

# Chiho Choi, Ph.D.

## CONTACT INFORMATION

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Honda Research Institute USA Inc.  
70 Rio Robles, San Jose, CA 95134  
[chihochoi@outlook.com](mailto:chihochoi@outlook.com)

[Website](#)  
[LinkedIn](#)  
[Google Scholar](#)

## RESEARCH INTERESTS

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My research interests span the fields of *computer vision*, *machine learning*, and *robotics*, focusing on understanding and prediction of human behavior in highly interactive environments. In this area, I build a new perspective for the safe operation of autonomous systems designed to cooperate with humans.

- Behavior Reasoning      • Motion Prediction      • Activity Forecasting      • Relational Inference
- Uncertainty Modeling    • Interactive Planning      • Human Pose Prediction    • Pose Estimation

## WORK EXPERIENCE

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*Honda Research Institute (HRI) USA*

San Jose, CA, USA

**Senior Scientist**

July 2021 – Present

- Leading multiple projects on understanding of human action, intention, and future behavior.

**Scientist**

February 2018 – June 2021

- Worked on recognition, reasoning, and prediction of human states and behaviors in multi-agent interacting environments.

*HERE Technologies*

Chicago, IL, USA

**Intern**

May 2017 – August 2017

- Worked on traffic scene understanding (detection and recognition) for automated driving.
- Proposed a solution to learn from imbalanced data for generic machine learning systems.
- Supervisor: Dr. Xiang Ma and Prof. Xin Chen

## EDUCATION

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*Purdue University*

West Lafayette, IN, USA

**Ph.D., Electrical and Computer Engineering**

January 2018

- Specialization: deep learning, 3D vision, recognition, tracking
- Committee members: Karthik Ramani, Stanley H. Chan, Mireille Boutin, Jeffrey M. Siskind

*University of Southern California*

Los Angeles, CA, USA

**M.S., Electrical Engineering**

May 2013

- Specialization: 3D shape matching, registration
- Advisor: Prof. Suya You, Department of Computer Science

*Hanyang University*

Seoul, Korea

**B.S., Electronics and Computer Engineering**

February 2011

- Minor: Mechanical Engineering

## PUBLICATIONS

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**Refereed Papers**

- [C18] H. Girase\*, H. Gang\*, S. Malla, J. Li, A. Kanehara, K. Mangalam, and **C. Choi**. “LOKI: Long Term and Key Intentions for Trajectory Prediction”. In *Proceedings of the IEEE International Conference on Computer Vision (ICCV) 2021*, to appear.
- [C17] J. Li, F. Yang, H. Ma, S. Malla, M. Tomizuka, and **C. Choi**. “RAIN: Reinforced Hybrid Attention Inference Network for Motion Forecasting”. In *Proceedings of the IEEE International Conference on Computer Vision (ICCV) 2021*, to appear.
- [C16] H. Ma\*, Y. Sun\*, J. Li, M. Tomizuka, and **C. Choi**. “Continual Multi-agent Interaction Behavior Prediction with Conditional Generative Memory”. *IEEE Robotics and Automation Letters (RA-L)*, to appear.
- [C15] **C. Choi\***, J. H. Choi\*, J. Li, and S. Malla “Shared Cross-Modal Trajectory Prediction for Autonomous Driving”. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2021*, **Oral presentation** (4.2% acceptance rate). [arXiv: 2011.08436](#)
- [C14] S. Malla, **C. Choi**, and B. Dariush “Social-STAGE: Spatio-Temporal Multi-Modal Future Trajectory Forecast”. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA) 2021*. [arXiv: 2011.04853](#)
- [C13] J. Li, F. Yang, M. Tomizuka, and **C. Choi**. “EvolveGraph: Multi-Agent Trajectory Prediction with Dynamic Relational Reasoning”. In *Proceedings of the Conference on Neural Information Processing Systems (NeurIPS) 2020*. [arXiv: 2003.13924](#)
- [C12] **C. Choi**, S. Malla, A. Patil, and J. H. Choi. “DROGON: A Trajectory Prediction Model based on Intention-Conditioned Behavior Reasoning”. In *Proceedings of the Conference on Robot Learning (CoRL) 2020*. [arXiv:1908.00024](#)
- [C11] I. Dwivedi, S. Malla, B. Dariush, and **C. Choi**. “SSP: Single Shot Future Trajectory Prediction”. In *Proceedings of the IEEE International Conference on Intelligent Robots and Systems (IROS) 2020*. [arXiv: 2004.05846](#)
- [C10] S. Malla, B. Dariush, and **C. Choi**. “TITAN: Future Forecast using Action Priors”. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2020*, **Oral presentation** (5.7% acceptance rate). [arXiv:2003.13886](#)
- [C9] S. Bae, D. Saxena, A. Nakhaei, **C. Choi**, K. Fujimura, and S. Moura. “Cooperation-Aware Lane Change Maneuver in Dense Traffic based on Model Predictive Control with Recurrent Neural Network”. In *Proceedings of the American Control Conference (ACC) 2020*. [arXiv:1909.05665](#)
- [C8] **C. Choi** and B. Dariush. “Looking to Relations for Future Trajectory Forecast”. In *Proceedings of the IEEE International Conference on Computer Vision (ICCV) 2019*. [arXiv: 1905.08855](#)
- [C7] **C. Choi** and B. Dariush. “Learning to Infer Relations for Future Trajectory Forecast”. In *the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops 2019*.
- [C6] Y. Yao, M. Xu, **C. Choi**, D. Crandall, E. Atkins, and B. Dariush. “Egocentric Vision-based Future Vehicle Localization for Intelligent Driving Assistance Systems”. In *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA) 2019*.
- [C5] M. Liu, F. Yao, **C. Choi**, A. Sinha, and K. Ramani. “Deep Learning 3D Shapes Using Alt-az Anisotropic 2-Sphere Convolution”. In *Proceedings of the International Conference on Learning Representations (ICLR) 2019*.
- [C4] **C. Choi**, S. Kim, and K. Ramani. “Learning Hand Articulations by Hallucinating Heat Distribution”. In *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”. In *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”. In *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”. In *Proceedings of the IEEE International Conference on Computer Vision (ICCV) 2015*.

