2018). Shape matters: Evidences from machine learning on body shape-income relationship. In *88th Southern Economic Association Annual Meetings (SEA 2018)*. **Accepted**.

51. Baek, S. & Song, S. (2018). Shape matters: Evidences from machine learning on body shape-income relationship. In *28th Annual Meeting of Midwest Econometrics Group (MEG 2018)*. **Accepted**.

50. Yoon, S., Baek, S., & Lee, D. (2018). 4D cardiac motion modeling using pair-wise mesh registration. In *21st International Conference on Medical Image Computing & Computer Assisted Intervention (MICCAI) Workshop*. **Accepted**.

49. Baek, S. & Song, S. (2018). Economic models with non-euclidean data. In *2018 Joint Statistical Meetings (JSM 2018)*. Vancouver, Canada.

48. Baek, S., Sun, Z., Yaddanapudi, S., Kim, Y., Gross, B., Hawkes, K., McCune, K., Yuan, T., & Xia, J. (2018). Applying machine learning for automated liver segmentation on radiotherapy planning CT. In *2018 Annual Meeting of the American Association of Physicists in Medicine (AAPM 2018)*. Nashville, Tennessee.

47. He, Y., Fei, F., Wang, W., Song, X., Sun, Z., & Baek, S. (2018). Predicting manufactured shapes of a projection micro-stereolithography process via convolutional encoder-decoder networks. In *ASME 2018 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE 2018)*. Quebec, Canada.

46. Baek, S., Sun, Z., & Lu, J. (2018). Wall stress estimation in cerebral aneurysm via geometric convolutional neural network. In *The 8th World Congress of Biomechanics (WCB 2018)*. Dublin, Ireland.

45. Luo, Y., Fan, Z., Baek, S., & Lu, J. (2018). Machine-learning investigation of relationship between strength and response features in ascending thoracic aneurysm tissue. In *The 8th World Congress of Biomechanics (WCB 2018)*. Dublin, Ireland.

44. Baek, S. & Song, S. (2018). Estimation of economic models with non-euclidean data. In *New Frontiers in Econometrics*. Stamford, Connecticut.

43. Sun, Z., Lu, J., & Baek, S. (2018). Wall stress estimation of cerebral aneurysm based on zernike convolutional neural networks. In *ArXiv Preprint: ArXiv:1806.07441*.

42. Gritsenko, A., Sun, Z., Baek, S., Miche, Y., Hu, R., & Lendasse, A. (2017). Deformable surface registration with extreme learning machines. In *International Conference on Extreme Learning Machines (ELM2017)*. Yantai, China.

41. Nolte, Z., Riley, M., Harik, R., & Baek, S. (2017). Mosquito Popper: a multiplayer online game for 3d body scan data segmentation. In *14th Annual International CAD Conference (CAD'17)*. Okayama, Japan.

40. Shi, Y., Zhang, Y., Baek, S., & Harik, R. (2017). Validation of feature recognition on manufacturability analysis for additive manufacturing. In *14th Annual International CAD Conference (CAD'17)*. Okayama, Japan.

39. Sun, Z., Baek, S., & Harik, R. (2017). Mesh segmentation via geodesic curvature flow. In *14th Annual International CAD Conference (CAD'17)*. Okayama, Japan.

38. Baek, S., Lee, H., Bhatt, R., Farrell, K., Arora, J. S., & Abdel-Malek, K. (2017). Parametric modeling of korean construction workers for the safer construction environment. In *International Conference on Maintenance and Rehabilitation of Constructed Infrastructure Facilities (2017 MAIREINFRA)*. Seoul, Korea. **Best Paper Award**.

37. Luo, Y., Baek, S., & Lu, J. (2017). Classifying stress strain curves obtained at rupture and non-rupture sites in ascending thoractic aneurysm tissue using machine learning. In *5th International Conference on Computational and Mathematical Biomedical Engineering (CMBE2017)*.

