
CONTACT INFORMATION	NVIDIA Corporation 2788 San Tomas Expressway Santa Clara, CA 95050 USA	<i>Mobile:</i> +1-678-707-3912 <i>E-mail:</i> kihwan23.kim@gmail.com <i>Homepage:</i> Personal & NVIDIA
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RESEARCH INTERESTS	3D Vision and machine learning problems including dynamic and static scene understanding; 3D/4D reconstruction, camera pose estimation (SLAM and VO), object detection and tracking with various modalities such as RGB/D and Lidar/Radar sensors. Applications include the localization and environmental aware systems for autonomous driving, AR/VR and various robotics applications.	
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EDUCATION	Georgia Institute of Technology Ph.D., M.S. in Computer Science (Computer vision), Dec. 2011 <ul style="list-style-type: none"> • Thesis: <i>Spatio-temporal Data Interpolation for Dynamic Scene Analysis</i> • Advisor: Professor Irfan Essa Yonsei University B.S. in Electrical Engineering, 1994 –1996, 1998 –2001	Atlanta, Georgia Seoul, South Korea
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EMPLOYMENT HISTORY	NVIDIA Research Research Staff, Senior research scientist Georgia Institute of Technology, College of Computing Graduate Research Assistant Disney Research Pittsburgh Visiting Research Associate/Research Intern Samsung IT R&D Center, SDS Software Engineer Samsung Electronics, Digital Solution Center Ubiquitous Task Force Republic of Korea Air Force Engineer/Sergeant	Santa Clara, California Jan. 2012 – Present Atlanta, Georgia Aug. 2005 – Dec. 2011 Pittsburgh, Pennsylvania Jan. 2009 – Aug. 2009 Seoul, South Korea Mar. 2001 – Aug. 2005 Seoul, South Korea Jun. 2003 – Jan. 2004 Suwon, South Korea Mar. 1996 – Sep. 1998
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SUMMARY OF RECENT PROJECTS	<p>[Autonomous Driving] Leading projects for creating localization and mapping algorithms with different modalities. Contributing to SDKs/DrivePX/legacy VisionWorks.</p> <p>[3D Vision for AR/VR] 6DOF Camera tracking with HQ 3D reconstruction, inverse rendering (light and reflectance estimation) for AR/VR applications and SDKs.</p> <p>[VirtualEye] Led DARPA funded real-time 4D dynamic scene reconstruction project.</p> <p>[NVSLAM] Core umbrella project for various 3D vision applications including SLAM.</p> <p>[Robotics] Point cloud processing for robot navigation and affordance prediction.</p> <p>[User Interface] Multi-modal gesture recognition framework for VR and DriveIX.</p> <p>[Mid-level vision] Algorithms for scene flow, plane detection, object detection.</p>	
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LATEST
ARXIV PAPERS

- [ARXV19a]** M. Innmann, K.Kim, J. Gu, M. Nießner, C. Loop, M. Stamminger, J.Kautz, *NR-MVS: Non-Rigid Multi-view Stereo*. arXiv:1901.03910
- [ARXV19b]** C.Liu, K.Kim, J.Gu, Y. Furukawa, J.Kautz, *PlaneRCNN: 3D Plane Detection and Reconstruction from a Single View*. arXiv:1812.04072
- [ARXV19c]** C.Liu, J.Gu, K.Kim, S. Narasimhan, J.Kautz, *Neural RGB→D Sensing: Depth and Uncertainty from a Video Camera*. arXiv:1901.02571
- [ARXV19d]** S.Sengupta, J. Gu, K.Kim, G.Liu, D. Jacobs, J.Kautz, *Neural Inverse Rendering of an Indoor Scene from a Single Image*. arXiv:1901.02453
- [ARXV18a]** A. Ranjan, V. Jampani, K.Kim, D.Sun, L.Balles, J.Wulff, M.Black, *Collaboration: Joint Unsupervised Learning of Depth, Camera Motion, Optical Flow and Motion Segmentation*. arXiv:1805.09806

