Haoshu Fang

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RESEARCH GOAL

My research goal is to enable **robotic systems** to achieve *human-level manipulation* ability from raw sensory inputs, by solving the **core data problem** through a unified investigation of **hardware design**, **data scaling laws**, and **efficient learning**.

EDUCATION & WORK

Massachusetts Institute of Technology (MIT), USA *Dec. 2023 - present*
Postdoctoral Researcher, CSAIL
Advisor: Pulkit Agrawal / Edward Adelson

Shanghai Jiao Tong University (SJTU), China *Sep. 2013 - Sep. 2023*
B.E. & Ph.D., Computer Science and Engineering, Wu Wenjun Honorable Class
Advisor: Cewu Lu

SELECTED AWARDS

Best RoboCup Paper Finalist, IROS 2024 *Oct. 2024*
Best Paper Award, ICRA 2024 *May. 2024*
Best Paper Award, IROS 2023 Manipulation and Grasping Workshop *Oct. 2023*
ByteDance PhD Fellowship *June. 2021*
Microsoft Research Asia PhD Fellowship *Nov. 2020*
Baidu PhD Fellowship *Dec. 2019*
CCF-CV Rising Scholar *Sep. 2019*

SELECTED PUBLICATIONS

Total Citations: 7552

Summary: Published **36** peer-reviewed papers (3 best paper/nomination awards), including **18** first-author papers on robotics (T-RO, IJRR, ICRA, IROS) and computer vision (T-PAMI, IJCV, ICCV, CVPR, ECCV), and **13** papers first/co-first authored by mentees under my mentorship.

EyeSight Hand: Design of a Fully-Actuated Dexterous Robot Hand with Integrated Vision-Based Tactile Sensors and Compliant Actuation [paper][project]
Branden Romero*, **Hao-Shu Fang***, Pulkit Agrawal, Edward Adelson
IEEE/RSJ International Conference on Intelligent Robots and Systems **(IROS)** *2024 (Best RoboCup Paper Nomination)*

Low-Cost Exoskeletons for Learning Whole-Arm Manipulation in the Wild [paper][project]
Hongjie Fang*, **Hao-Shu Fang***, Yiming Wang*, Jieji Ren, Jingjing Chen, Ruo Zhang, Weiming Wang, Cewu Lu
The International Conference on Robotics and Automation **(ICRA)**, *2024*

Open X-Embodiment: Robotic Learning Datasets and RT-X Models [paper][project]
..., **Hao-Shu Fang**, ...
The International Conference on Robotics and Automation **(ICRA)**, *2024 (Best Paper Award)*

AnyGrasp: Robust and Efficient Grasp Perception in Spatial and Temporal Domains [paper][project]
Hao-Shu Fang, Chenxi Wang, Hongjie Fang, Minghao Gou, Jirong Liu, Hengxu Yan, Wwenhai Liu, Yichen Xie, Cewu Lu
IEEE Transaction on Robotics **(T-RO)**, *2023 (Best Paper Award on IROS 2023 workshop)*

Robust Grasping Across Diverse Sensor Qualities: The GraspNet-1Billion Dataset [paper][project]
Hao-Shu Fang, Minghao Gou, Chenxi Wang, Cewu Lu
The International Journal of Robotics Research **(IJRR)**, *2023*

AlphaPose: Whole-body Regional Multi-person Pose Estimation and Tracking in Real-time [paper] [code]
Hao-Shu Fang*, Jiefeng Li*, Hongyang Tang, Chao Xu, Haoyi Zhu, Yuliang Xiu, Yong-Lu Li, Cewu Lu
IEEE Transactions on Pattern Analysis and Machine Intelligence **(T-PAMI)**, *2022 (8000+ stars on GitHub)*

TEACHING

Lecturer, 6.S186 Modern Robot Learning: Hands-on Tutorial, MIT *2025*
Teaching Assistant, AI 1602 Introduction to Artificial Intelligence *2022*
Guest Lecturer, CS 386 Digital Image Processing *2020*
Teaching Assistant, AI 1602 Introduction to Artificial Intelligence *2020*
Teaching Assistant, CS348 Computer Vision *2017*