36. Akusok, A., Eirola, E., Miche, Y., Oliver, I., Björk, K.-M., Gritsenko, A., Baek, S., & Lendasse, A. (2016). Incremental ELMVIS for unsupervised learning. In *International Conference on Extreme Learning Machines (ELM2016)*. Marina Bay Sands, Singapore.

35. Gritsenko, A., Akusok, A., Baek, S., & Lendasse, A. (2016). ELMVIS++R – Mastering visualization with target variables. In *International Conference on Extreme Learning Machines (ELM2016)*. Marina Bay Sands, Singapore.

34. Baek, S., Sun, Z., & Mate, S. S. (2016). Development of full-resolution anthropometric human models based on nonlinear statistical shape analysis. In *7th International Conference of Applied Human Factors and Ergonomics*. Orlando, Florida.

33. Gritsenko, A., Akusok, A., Miche, Y., Bjork, K.-M., Baek, S., & Lendasse, A. (2016). Combined nonlinear visualization and classification: ELMVIS++C. In *2016 International Joint Conference on Neural Networks (IJCNN 2016)*. Vancouver, Canada. **(Acceptance rate: 58.33%)**.

32. Harik, R., Baek, S.-Y., Bruchem, B.-J. V., & Tooren, M. V. (2015). SHAPE TERRA: industrial feature recognition based on persistent heat signature. In *12th Annual International CAD Conference (CAD'15)*. London, The United Kingdom.

31. Harik, R., Baek, S.-Y., Bruchem, B.-J. V., & Tooren, M. V. (2015). Shape Terra: a feature recognition tool using persistent heat signature. In *2015 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

30. Jang, S., Woo, S., Kam, D.-U., Baek, S.-Y., & Lee, K. (2014). Automatic generation of lego layout from 3d model. In *2014 Autumn Conference of the Korean Society of Mechanical Engineers*. Gwangju, Korea.

29. Kim, D.-W., Baek, S.-Y., & Lee, K. (2014). Local parameterization of meshes using geodesics. In *2014 Autumn Conference of the Korean Society of Mechanical Engineers*. Gwangju, Korea.

28. Lee, J., Lim, J., Baek, S.-Y., & Lee, K. (2014). Extraction of a margin line for dental CAD. In *2014 Autumn Conference of the Korean Society of Mechanical Engineers*. Gwangju, Korea.

27. Woo, S., Baek, S.-Y., & Lee, K. (2014). Optimization method for rapid rigid-registration between x-ray and digitally reconstructed radiography. In *2014 Autumn Conference of the Korean Society of Mechanical Engineers*. Gwangju, Korea.

26. Baek, S.-Y., Lim, J., & Lee, K. (2014). Isometric shape interpolation. In *Shape Modeling International (SMI 2014)*. Hong Kong. **(Acceptance rate: 36%)**.

25. Baek, S.-Y., Kam, D.-U., & Lee, K. (2014). Differential operators on a triangular mesh and their applications. In *2014 Summer Conference of the Society of CAD/CAM Engineers*. Muju, Korea. **Best Paper Award**.

24. Kim, D.-W., Lee, J., Baek, S.-Y., & Lee, K. (2014). Algorithm for generating high-precision point cloud using quaternary coded structured light and phase. In *2014 Summer Conference of the Society of CAD/CAM Engineers*. Muju, Korea.

23. Woo, S., Lee, J.-H., Baek, S.-Y., & Lee, K. (2014). Automatic generation of high-quality digitally reconstructed radiography for registration between 2d x-ray image and 3d CT image. In *2014 Summer Conference of the Society of CAD/CAM Engineers*. Muju, Korea.

22. Lee, J.-H., Woo, S., Baek, S.-Y., Lee, K., Dong, Y., & Lee, S. (2014). A c-arm calibration method for 2d-3d registration. In *2014 Annual Conference of the Korean Society of Medical Robot*. Seoul, Korea.