### Non-Refereed Papers

- [T4] S. Su, C. Peng, J. Shi, and **C. Choi**. “Potential Field: Interpretable and Unified Representation for Trajectory Prediction”. November 2019. [arXiv:1911.07414](https://arxiv.org/abs/1911.07414)
- [T3] S. Malla, I. Dwivedi, B. Dariush, and **C. Choi**. “NEMO: Future Object Localization Using Noisy Ego Priors”. September 2019. [arXiv:1909.08150](https://arxiv.org/abs/1909.08150)
- [T2] **C. Choi**, S. Kim, J. H. Choi, and K. Ramani. “Embedding Compressive Layers in Deep Neural Networks”. *Technical Report, Purdue University, May 2017*.
- [T1] **C. Choi** and S. You. “Dense and Reliable Shape Matching using 3D Particle Filtering”. *Technical Report, University of Southern California, May 2013*.

### Thesis

- [D1] **C. Choi**. “Computational Learning for Hand Pose Estimation”. *Ph.D. Dissertation, Purdue University, Jan 2018*.

### PATENT APPLICATIONS

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- [P21] J. Li, H. Gang, H. Ma, and **C. Choi**. “System and Method for Important Object Identification with Semi-Supervised Learning”. Application pending.
- [P20] H. Girase, H. Gang, S. Malla, J. Li, A. Kanehara, and **C. Choi**. “System and Method for Providing Long Term Key Intentions for Trajectory Prediction”. Application pending.
- [P19] H. Ma, J. Li, and **C. Choi**. “System and Method for Completing Continual Multi-Agent Trajectory Forecasting”. Application pending.
- [P18] **C. Choi**, S. Malla, and S. Bae. “System and Method for Completing Trajectory from Agent-Augmented Environments”. Application pending.
- [P17] J. Li and **C. Choi**. “System and Method for Reinforced Hybrid Attention for Motion Forecasting”. Application pending.
- [P16] S. Malla, **C. Choi**, and B. Dariush. “System and Method for Providing Social-Stage Spatio-Temporal Multi-Modal Future Forecasting”. Application pending.
- [P15] **C. Choi**. “System and Method for Shared Cross-Modal Trajectory Prediction”. Application pending.
- [P14] J. Li and **C. Choi**. “Systems and Methods for Heterogeneous Multi-Agent Multi-Modal Trajectory Prediction with Evolving Interaction Graphs”. Application pending.
- [P13] I. Dwivedi, S. Malla, **C. Choi**, and Behzad Dariush. “System for Single Shot Prediction using Composite Fields and Method Thereof”. Application pending.
- [P12] S. Malla, **C. Choi**, and Behzad Dariush. “System and Method for Future Forecasting using Action Priors”. Application pending.
- [P11] S. Su and **C. Choi**. “System and Method for Providing an Interpretable and Unified Representation for Trajectory Prediction”. Application pending.
- [P10] A. Nakhaei, K. Fujimura, **C. Choi**, S. Bae, D. Saxena. “System and Method for Providing Cooperation-Aware Lane Change Control in Dense Traffic”. US 16/844331
- [P9] S. Malla and **C. Choi**. “System and Method for Providing Future Object Localization”. US 16/828343
- [P8] **C. Choi**. “Trajectory Prediction”. No. 16/524821
- [P7] Y. Yao, M. Xu, **C. Choi**, and B. Dariush. “System and Method for Egocentric-vision based Future

Vehicle Localization”. Publication No. 16/386964

[P6] **C. Choi**. “Methods and Apparatuses for Future Trajectory Forecast”. US 11/062141

[P5] X. Chen, X. Ma, S. Sood, and **C. Choi**. “Semi-automatic Training Data Selection based on High-dimensional Data Projection to Subspaces”. Application pending.