REFEREED
CONFERENCE
PUBLICATIONS

- [ECCV18a]** Z. Lv, K. Kim, A. Troccoli, D. Sun, J. Rehg, J. Kautz, *Learning Rigidity in Dynamic Scenes with a Moving Camera for 3D Motion Field Estimation*, In *Proceeding of 2018 European Conference on Computer Vision, ECCV 2018*
- [ECCV18b]** B. Eckart, K. Kim, J. Kautz, *Fast and Accurate Point Cloud Registration using Trees of Gaussian Mixtures*, In *Proceeding of 2018 European Conference on Computer Vision, ECCV 2018*
- [CVPR18]** S. Brahmbhatt, J. Gu, K. Kim, J. Hays, J. Kautz, *Geometry-Aware Learning of Maps for Camera Localization (MapNet)*, In *Proceeding of 2018 IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2018*
- [ICCV17a]** K. Kim, J. Gu, S. Tyree, P. Molchanov, M. Nießner, J. Kautz, *A Lightweight Approach for On-the-Fly Reflectance Estimation*, In *Proceeding of 2017 IEEE International Conference on Computer Vision, ICCV 2017*
- [ICCV17b]** R. Maier, K. Kim, M. Nießner, D. Cremers, J. Kautz, *Intrinsic3D: High-Quality 3D Reconstruction by Joint Appearance and Geometry Optimization with Spatially-Varying Lighting*, In *Proceeding of 2017 IEEE International Conference on Computer Vision, ICCV 2017*
- [3DV17]** V. Golyanik, K. Kim, R. Maier, M. Nießner, J. Kautz, *Multiframe Scene Flow with Piecewise Rigid Motion*, In *Proceeding of 2017 IEEE International Conference on 3D Vision, 3DV 2017*
- [CVPR16a]** B. Eckart, K. Kim, A. Troccoli, A. Kelly, J. Kautz, *Accelerated Generative Models for 3D Point Cloud Data*, In *Proceeding of 2016 IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016*
- [CVPR16b]** P. Molchanov, X. Yang, S. Gupta, K. Kim, S. Tyree, J. Kautz, *Online Detection and Classification of Dynamic Hand Gestures with Recurrent 3D Convolutional Neural Networks*, In *Proceeding of 2016 IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016*
- [IV16]** S. Gupta, P. Molchanov, X. Yang, K. Kim, S. Tyree, J. Kautz, *Towards Selecting Robust Hand Gestures for Automotive Interfaces*, In *Proceeding of 2016 IEEE Intelligent Vehicles Symposium, IV 2016*
- [3DV15]** B. Eckart, K. Kim, A. Troccoli, A. Kelly, J. Kautz, *MLMD: Maximum Likelihood Mixture Decoupling for Fast and Accurate Point Cloud Registration*, In *IEEE 3D Vision, 3DV2015*