MENTORSHIP

Undergraduate students

- Arthur Hu, MIT *Under review ICRA 2025*
- Juan Alvarez, MIT *2024*
- Sameen Ahmad, MIT *2024*
- Hongjie Fang, SJTU undergrad → SJTU PhD student *RA-L 2022, ICRA 2024*
- Gu Zhang, SJTU undergrad → Tsinghua PhD student *IROS 2023*
- Haoyi Zhu, SJTU undergrad → UTSC PhD student *WACV 2023*
- Yichen Xie, SJTU undergrad → **UCB PhD** student *2×AAAI 2021*
- Hanwen Cao, SJTU undergrad → UCSD PhD student *RA-L 2021*
- Jianhua Sun, SJTU undergrad → SJTU PhD student *ICCV 2019*

Graduate students

- Shangning Xia, SJTU Master's student *Under review ICRA 2025*
- Hengxu Yan, SJTU PhD student *RA-L 2024, ICRA 2024*
- Jirong Liu, SJTU PhD student *CVPR 2023*
- Minghao Gou , SJTU Master's student → DJI Robotics *ICRA 2021*
- Chenxi Wang, SJTU Master's student → Flexiv Robotics *ICCV 2021*

INVITED TALKS

- 2024/12, Cornell University, Guest Lecture on Robot Learning, USA
- 2024/07, ICML Workshop Panelist, Vienna
- 2024/04, MIT ML Tea Talk, Cambridge, "Break the Data Wall for General Robotic manipulation"
- 2023/08, ByteDance Robotic Team, Beijing, "Introduction to RH20T: the Current Largest Robotic Dataset"
- 2023/07, RSS Workshop on Learning Dexterous Manipulation, Korea, "Data Efficiency in Robotic Manipulation"
- 2023/06, Vision And Learning Sminar, Wuxi, "Towards General Robotic Skill Learning"
- 2023/04, BIGAI, Beijing, "From General Object Grasping to General Skill Learning in Robotic Manipulation"
- 2022/12, SU lab, UCSD, "Efficient Learning for Robotic Manipulation in Real World"
- 2022/08, IDEA, Shenzhen, "AnyGrasp: Human-level General Robotic Grasping"
- 2021/08, Tsinghua Univ, Beijing, "AnyGrasp: Human-level General Robotic Grasping"

ACADEMIC SERVICES

Organizer for the ICML 2024 MFM-EAI Workshop.
Reviewer for journals including T-RO, IJRR, T-PAMI, IJCV, TMM, TOC, TIP, RA-L, *etc.*
Reviewer for conferences including RSS, ICRA, IROS, CoRL, CVPR, NeurIPS, ICLR, ICCV, ECCV, AAAI, *etc.*

PATENTS

Hand Exoskeleton System For Data Collection 2024
Hao-Shu Fang, Arthur Hu, Branden Romero, Edward Adelson, Pulkit Agrawal
US Provisional App.: 63/703,866

MANUSCRIPTS UNDER REVIEW

† denotes students that I mentored

Toward General-purpose Robots via Foundation Models: A Survey and Meta-analysis [paper]
Yafei Hu, Quanting Xie, Vidhi Jain, Jonathan Francis, Jay Patrikar, Nikhil Keetha, Seungchan Kim, Yaqi Xie, Tianyi Zhang, **Hao-Shu Fang**, Shibo Zhao, Shayegan Omidshafiei, Dong-Ki Kim, Ali-akbar Agha-mohammadi, Katia Sycara, Matthew Johnson-Roberson, Dhruv Batra, Xiaolong Wang, Sebastian Scherer, Chen Wang, Zsolt Kira, Fei Xia, Yonatan Bisk
In submission to The International Journal of Robotics Research **(IJRR)**

AnyDexGrasp: Learning General Dexterous Grasping for Any Hands with Human-level Learning Efficiency [paper]
Hao-Shu Fang, Hengxu Yan, Zhengyu Tang, Hongjie Fang, Chenxi Wang, Cewu Lu
In submission to Nature Machine Intelligence

DEXO: Hand Exoskeleton System for Teaching Robot Dexterous Manipulation In-The-Wild [paper]
Hao-Shu Fang, Branden Romero, Arthur Hu, Lirui Wang, Edward Adelson, Pulkit Agrawal
In submission to The International Conference on Robotics and Automation **(ICRA)**, *2025*

