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Chiho Choi

Computer Vision | Machine Learning
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RESEARCH INTERESTS

My research interest lies at the intersection of machine learning and computer vision, focusing on computational learning for understanding humans from an everyday environment. In this area, I broadly build machine learning (deep learning) algorithms for computer vision systems.

EDUCATION

Purdue University (PURDUE) — West Lafayette, IN, USA
Ph.D., Electrical and Computer Engineering — January 2018
- Specialization: deep learning, 3D vision, recognition, tracking
- Computational learning for hand pose estimation (four papers in CVPR and ICCV as a first author)
- Committee members: Karthik Ramani, Stanley H. Chan, Mireille Boutin, and Jeffrey M. Siskind

University of Southern California (USC) — Los Angeles, CA, USA
M.S., Electrical Engineering — May 2013
- Specialization: 3D shape analysis (matching and registration)
- Advisor: Prof. Suya You, Department of Computer Science, USC

Hanyang University (HYU) — Seoul, Korea
B.S., Electronics and Computer Engineering — February 2011
- Minor: Mechanical Engineering

WORKING EXPERIENCE

Honda Research Institute (HRI) — Mountain View, CA, USA
Scientist — February 2018 – Present
- Work on analysis, recognition, reconstruction, and interpretation of scenes captured by multi-modal data.

HERE Technologies (HERE) — Chicago, IL, USA
Research Intern — May 2017 – August 2017
- Worked on a large-scale deep learning problem for Highly Automated Driving.
- Advisor: Xin Chen and Xiang Ma

PUBLICATIONS

Conferences

[C4] **C. Choi**, S. Kim, and K. Ramani. "Learning Hand Articulations by Hallucinating Heat Distribution". *Proceedings of the IEEE International Conference on Computer Vision (**ICCV**) 2017*.

[C3] **C. Choi**, S. H. Yoon, C. N. Chen, and K. Ramani. "Robust Hand Pose Estimation during the Interaction with an Unknown Object". *Proceedings of the IEEE International Conference on Computer Vision (**ICCV**) 2017*.

[C2] **C. Choi***, A. Sinha*, and K. Ramani (* Co-first Author, order changed for emphasis). "DeepHand: Robust Hand Pose Estimation by Completing a Matrix Imputed with Deep Features". *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2016.*

[C1] **C. Choi**, A. Sinha, J. H. Choi, S. Jang, and K. Ramani. "A Collaborative Filtering Approach to Real-Time Hand Pose Estimation". *Proceedings of the IEEE International Conference on Computer Vision (**ICCV**) 2015.*

Technical Reports

[T2] **C. Choi**, S. Kim, J. H. Choi, and K. Ramani. "Embedding Compressive Layers in Deep Neural Networks". *http://www.chihochoi.me/embedding.pdf*, *May 2017*.

[T1] **C. Choi** and S. You. "Dense and Reliable Shape Matching using 3D Particle Filtering". *USC CGIT Lab Technical Report, May 2013*.

PATENT APPLICATION

[P4] X. Chen, X. Ma, S. Sood, and **C. Choi**. "Semi-automatic Training Data Selection based on High-dimensional Data Projection to Subspaces". Application pending.

[P3] X. Chen, X. Ma, S. Sood, and **C. Choi**. "Deep Neural Machine for Lane Marking Style Classification based on Unwrapped Perspective Images". Application pending.

[P2] X. Chen, X. Ma, S. Sood, and **C. Choi**. "Deep Neural Machine for Lane Marking Color and Material Classification based on Image Patches". Application pending.

[P1] A. Sinha, **C. Choi**, J. H. Choi, and K. Ramani. "Method and System for Hand Pose Estimation". USPTO Application No. 15380002 (ref. [C1] and [C2]).