21. Lim, J., Baek, S.-Y., Lee, J., & Lee, K. (2014). Automatic determination of the insertion axis of a dental crown that minimizes undercut area. In *10th International Symposium on Tools and Methods for Competitive Engineering (TMCE 2014)*. Budapest, Hungary.

20. Baek, S.-Y. & Lee, K. (2014). An isometric shape interpolation method on mesh models. In *2014 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea. **Best Paper Award**.

19. Choi, J.-H., Baek, S.-Y., Kim, Y., Son, T.-G., Park, S., & Lee, K. (2014). Automatic detection of inferior alveolar nerve canal from cone-beam computed tomography images for dental surgery planning. In *NEXTMED/MMVR21*. Manhattan Beach, CA, USA.

18. Lim, J., Baek, S.-Y., Lee, J., & Lee, K. (2014). Automatic algorithm for finding insertion axis of dental prosthesis. In *2014 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

17. Park, J.-S., Kim, T., Baek, S.-Y., & Lee, K. (2014). An algorithm for estimating surface normal from its boundary curves. In *2014 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea. **Best Student Paper Award**.

16. Song, J., Cho, S., Baek, S.-Y., Lee, K., & Bang, H. (2013). GaFinC: Gaze and finger control interface for 3d model manipulation in cad application. In *SIAM Conference on Geometric & Physical Modeling (GD/SPM13)*. Denver, CO, USA. **(Acceptance rate: 26.8%)**.

15. Park, H., Lee, D., Yang, S., Lee, S., Baek, S.-Y., & Lee, K. (2012). Kinecad: a novel gesture-based CAD system using kinect. In *2012 Asian Conference on Design and Digital Engineering (ACDDE 2012)*. Hokkaido, Japan.

14. Baek, S.-Y., Wang, J. H., Song, I., Lee, K., & Koo, S. (2012). Automated bone landmarks prediction on the femur using anatomical deformation technique. In *Symposium on Solid and Physical Modeling (SPM 2012)*. Dijon, France. **(Acceptance rate: 44%)**.

13. Lee, S., Baek, S.-Y., Son, J., Kim, D., & Lee, K. (2012). Changes in medio-lateral knee joint reactions of flatfoot patients due to insole conditions. In *18th Congress of the European Society of Biomechanics*. Lisbon, Portugal.

12. Baek, S.-Y., Son, J., & Lee, K. (2012). Statistical analysis of foot shape for designing mass-customized footwear. In *9th International Symposium on Tools and Methods for Competitive Engineering (TMCE 2012)*. Karsluhe, Germany.

11. Son, J., Baek, S.-Y., & Lee, K. (2012). Automatic measurement of dimensions of 3d foot scan data. In *Asian Workshop on 3D Body Scanning Technologies*. Tokyo, Japan.

10. Baek, S.-Y., Son, J., & Lee, K. (2012). Knowledge-based design framework for user-tailored insoles. In *2012 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea. **Invited Talk**.

9. Lee, S., Baek, S.-Y., Son, J., Kim, D., & Lee, K. (2012). Changes in medio-lateral knee joint reaction force of patients with over-pronation during gait due to insole parameters. In *2012 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

8. Son, J., Baek, S.-Y., & Lee, K. (2012). An algorithm for automatic measurement of dimensions of 3d foot scan data. In *2012 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

7. Baek, S.-Y., Lee, J., & Lee, K. (2011). Deformation of raw 3d scan surfaces via multi-resolution RBF networks. In *Asian Workshop on 3D Body Scanning Technologies*. Tokyo, Japan.

6. Jo, J., Baek, S.-Y., Lee, K., Song, I.-s., & Koo, S. (2011). Statistical deformation of femur geometry. In *2011 Spring Conference of the Korean Society of Mechanical Engineers*. Pohang, Korea.