- [EGSR15]** S. U. Mehta, K. Kim, D. Pajak, K. Pulli, J. Kautz, R. Ramamoorthi, *Filtering Environment Illumination for Interactive Physically-Based Rendering in Mixed Reality*, In *Eurographics Symposium on Rendering, EGSR 2015*
- [CVPRW15]** P. Molchanov, S. Gupta, K. Kim, J. Kautz, *Hand Gesture Recognition with 3D Convolutional Neural Networks*, In *IEEE CVPR 2015 Workshop on Hand Gesture Recognition*
- [FG15]** P. Molchanov, S. Gupta, K. Kim, K. Pulli, *Multi-sensor System for Drivers Hand-Gesture Recognition*, In *IEEE Automatic Face and Gesture recognition, FG2015*
- [RADAR15]** P. Molchanov, S. Gupta, K. Kim, K. Pulli, *Short-Range FMCW Monopulse Radar for Hand-Gesture Sensing*, In *IEEE International Radar Conference 2015*
- [3DV14]** D. Herrera, K. Kim, J. Kannala, K. Pulli, and J. Heikkila , *DT-SLAM: Deferred Triangulation for Robust SLAM*, In *IEEE 3D Vision, 3DV2015*
- [SIGGRAPH13]** J. Baek, D. Pajak, K. Kim, K. Pulli, and M. Levoy, *WYSIWYG Computational Photography via Viewfinder Editing*, In *ACM Transactions on Graphics, SIGGRAPH Asia 2013*
- [CVPR12]** K. Kim, D. Lee, and I. Essa, *Detecting Regions of Interest in Dynamic Scenes with Camera Motions*, In *Proceeding of 2012 IEEE Conference on Computer Vision and Pattern Recognition*
- [ICCV11]** K. Kim, D. Lee, and I. Essa, *Gaussian Process Regression Flow for Analysis of Motion Trajectories*, In *Proceeding of 2011 IEEE International Conference on Computer Vision*
- [CVPR10a]** K. Kim, M. Grundmann, A. Shamir, I. Matthews, J. Hodgins, and I. Essa, *Motion Fields to Predict Play Evolution in Dynamic Sports Scenes*, In *Proceeding of 2010 IEEE Conference on Computer Vision and Pattern Recognition*
- [CVPR10b]** R. Hamid, R. Kumar, M. Grundmann, K. Kim, I. Essa and J. Hodgins, *Player Localization Using Multiple Static Cameras for Sports Visualization*, In *Proceeding of 2010 IEEE Conference on Computer Vision and Pattern Recognition*
- [ISMAR09]** K. Kim, S. Oh, J. Lee and I. Essa, *Augmenting Aerial Earth Maps with Dynamic Information*, In *Proceeding of 2009 IEEE/ACM International Symposium on Mixed and Augmented Reality*
- [ISWC08]** K. Kim, J. Summet, T. Starner, D. Ashbrook, M. Kapade and I. Essa, *Localization and 3D Reconstruction of Urban Scenes Using GPS*, In *Proceeding of 2008 IEEE International Conference on Wearable Computers*
- [ACMMM06]** K. Kim, I. Essa and G. D. Abowd, *Interactive Mosaic Generation for Video Navigation*, In *Proceeding of 2006 ACM International Conference on Multimedia*
- [TOG13]** J. Baek, D. Pajak, K. Kim, K. Pulli, and M. Levoy, *WYSIWYG Computational Photography via Viewfinder Editing*, In *ACM Transactions on Graphics, Volume 32*.
- [VR11]** K. Kim, S. Oh, J. Lee and I. Essa, *Augmenting Aerial Earthmaps with Dynamic Information from Videos* , In *Virtual Reality Journal* [Special issue on Augmented Reality], Springer London, 2011 (VR)
- [JGT08]** B. Kim, K. Kim and G. Turk, *A Shadow Volume Algorithm for Opaque and Transparent Non-Manifold Casters*, In *Journal of Graphics Tools*, A.K. Peters, 2008