RESEARCH EXPERIENCE

Human Shape Interaction August 2013 – January 2018

Research Assistant, Computational Design & Innovation Lab

- **Spherical CNN for Deep Learning 3D Non-Rigid Shapes** (September 2017 – January 2018)
  : Developed a new convolution technique for seamless learning 3D non-rigid shapes by applying a convolution operator onto mesh surface. *(Role: Sole developer)*
- **Learning Hand by Hallucinating Geometric Representations** (November 2016 – May 2017)
  : The behavior of heat diffusion on the hand surface was investigated to learn the geometrically descriptive representations and used as an additional input modality to depth data. *(Role: Project leader / Sole developer, Relevant publication: [C4])*
- **Learning Hand from a Manipulating Object** (May 2016 – November 2016)
  : Employed pose dependency on the shape of an object to learn discriminative features of the hand-object interaction. *(Role: Project leader / Sole developer, Relevant publication: [C3])*
- **Embedding Compressive Layers in Deep Neural Networks** (November 2015 – May 2016)
  : Designed a deeper network while preserving the original network structure by compressing the embedded layers. *(Role: Project leader / Sole developer, Relevant publication: [T2])*
- **Learning Hand from Low-Dimensional Visual Representations** (April 2015 – November 2015)
  : Convolutional neural networks were trained to output a low-dimensional discriminative feature which is representative of the global or local joint angle parameters of an input hand pose. *(Role: Project leader / Sole developer, Relevant publication: [C2], [P1])*
- **Learning Hand from Recommendations of Similar Poses** (August 2014 – April 2015)
  : A novel joint matrix factorization and completion (JMFC) model was developed to collaboratively regress the unknown pose parameters of all neighborhood poses. *(Role: Project leader / Sole developer, Relevant publication: [C1], [P1])*
- **Real-Time 3D Object Tracking from Depth** (August 2013 – August 2014)
  : Built a 3D rigid object tracking system using an energy minimization approach. *(Role: Project leader / Sole developer)*

Advisor: Prof. Karthik Ramani, School of Electrical and Computer Engineering, PURDUE

3D Shape Analysis May 2012 – May 2013

Student Researcher, Computer Graphics & Immersive Technologies Lab

- **Scale and Rotation Invariant 3D Shape Matching** (Aug 2012 – May 2013)
  : Devised a pipeline to generate dense and reliable mappings from given 3D spatio-temporal sequences using SIFT and 3D particle filtering algorithm. *(Role: Project leader / Sole developer, Relevant publication: [T1])*
- **Finding Dense Correspondences between 3D Shapes** (May 2012 – Aug 2012)
  : Built a heat diffusion algorithm and applied to human bodies as well as aerial LiDAR datasets. *(Role: Project leader / Sole developer)*

Advisor: Prof. Suya You, Department of Computer Science, USC

TEACHING EXPERIENCE

Teaching Assistant, PURDUE January 2015 – May 2015

- ME 444: Computer-aided Design and Rapid Prototyping
- Introduction to advanced computer-aided design (CAD) for product design, modeling, and prototyping.

Teaching Assistant (Graduate Level Course), USC August 2012 – December 2012

- CSCI-588 Specification and Design of User Interface Software
- A design and implementation of user interface software relating to human/computer interaction.

SKILLS

Programming Languages/Tools	C, C++, Python, Visual Studio, MATLAB
Deep Learning Frameworks	Caffe, TensorFlow, MatConvNet
Graphic Tools	Unity, Blender
MCU Tools	CodeVision, Code Composer Studio
CAD Tools	PTC Creo Parametric, CATIA

MEDIA COVERAGE

Freeing Our Fingers: Handing Over VR's Toughest Challenge to GPUs, NVIDIA Blog, August 24 2016.
https://blogs.nvidia.com/blog/2016/08/24/deephand-vr/

AI and VR: New Experiments at Purdue University, ENGINEERING.com, June 30, 2016
http://www.engineering.com/Hardware/ArticleID/12558/Artificial-Intelligence-and-Virtual-Reality-New-Experiments-at-Purdue-University.aspx

DeepHand motion tracking enters the VR arms race, New Atlas, June 23, 2016
http://newatlas.com/deephand-vr-hand-tracking/44004/

New tool for virtual and augmented reality uses 'deep learning', Purdue News, June 22 2016.
https://youtu.be/RhIjq-MxcW0
http://www.purdue.edu/newsroom/releases/2016/Q2/new-tool-for-virtual-and-augmented-reality-uses-deep-learning.html

ACADEMIC SERVICE

A member of the program committee / reviewer of the *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2018

A reviewer of the *IEEE Transactions on Multimedia (T-MM)*, 2017

HORNORS

National Science and Technology Scholarship 2003 – 2010
from *Ministry of Education, Science and Technology*, Korea

WEBSITES

http://www.chihochoi.me/
https://www.linkedin.com/in/chihochoi/

REFERENCES

Available Upon Request