5. Lee, J., Baek, S.-Y., & Lee, K. (2011). 3d generic vertebra model for computer aided diagnosis. In *2011 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

4. Baek, S.-Y. & Lee, K. (2010). Interactive parametric modeling of human body shape. In *2010 Asian Conference on Design and Digital Engineering (ACDDE 2010)*. Jeju, Korea.

3. Baek, S.-Y. & Lee, K. (2010). Parametric human body modeling system for virtual garment fitting. In *8th International Symposium on Tools and Methods of Competitive Engineering (TMCE 2010)*. Ancona, Italy.

2. Baek, S.-Y., Kim, B.-Y., & Lee, K. (2009). 3d face model reconstruction from single 2d frontal image. In *8th ACM SIGGRAPH International Conference on Virtual Reality Continuum and Its Applications in Industry (VRCAI '09)*. Tokyo, Japan. **(Acceptance rate: 41%)**.

1. Jang, T., Baek, S.-Y., & Lee, K. (2009). Synthesis of human body shape for given body parameters using 3d body scan data. In *2009 Annual Conference of the Society of CAD/CAM Engineers*. Pyeongchang, Korea.

Invited Talks

Navigating the Space of Shapes through the Lens of Deep Learning. *Graduate Seminar*, Departmenbt of Industrial and Manufacturing Systems Engineering, Iowa State University, Ames, IA, March 2019.

Navigating the Space of Shapes through the Lens of Deep Learning. *College of Nursing Research Forum*, The University of Iowa, Iowa City, IA, March 2019.

Navigating the Space of Shapes through the Lens of Deep Learning. *Informatics Day*, The University of Iowa Informatics Initiative (UI3), The University of Iowa, Iowa City, IA, February 2019.

Navigating the Space of Shapes through the Lens of Deep Learning. *AMCS Seminar*, Interdisciplinary Graduate Program in Applied Mathematical and Computational Sciences, The University of Iowa, Iowa City, IA, February 2019.

Navigating the Space of Shapes through the Lens of Deep Learning. *Radiology Insight Lecture Series*, Department of Radiology, University of Iowa Hospitals and Clinics, The University of Iowa, Iowa City, IA, January 2019.

Navigating the Space of Shapes through the Lens of Deep Learning. *Graduate Seminar*, Department of Mechanical Engineering, Chung-Ang University, Seoul, South Korea, December 2018.

Navigating the Space of Shapes through the Lens of Deep Learning. *Translational Research Seminar*, Department of Radiation Oncology, University of Iowa Hospitals and Clinics, The University of Iowa, Iowa City, IA, October 2018.

Visual Intelligence Laboratory. *Department of Mechanical and Industrial Engineering Advisory Board Meeting*, The University of Iowa, Iowa City, IA, April 2018.

Digital Human Modeling for Prediction and Prevention of Musculoskeletal Injury. *Greater Iowa Asphalt Conference*, Asphalt Paving Association of Iowa, Des Moines, IA, March 2018.

Deep Learning on Non-Euclidean Data. *Midwest Conference on Careers for Frontier Science and the 4th Generation Industrial Revolution Technology*, Korean-American Scientists and Engineers Association, Schaumburg, IL, November 2017.

Deep Learning on Non-Euclidean Data. *Translational Research Seminar*, Department of Radiation Oncology, University of Iowa Hospitals and Clinics, The University of Iowa, Iowa City, IA, November 2017.

Teaching Computers How to Design. *Mechanical Engineering Graduate Seminar*, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, October 2017.

Teaching Computers How to Design. Korea Institute of Science and Technology, Seoul, Korea, August 2017.

Digital Human Models for Human-Centered Infrastructure, Korea Institute of Construction Technology, Goyang, Korea, August 2017.

Teaching Computers How to Design, Department of Mechanical Engineering, Kyungpook National University, Daegu, Korea, August 2017.