- THESIS **[BSTHESIS01]** K. Kim, *Simple Enhanced Block-Matching Algorithm for Intermediate View Reconstruction*, Department of Electrical Engineering, Yonsei University
- [PHDTHESIS11]** K. Kim, *Spatio-temporal Data Interpolation for Dynamic Scene Analysis*, College of Computing, Georgia Institute of Technology
- OTHER PUBLICATIONS POSTERS, TECH' REPORTS **[STS11][ISMICS 2011]** E. Sarin, K. Kim, I. Essa, and W. Cooper, *3-Dimensional Visualization of the Operating Room Using Advanced Motion Capture: A Novel Paradigm to Expand Simulation-Based Surgical Education*
- [4GS09]** K. Kim, M. Grundmann, I. Essa, *Collaborative Crowd-casting using Mobile devices*, In *4G Symposium*, Las Vegas 2009
- [TECH07]** B. Kim, K. Kim, G. Turk, *Real-time Shadow of Transparent Casters Using Shadow Volume*, In *Georgia Institute of Technology Technical Report GT-IC-07-04*
- [TECH06]** K.Kim, J.Summet, T.Starner, D.Ashbrook, M.Kapade and I.Essa, *Localization and 3D Reconstruction of Urban Scenes Using GPS*, 2008 In *Georgia Institute of Technology Technical Report GT-IC-08-06*
- [GT-CMU06A]** K.Kim, I.Essa and F. Dellaert *Augmenting Earth Maps with Dynamic Information Using Vanishing Point Clustering*, In 2006 GT-CMU Retreat for Graphics
- [GT-CMU06B]** B. Kim and K. Kim, *Transparent Shadow Casters and Softened Self-Shadow Using Shadow Volume*, In 2006 GT-CMU Retreat for Graphics
- [GT-CMU05]** K. Kim and I. Essa, *Multi-scale Photomosaic*, In 2005 GT-CMU Retreat for Graphics
- INVITED TALK **[SNU11]** K. Kim, *Spatio-temporal Analysis of Videos for Visualization*, Department of Computer Science and Engineering, Seoul National University January.2011
- [Google13]** K. Kim, *Sparse-to-dense approaches for video analysis*, **Google Tech-talk**, Google Research. 2013.
- PATENTS ISF **[P17a]** P. Molchanov, X. Yang, S. De Mello, K Kim, S. Tyree, K. Kim *Online detection and classification of dynamic gestures with recurrent convolutional neural networks* US Patent: 15,402,128
- [P16a]** B. Eckart, K. Kim, A. Troccoli, J. Kautz *Modeling Point Cloud Data - Hierarchies of Gaussian Mixture Models* US Patent.
- [P16b]** P. Molchanov, S. Gupta, K. Kim, *Multi-Sensor Based User Interface* US Patent: 15,060,525
- [P16c]** P. Molchanov, S. Gupta, K. Kim, *In-Vehcle Short-range RADAR system for Intelligent UIs* US Patent App.
- [P16c]** P. Molchanov, S. Gupta, K. Kim, *Radar based user interface* US Patent App: 15,060,545
- [P14]** K. Kim, D. Pajak, K. Pulli,. *System, Method, and computer program product for performing one-dimensional searches in two-dimensional images* , US Patent: 14/191,332
- [P13]** K. Kim, A. Shamir, IA Matthews, M. Grundmann, JK. Hodgins, and Irfan Essa. *System and Method for Utilizing Motion Fields to Predict Evolution in Dynamic Scenes*, US Patent: 13,075,947
- REVIEWER TC,EDITOR Reviewer in CVPR, ICCV, BMVC, ACCV, Eurographics, SIGGRAPH, SIGGRAPH ASIA, tPAMI, tIP, HPG, EVC (TC), EVW(TC), IWMV(TC), IEICE (Assc.Editor).

MEDIA
COVERAGE

[CNN09] H. Collins, J. Levs, *New technology tracks movement on ground*, CNN News-room, aired on October 2009

[NS09] V. Venkatraman, *Live video makes Google Earth cities bustle*, NewScientist, September 2009, Magazine Issue 2728

[PS09] S.F. Locke, *Augmented Google Earth Gets Real-Time People, Cars, Clouds*, PopularScience, September 2009

RESEARCH AND
PROFESSIONAL
PROJECTS
INVOLVED

NVIDIA Research

Santa Clara, CA USA

Learning and Perception Research Group

- Leading **Sensor-based localization project (autonomous driving)**: mapping and registration of points cloud captured from a Lidar sensor**[3DV15][ECCV18b]**.
- Leading **VirtualEye (DARPA)** project: 3D mapping and free view-point video.
- Leading **NVIDIA SLAM(NVSLAM)**: An umbrella project of a various 3D Vision projects for next generation augmented/virtual reality and autonomous driving: **[3DV14/15][EGSR15] [CVPR16a][ICCV17a][ICCV17b][CVPR18][ECCV18a][ARX18a][ARXV19a,b,c,d]**
- Tech-transfer for NVIDIA products: ISAAC SDK (Robotics), SDKs for DrivePX, legacy VisionWorks, internal VR/AR SDKs and various open-source projects.
- Collaboration with Google/ATAP for **Tango** project (AR demo).
- Conducting a project for **Driver's gesture recognition system** for Advanced Driver Assistant System (ADAS) using multi-modal sensors and Deep Neural Network (CNN) **[FG15][RADAR15][P15-a,b][IV16][CVPRW15][CVPR16b]**
- Conducting tracking and scene reconstruction research for ADAS and autonomous driving project (Sensor fusion: depth-camera, vision, IMU, etc.)
- Conducted an Real-time viewfinder editing project: **[SIGGRAPH13]**.
- Co-author of a tutorial on OpenCV for native Android: SIGGRAPH13 (mobile)
- Fast Image registration and tracking for mobile vision **[P14]**
- Stochastic Motion field analysis using Gaussian Process **[CVPR12]**

