Chiho Choi, Ph.D.

Senior Scientist, Honda Research Institute USA

Contact Infromation

Honda Research Institute USA Inc.
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Website
LinkedIn
Google Scholar

Research Interests

My research interests span the fields of *computer vision*, *machine learning*, and *robotics*, focusing on understanding and prediction of human behavior in multi-agent interacting environments. In this area, I build a new perspective for 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

Honda Research Institute (HRI) USA — San Jose, CA, USA
Senior Scientist — July 2021 – Present
- Leading multiple projects on vision-based future prediction research at Honda Research Institute USA.
- Supervising researchers and interns as a group leader.

Scientist — February 2018 – June 2021
- Worked on understanding, 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.
- Developed a solution to learn from imbalanced data for generic machine learning systems.
- Supervisor: Dr. Xiang Ma and Prof. Xin Chen

Education

Purdue University — West Lafayette, IN, USA
Ph.D., Electrical and Computer Engineering — May 2018
- Specialization: deep learning, detection, tracking, 3D vision
- 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

Journal Articles

[J1] 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**) vol. 6, no. 4, Oct. 2021*.

Refereed Conference Proceedings

[C19] H. Ma, J. Li, R. Hosseini, M. Tomizuka, and **C. Choi**. "Multi-objective Diverse Human Motion Prediction with Knowledge Distillation". *In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2022*, to appear.

[C18] R. Ghoddoosian, N. Agarwal, I. Dwivedi, **C. Choi**, and B. Dariush. "Weakly-Supervised Online Action Segmentation in Multi-view Instructional Videos". *In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2022*, to appear.

[C17] J. Li*, H. Gang*, H. Ma, M. Tomizuka, and **C. Choi**. "Important Object Identification with Semi-Supervised Learning for Autonomous Driving". *In Proceedings of the IEEE International Conference on Robotics and Automation (**ICRA**) 2022*, to appear. *arXiv: 2203.02634*

[C16] 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*. *arXiv: 2108.08236*

[C15] 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*. *arXiv: 2108.01316*

[C14] **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*

[C13] 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*

[C12] 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*

[C11] **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*

[C10] 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*

[C9] 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*

[C8] 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*

[C7] **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*

[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.*

Workshop Papers

[W3] H. Ma*, Y. Sun*, J. Li, M. Tomizuka, and **C. Choi**. "Continual Multi-agent Interaction Behavior Prediction with Conditional Generative Memory". *In ICCV Workshop on Multi-Agent Interaction and Relational Reasoning 2021*, **Best Paper Runner-up**.

[W2] J. Li, F. Yang, M. Tomizuka, and **C. Choi**. "EvolveGraph: Multi-Agent Trajectory Prediction with Dynamic Relational Reasoning". *In NeurIPS Workshop on Machine Learning for Autonomous Driving 2020.*

[W1] **C. Choi** and B. Dariush. "Learning to Infer Relations for Future Trajectory Forecast". *In CVPR Workshop on Precognition: Seeing through the Future 2019.*

Non-Refereed Papers / Preprints

[T4] S. Su, C. Peng, J. Shi, and **C. Choi**. "Potential Field: Interpretable and Unified Representation for Trajectory Prediction". *November 2019. arXiv: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*

[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.*

PATENTS

[P21] H. Ma, J. Li, R. Hosseini, and **C. Choi**. "Accuracy Prior and Diversity Prior Based Future Prediction". Application pending.

[P20] H. Ma, and **C. Choi**. "System and Method for Predicting Future Frames using Diverse Sampling". Application pending.