CAGE: Causal Attention Enables Data-Efficient Generalizable Robotic Manipulation [paper][project]
Shangning Xia†, Hongjie Fang, Cewu Lu, **Hao-Shu Fang**
In submission to The International Conference on Robotics and Automation **(ICRA)**, *2025*

PUBLICATIONS

total citations: 7552

∗ denotes equal contribution and † denotes students that I mentored

Journal Papers:

AViTa: Adaptive Visual-Tactile Dexterous Grasping [paper]
Hengxu Yan†, **Hao-Shu Fang**, Cewu Lu
IEEE Robotics and Automation Letters **(RA-L)**, *2024*

AnyGrasp: Robust and Efficient Grasp Perception in Spatial and Temporal Domains [paper][project]
Hao-Shu Fang, Chenxi Wang, Hongjie Fang, Minghao Gou, Jirong Liu, Hengxu Yan, Wwenhai Liu, Yichen Xie, Cewu Lu
IEEE Transaction on Robotics **(T-RO)**, *2023 (Best Paper Award on IROS 2023 workshop)*

Robust Grasping Across Diverse Sensor Qualities: The GraspNet-1Billion Dataset [paper][project]
Hao-Shu Fang, Minghao Gou, Chenxi Wang, Cewu Lu
The International Journal of Robotics Research **(IJRR)**, *2023*

InstaBoost++: Visual Coherence Principles for Unified 2D/3D Instance Level Data Augmentation [paper] [code]
Jianhua Sun*, **Hao-Shu Fang***, Yuxuan Li, Runzhong Wang, Minghao Gou, Cewu Lu
The International Journal of Computer Vision **(IJCV)**, *2023*

Regularity Learning via Explicit Distribution Modeling for Skeletal Video Anomaly Detection [paper]
Shoubin Yu, Zhongyin Zhao, **Hao-Shu Fang**, Andong Deng, Haisheng Su, Dongliang Wang, Weihao Gan, Cewu Lu, Wei Wu
IEEE Transactions on Circuits and Systems for Video Technology **(TCSVT)**, *2023*

AlphaPose: Whole-body Regional Multi-person Pose Estimation and Tracking in Real-time [paper] [code]
Hao-Shu Fang*, Jiefeng Li*, Hongyang Tang, Chao Xu, Haoyi Zhu, Yuliang Xiu, Yong-Lu Li, Cewu Lu
IEEE Transactions on Pattern Analysis and Machine Intelligence **(T-PAMI)**, *2022*

AlphaTracker: a Multi-animal Tracking and Behavioral Analysis Tool [paper] [code]
Zexin Chen*, Ruihan Zhang*, **Hao-Shu Fang***, Yu E Zhang, Aneesh Bal, Haowen Zhou, Rachel R Rock, Nancy Padilla-Coreano, Laurel R Keyes, Haoyi Zhu, Yong-Lu Li, Takaki Komiyama, Kay M Tye, Cewu Lu
Frontiers in Behavioral Neuroscience, 2022

TransCG: A Large-scale Real-world Dataset for Transparent Object Depth Completion [paper] [project]
Hongjie Fang†, **Hao-Shu Fang**, Sheng Xu, Cewu Lu
IEEE Robotics and Automation Letters **(RA-L)**, *2022*

Cortical Ensembles Orchestrate Social Competition Through Hypothalamic Outputs [paper][code]
N.P.-Coreano, K. Batra, M. Patarino, Z. Chen, R. R. Rock, R. Zhang, S. B. Hausmann, J. C. Weddington, R. Patel, Y. E. Zhang, **H.-S. Fang**, S. Mishra, D. O. LeDuke, J. Revanna, H. Li, M. Borio, R. Pamintuan, A. Bal, L. R. Keyes, A. Libster, R. Wichmann, F. Mills, F. H. Taschbach, G. A. Matthews, J. P. Curley, I. R. Fiete, C. Lu, K. M. Tye
Nature, 2022

HAKE: A Knowledge Engine Foundation for Human Activity Understanding [paper]
Yong-Lu Li, Xinpeng Liu, Xiaoqian Wu, Yizhuo Li, Zuoyu Qiu, Liang Xu, Yue Xu, **Hao-Shu Fang**, Cewu Lu
IEEE Transactions on Pattern Analysis and Machine Intelligence **(T-PAMI)**, *2022*