Georgia Institute of Technology

Atlanta, Georgia

Dynamic Scene Analysis

- Recognizing traffic patterns and detecting anomalous events using Gaussian Process Regression Flow, and 4th-order moment. Persistent Stare Exploitation and Analysis System (*PerSEAs*) with *Kitware/DARPA*. Published in **[ICCV11]**
- Analysis and prediction of multi-agent motions in dynamic sports scene. (*Microcasting at Disney Research*) Spatio-temporal radial basis network for dense flow generation. Tracking ground positions using geometric constraint optimization. Published in **[CVPR10A]** and **[CVPR10B]**
- Video retargeting for automated sports broadcasting. Auto-directed crop region, and its paths are calculated from motion saliency. Submitted to **[S11]**

Dynamic Scene Visualization and Augmented Reality

- City-level visualization of dynamic scenes from distributed videos using spatio-temporal interpolation and analysis. Published in **[ISMAR09]**, **[VR11]**, **[4GS09]** and **[GT-CMU06A]** Media coverage and articles in **[CNN09]**, **[NS09]** and **[PS09]**
- 3D Reconstruction and localization of nearby buildings from the analysis of GPS signals having low signal-to-noise ratio. Published in **[ISWC08]** and **[TECH06]**

Video-based Rendering

- Video-based spatio-temporal view interpolation for Simulating Cardiac Surgery (Emory/Inova Heart Vascular Institute) Presented in **[STS11]** and **[ISMICS11]**
- Generation of painterly and water-colored videos using fore-ground segmentation and gradient field (Samsung STAR/SAIT) Fed into mobile NPR project.

Interactive Video and Multimedia System

- Automatic generation of the annotated collection of mosaics for interactive video navigation. (AwareHome/Tunner Studio) **[ACMMM06]** and **[GT-CMU05]**

Real-time Rendering Algorithm

- Generalized Shadow Volume algorithm for the real-time rendering of non-manifold transparent casters. Published in **[JGT08]**, **[TECH07]** and **[GT-CMU06B]**

Disney Research, Pittsburgh

Pittsburgh, PA USA

Scene Analysis and Micro-casting

- Conducted a project for detecting important location in the game. Designed and implemented proto-type system for micro-casting. **[CVPR10A]**
- Implemented player tracking algorithm using particle filter and mean-shift , and team classification algorithm for sports visualization. **[CVPR10B]**

Samsung SDS IT R&D Center, and Samsung Electronics

Seoul, South Korea

Face Recognition, Real-time Collaboration System

- Responsible for face detection part. Fisher-face, and statistical skin segmentation were used for ViaFaceTM. Appeared in COMDEX 2001 Las Vegas.
- Designed and developed Real-time Collaboration System: SyncbizTM (2002 Samsung Best solution award)
- Developed embedded framework for IP-Set top box: LivingWiseTM (fed into Korea Telecommunication's IP-STB services)
- Ubiquitous Home network framework: NEX (framework fed into U-City projects at Samsung SDS): Remote Management system in the home server for U-City.

SOFTWARE AND
HARDWARE SKILLS

Languages, Scripts, and Wrappers:

- C, C++, Embedded C, Python, PyTorch, Caffe, Android Native C/C++, Java, JavaScript, MFC, ATL, COM, SQL, MySQL, MATLAB, under various IDE environments
- Libraries for Vision/Graphics/Math : OpenCV, OpenGL, GLSL, DirectX, Lapack, Intel Math Kernel Library

Digital Logic Circuit:

- FPGA and Computer-Aided Design Tools: VHDL, MAX+PLUS, SPICE

Video and Image Editing tools, and Renderer:

- 3D Studio Max, Autodesk Maya, Adobe Photoshop, Premiere, and others
- POV-Ray, Indigo, Blender

LANGUAGES

Fluent in Korean, English and Japanese

Last update: Jan, 2019