[P4] X. Chen, X. Ma, S. Sood, and **C. Choi**. “Deep Neural Machine for Lane Marking Style Classification based on Unwrapped Perspective Images”. Application pending.

[P3] 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.

[P2] A. Sinha, **C. Choi**, J. H. Choi, and K. Ramani. “Method of training neural networks for hand pose detection”. US 10/503270

[P1] A. Sinha, **C. Choi**, J. H. Choi, and K. Ramani. “Method and System for Hand Pose Estimation”. US 10/318008

## TEACHING EXPERIENCE

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### Students Supervised

• Reza Ghoddoosian (Ph.D.), from University of Texas, Arlington	May 2021 – Present
• Ramtin Hosseini (Ph.D.), from Tufts University	May 2021 – Present
• Hengbo Ma (Ph.D.), from University of California, Berkeley	January 2021 – Present
• Harshayu Girase (M.S.), from University of California, Berkeley	January 2021 – Present
• Jiachen Li (Ph.D.), from University of California, Berkeley	September 2019 – May 2021
• Crane He Chen (Ph.D.), from Johns Hopkins University	January 2021 – April 2021
• Shan Su (Ph.D.), from University of Pennsylvania	July 2019 – December 2020
• Sangjae Bae (Ph.D.), from University of California, Berkeley	May 2020 – August 2020
	June 2019 – September 2019
• Yu Yao (Ph.D.), from University of Michigan	May 2018 – August 2018

### Teaching Assistant

• Purdue University	January 2015 – May 2015
ME 444: Computer-aided Design and Rapid Prototyping	
Introduction to advanced computer-aided design for product design, modeling, and prototyping.	
• University of Southern California	August 2012 – December 2012
CSCI 588 (graduate-level course): Specification and Design of User Interface Software	
A design and implementation of user interface software relating to human/computer interaction.	

## INVITED TALKS

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Guest Lecturer, Purdue University	December 2017
• Introduction to Pose Estimation – Probabilistic models in computer vision	

## ACADEMIC SERVICES

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### Organizing Chair

- 1<sup>st</sup> Workshop on *Multi-Agent Interaction and Relational Reasoning* in conjunction with ICCV 2021

### Publication Committee

- Honda Research Institute USA

February 2020 – Present

### Program Committee / Reviewer

- International Conference on Learning Representations (ICLR) 2021, 2022
- IEEE Winter Conference on Applications of Computer Vision (WACV) 2021, 2022

- Conference on Neural Information Processing Systems (NeurIPS) 2020, 2021
- IEEE International Conference on Intelligent Robots and Systems (IROS) 2021
- IEEE International Conference on Computer Vision (ICCV) 2019, 2021
- International Conference on Machine Learning (ICML) 2021
- IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2018, 2019, 2020, 2021
- Association for Advancement of Artificial Intelligence (AAAI) 2020, 2021
- Asian Conference on Computer Vision (ACCV) 2018, 2020
- European Conference on Computer Vision (ECCV) 2020
- IEEE Intelligent Vehicles Symposium (IV) 2020
- ACM CHI Conference on Human Factors in Computing Systems (CHI) 2019
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transactions on Intelligent Vehicles (T-IV)
- IEEE Transactions on Image Processing (T-IP)
- IEEE Transactions on Multimedia (T-MM)

## HONORS

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National Science and Technology Scholarship from <i>Ministry of Education, Science and Technology</i> , Korea	2003 – 2010
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## MEDIA COVERAGE

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- [Looking to Relations for Future Trajectory Forecast](#), ICCV Daily Magazine, October 30, 2019.
- [AI Can Predict the Future Location of Vehicles](#), NVIDIA NEWS Center, September 27, 2018.
- [Freeing Our Fingers: Handing Over VR's Toughest Challenge to GPUs](#), NVIDIA Blog, August 24, 2016.
- [AI and VR: New Experiments at Purdue University](#), ENGINEERING.com, June 30, 2016
- [DeepHand motion tracking enters the VR arms race](#), New Atlas, June 23, 2016
- [New tool for virtual and augmented reality uses 'deep learning'](#), Purdue News, June 22, 2016.

## REFERENCES

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Available Upon Request