[P19] R. Ghoddoosian, N. Agarwal, I. Dwivedi, **C. Choi**, and B. Dariush. "System and Method for Providing Weakly-Supervised Online Action Segmentation". Application pending. US 17/590379

[P18] J. Li, H. Gang, H. Ma, and **C. Choi**. "Object Identification". Application pending. US 17/411894

[P17] 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. US 17/352540

[P16] H. Ma, J. Li, and **C. Choi**. "System and Method for Completing Continual Multi-Agent Trajectory Forecasting". Application pending. US 17/380224

[P15] **C. Choi**, S. Malla, and S. Bae. "System and Method for Completing Trajectory from Agent-Augmented Environments". Application pending. US 17/161136

[P14] J. Li and **C. Choi**. "System and Method for Reinforced Hybrid Attention for Motion Forecasting". Application pending. US 17/173460

[P13] S. Malla, **C. Choi**, and B. Dariush. "System and Method for Providing Social-Stage Spatio-Temporal Multi-Modal Future Forecasting". Application pending. US 17/160747, CN 202110727535.9

[P12] **C. Choi**. "System and Method for Shared Cross-Modal Trajectory Prediction". US 16/989066

[P11] J. Li and **C. Choi**. "Systems and Methods for Heterogeneous Multi-Agent Multi-Modal Trajectory Prediction with Evolving Interaction Graphs". US 17/024080

[P10] I. Dwivedi, **C. Choi**, S. Malla, and B. Dariush. "Composite Field based Single Shot Prediction". US 16/917864, CN 113379096, JP 2021136019

[P9] S. Malla, **C. Choi**, and Behzad Dariush. "System and Method for Future Forecasting using Action Priors". US 16/913260, JP2021070471A

[P8] S. Su and **C. Choi**. "System and Method for Providing an Interpretable and Unified Representation for Trajectory Prediction". US 16/911661

[P7] A. Nakhaei, K. Fujimura, **C. Choi**, S. Bae, and D. Saxena. "System and Method for Providing Cooperation-Aware Lane Change Control in Dense Traffic". US 16/844331, CN112537306A, JP2021046193A

[P6] S. Malla and **C. Choi**. "System and Method for Providing Future Object Localization". US 16/828343

[P5] **C. Choi**. "Trajectory Prediction". US 11/087477, WO2021021355A1

[P4] Y. Yao, M. Xu, **C. Choi**, and B. Dariush. "System and Method for Egocentric-vision based Future Vehicle Localization". US 16/386964, CN110895674A, JP6833936B2

[P3] **C. Choi**. "Methods and Apparatuses for Future Trajectory Forecast". US 11/062141

[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

Students Supervised

• Manh Huynh (Ph.D.), from University of Colorado Denver	January 2022 – Present
• Behrad Toghi (Ph.D.), from University of Central Florida	September 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
• Reza Ghoddoosian (Ph.D.), from University of Texas Arlington	May 2021 – December 2021
• Ramtin Hosseini (Ph.D.), from Tufts University	May 2021 – September 2021
• 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

• Kwangwoon University, Seoul, Korea November 2021
Guest Lecturer: Behavior Prediction for Autonomous Systems

• ICCV Workshop on Benchmarking Trajectory Forecasting Models October 2021
Presentation: Shared Cross-Modal Trajectory Prediction for Autonomous Driving

• Samsung Advanced Institute of Technology September 2021
Seminar: Trajectory Prediction in Multi-Agent Interacting Environments

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

ACADEMIC SERVICES

Publication Committee

• Honda Research Institute USA 2020, 2021, 2022

Organizing Committee

• Co-organizer: Workshop on *Multi-Agent Interaction and Relational Reasoning* in conjunction with IEEE ICCV 2021

Program Committee / Reviewer

• European Conference on Computer Vision (ECCV) 2020, 2022
• International Conference on Machine Learning (ICML) 2021, 2022
• IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2018, 2019, 2020, 2021, 2022
• Association for Advancement of Artificial Intelligence (AAAI) 2020, 2021, 2022
• 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
• Asian Conference on Computer Vision (ACCV) 2018, 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 and AWARDS

• ICCV Workshop on Multi-Agent Interaction and Relational Reasoning October 2021
Best Paper Award Runner Up

• Ministry of Education, Science and Technology, Korea 2003, 2007, 2009, 2010
National Science and Technology Scholarship

MEDIA COVERAGE

• LOKI: An intention dataset to train models for pedestrian and vehicle trajectory prediction, Tech Xplore, September 9, 2021.
• 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

Available upon request