Teaching Design to Computers. *Industrial Engineering Graduate Seminar*, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, March 2017.

Solving Computational Geometry Problems with Games, EPX Video Game and Animation Studio, The University of Iowa, Iowa City, IA, February 2017.

Inside IDEA lab, *Public Digital Arts Showcase*, Public Digital Arts (PDA) Cluster, The University of Iowa, Iowa City, IA, October 2016.

MetaCAD: CAD beyond CAD. *Informatics Symposium*, The University of Iowa Informatics Initiative (UI3), Iowa City, IA, April 2016.

Design from Big Data. *Graduate Seminar*, Department of Mechanical Engineering, University of Wisconsin at Madison, WI, January 2016.

MetaCAD: CAD beyond CAD. *ECE Graduate Seminar*, Department of Electrical and Computer Engineering, The University of Iowa, Iowa City, IA, January 2016.

Solving Industrial Engineering Problems using Global Brain. *Industrial Engineering Graduate Seminar*, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, October 2015.

Technology and Art. *Department of Mechanical and Industrial Engineering Advisory Board Meeting*, The University of Iowa, Iowa City, IA, October 2015.

MetaCAD: CAD beyond CAD. *Mechanical Engineering Graduate Seminar*, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, September 2015.

Understanding Digital Shapes. *Korean-American Scientists and Engineers Association (KSEA) Iowa City Chapter Meeting*, Iowa City, IA, September 2015.

Understanding Human Body Shapes. *Mechanical Engineering Graduate Seminar*, Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, IA, January 2015.

Understanding Human Body Shapes. *Graduate Seminar*, School of Mechatronics, Gwangju Institute of Science and Technology (GIST), Gwangju, Korea, December 2014.

Knowledge-Based Design Framework for User-Tailored Insoles. *2012 Annual Conference of the Society of CAD/CAM Engineers*, Pyeongchang, Korea, August 2012.

Patents

Baek, S.-Y., He, Y., Wu, X., Kim, Y., Allen, B.G., Buatti, J.M. System and Methods for Prognostic Prediction and Visualization of Cancer Survival, *United States Patent Application US62811326*, February 2019.

Abdel-Malek, K., **Baek, S.-Y.** System and Method for Identifying and Pacifying a Potential School Shooter, *United States Patent Application US62652513*, April 2018.

Lee, Y., Lee, K., **Baek, S.-Y.**, Kam, D.-U., Kim, D.-W., Yoo, S. Systems and Methods for Optical Recognition of Tire Specification, *United States Patent US9798946B2*, October 2017.

Lee. Y., Lee, K., **Baek, S.**, Kam, D.-U., Kim, D.-W., Yoo, S. Method and Apparatus for Measuring Tire Tread Abrasion, *United States Patent Application 20160221404*, August 2016.

Lee, Y., Lee, K., **Baek, S.**, Kam, D.-U., Kim, D.-W., Yoo, S. Method of Measuring Tread Abrasion of Tire and Appartus Thereof, *Republic of Korea Patent No. 10-1534259*, June 2015.

Lee, Y., Lee, K., **Baek, S.**, Kam, D.-U., Kim, D.-W., Yoo, S. Method of recognizing tire damage and method thereof, *Republic of Korea Patent No. 10-1504345*, March 2015.

Lee, K., **Baek, S.** Apparatus and Method for Displaying 3-dimensional Contents, *Republic of Korea Patent No. 10-1310498*, September 2013.

Lee, K., **Baek, S.**. Method of Manufacturing an Insole, *Republic of Korea Patent No. 10-1223238*, January 2013.

Ahn, S.-H., Park, S.-W., Li, L., **Baek, S.** Opening and Closing Door Knob Aids, *Republic of Korea Patent No. 10-1113498*, January 2012.

Lee, K., **Baek, S.** System for Creating 3D Human Body Model and Method Therefor, *Republic of Korea Patent No. 10-1072944*, October 2010.

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