SuctionNet-1Billion: A Large-Scale Benchmark for Suction Grasping [paper] [project]
Hanwen Cao†, **Hao-Shu Fang**, Wenhai Liu, Cewu Lu
IEEE Robotics and Automation Letters **(RA-L)**, *2021*

Conference Papers:

EyeSight Hand: Design of a Fully-Actuated Dexterous Robot Hand with Integrated Vision-Based Tactile Sensors and Compliant Actuation [paper][project]
Branden Romero*, **Hao-Shu Fang***, Pulkit Agrawal, Edward Adelson
IEEE/RSJ International Conference on Intelligent Robots and Systems **(IROS)** *2024 (Best RoboCup Paper Nomination)*

3D Perception Makes Real-World Robot Imitation Simple and Effective [paper][project]
Chenxi Wang†, Hongjie Fang†, **Hao-Shu Fang**, Cewu Lu
IEEE/RSJ International Conference on Intelligent Robots and Systems **(IROS)** *2024*

RH20T: A Comprehensive Robotic Dataset for Learning Diverse Skills in One-Shot [paper][project]
Hao-Shu Fang, Hongjie Fang, Zhenyu Tang, Jirong Liu, Chenxi Wang, Junbo Wang, Haoyi Zhu, Cewu Lu
The International Conference on Robotics and Automation **(ICRA)**, *2024*

Low-Cost Exoskeletons for Learning Whole-Arm Manipulation in the Wild [paper][project]
Hongjie Fang*†, **Hao-Shu Fang***, Yiming Wang*, Jieji Ren, Jingjing Chen, Ruo Zhang, Weiming Wang, Cewu Lu
The International Conference on Robotics and Automation **(ICRA)**, *2024*

A Surprisingly Efficient Representation for Multi-Finger Grasping [paper]
Hengxu Yan*†, **Hao-Shu Fang***, Cewu Lu
The International Conference on Robotics and Automation **(ICRA)**, *2024*

Open X-Embodiment: Robotic Learning Datasets and RT-X Models [paper][project]
..., **Hao-Shu Fang**, ...
The International Conference on Robotics and Automation **(ICRA)**, *2024 (Best Paper Award)*

Flexible Handover with Real-Time Robust Dynamic Grasp Trajectory Generation [paper]
Gu Zhang†, **Hao-Shu Fang**, Hongjie Fang, Cewu Lu
IEEE/RSJ International Conference on Intelligent Robots and Systems **(IROS)** *2023*

Target-Referenced Reactive Grasping for Dynamic Objects [paper][code]
Jirong Liu†, Ruo Zhang, **Hao-Shu Fang**, Minghao Gou, Hongjie Fang, Chenxi Wang, Sheng Xu, Hengxu Yan, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2023*

Correlation Field for Boosting 3D Object Detection in Structured Scenes [paper]
Jianhua Sun, **Hao-Shu Fang**, Xianghui Zhu, Jiefeng Li, Cewu Lu
AAAI Conference on Artificial Intelligence **(AAAI)** *2022*

Three Steps to Multimodal Trajectory Prediction: Modality Clustering, Classification and Synthesis [paper]
Jianhua Sun, Yuxuan Li, **Hao-Shu Fang**, Cewu Lu
Proceedings of the IEEE/CVF International Conference on Computer Vision **(ICCV)** *2022*

DIRV: Dense Interaction Region Voting for End-to-End Human-Object Interaction Detection [paper][code]
Hao-Shu Fang*, Yichen Xie*†, Dian Shao, Cewu Lu
AAAI Conference on Artificial Intelligence **(AAAI)** *2021*

DecAug: Augmenting HOI Detection via Decomposition [paper]
Hao-Shu Fang*, Yichen Xie*†, Dian Shao, Yong-Lu Li, Cewu Lu
AAAI Conference on Artificial Intelligence **(AAAI)** *2021*

RGB Matters: Learning 7-DoF Grasp Poses on Monocular RGBD Images [paper][code]
Minghao Gou†, **Hao-Shu Fang**, Zhanda Zhu, Sheng Xu, Chenxi Wang, Cewu Lu
The International Conference on Robotics and Automation **(ICRA)** *2021*

Graspness Discovery in Clutters for Fast and Accurate Grasp Detection [paper]
Chenxi Wang*†, **Hao-Shu Fang***, Minghao Gou, Hongjie Fang, Jin Gao, Cewu Lu
IEEE/CVF International Conference on Computer Vision **(ICCV)** *2021*

PaStaNet: Toward Human Activity Knowledge Engine [paper]
Yong-Lu Li, Liang Xu, Xinpeng Liu, Xijie Huang, Yue Xu, Shiyi Wang, **Hao-Shu Fang**, Ze Ma, Mingyang Chen, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2020*

GraspNet-1Billion: A Large-Scale Benchmark for General Object Grasping [paper][code]
Hao-Shu Fang, Chenxi Wang, Minghao Gou, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2020*

InstaBoost: Boosting Instance Segmentation via Probability Map Guided Copy-pasting [paper][code]
Hao-Shu Fang*, Jianhua Sun*†, Runzhong Wang*†, Minghao Gou, Yong-Lu Li, Cewu Lu
IEEE/CVF International Conference on Computer Vision **(ICCV)** *2019*

Cross-domain Adaptation for Animal Pose Estimation [paper]
Jinkun Cao, Hongyang Tang, **Hao-Shu Fang**, Xiaoyong Shen, Cewu Lu, Yu-Wing Tai
IEEE/CVF International Conference on Computer Vision **(ICCV)** *2019*

Crowdpose: Efficient Crowded Scenes Pose Estimation and A New Benchmark [paper]
Jiefeng Li, Can Wang, Hao Zhu, Yihuan Mao, **Hao-Shu Fang**, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2019*

Transferable Interactiveness Knowledge for Human-Object Interaction Detection [paper]
Yong-Lu Li, Siyuan Zhou, Xijie Huang, Liang Xu, Ze Ma, **Hao-Shu Fang**, Yanfeng Wang, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2019*

Pairwise Body-Part Attention for Recognizing Human-Object Interactions [paper]
Hao-Shu Fang, Jinkun Cao, Yu-Wing Tai, Cewu Lu
European Conference on Computer Vision **(ECCV)** *2018*

Weakly and Semi Supervised Human Body Part Parsing via Pose-Guided Knowledge Transfer [paper][code]
Hao-Shu Fang, Guansong Lu, Xiaolin Fang, Jianwen Xie, Yu-Wing Tai, Cewu Lu
IEEE/CVF Conference on Computer Vision and Pattern Recognition **(CVPR)** *2018*

Learning Pose Grammar to Encode Human Body Configuration for 3D Pose Estimation [paper][code]
Hao-Shu Fang*, Yuanlu Xu*, Wenguan Wang, Xiaobai Liu and Song-Chun Zhu
AAAI Conference on Artificial Intelligence **(AAAI)** *2018*

RMPE: Regional Multi-Person Pose Estimation[paper][code]
Hao-Shu Fang, Shuqin Xie, Yu-Wing Tai and Cewu Lu
IEEE/CVF International Conference on Computer Vision **(ICCV)** *2017*

SELECTED PROJECTS

RH20T First author
The largest robotic manipulation dataset, 140+ skills, 40+ TB in size *Oct, 2021 - June, 2023*

- Contains 110,000+ *contact-rich* robot manipulation sequences, all collected in the real world.
- Comprises diverse skills, robots, viewpoints, objects, backgrounds, etc.
- Provides rich visual, tactile, audio, and proprioception information.
- Each robotic manipulation is paired with diverse human demonstrations for the same task.

GraspNet First author
First community for 6-DoF general object grasping *June, 2020 - June 2023*

- The first large-scale real-world benchmark for 6-DoF cluttered object grasping.
- Enables robots to achieve human-level grasping.
- Ranked the 2nd most influential 6-DoF grasping paper in 10 years in a review by Stanford and UW.

AlphaPose First author
Over 8K stars on GitHub *2018 - 2022*

- Fast and accurate multi-person pose estimation and tracking system.
- Commercial license bought by over 20 oversea companies.
- Excellent open-source project in China, 2020 (the only one from the University among 10 winners).

INTERNSHIPS

Flexiv Robotics, Shanghai
Research Intern *Jul. 2018 - Sep. 2019*

VCLA, UCLA, California
Research Intern(advisor: Prof. Song-Chun Zhu) *Jun. 2017 - Oct. 2017*

Youtu Lab, Tencent, Shanghai
Research Intern(advisor: Dr. Yu-Wing Tai) *Feb. 2017 - Jun. 2017*