Karthik Desingh, Ph.D.

Postdoctoral Scholar

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Summary

My expertise lies in **robot perception** for mobile manipulation tasks. More precisely, I focus on providing perceptual capabilities to robots **using deep learning and probabilistic techniques** to enable them **to perform goal-directed tasks in unstructured environments**. My research interests broadly lie at the intersection of robotics, computer vision, and machine learning.

Education

University of Michigan — *Ann Arbor, MI, USA*
Ph.D. Computer Science and Engineering — *2016 - 2020*
- Advisor: Chad Jenkins
- Committee: Dmitry Berenson, Benjamin Kuipers, Edwin Olson, Gaurav Sukhatme
- Thesis: Efficient Belief Propagation for Perception and Manipulation in Clutter

Brown University — *Providence, RI, USA*
MS Computer Science — *2013 - 2015*
- Advisor: Chad Jenkins

International Institute of Information Technology — *Hyderabad, India*
MS Computer Science — *2010 - 2013*
- Advisor: K. Madhava Krishna
- Thesis: Visual Saliency and Next Best View Models for Object Recognition and Search

Osmania University — *Hyderabad, India*
BE Electronics and Communication — *2004 - 2008*

Professional Experience

2020-	**Postdoctoral Scholar**, University of Washington, PI: Dieter Fox
2016-2020	**Graduate Student Research Assistant**, University of Michigan, PI: Chad Jenkins
2013-2015	**Graduate Student Research Assistant**, Brown University, PI: Chad Jenkins
2014-2014	**Summer Intern**, Google Summer of Code, PI: Zoltan Csaba Marton (DLR Germany)
2010-2013	**Graduate Student Research Assistant**, IIIT Hyderabad, PI: K Madhava Krishna
2008-2010	**Software Engineer**, Capgemini, Chennai

Publications

Conference Publications

C12. Wentao Yuan, Chris Paxton, **Karthik Desingh**, and Dieter Fox, "SORNet: Spatial Object-Centric Representations for Sequential Manipulation," *Proceedings of the Conference on Robot Learning. (CoRL) 2021,* Best systems paper finalist.

C11. Junha Roh, **Karthik Desingh**, Ali Farhadi, and Dieter Fox, "LanguageRefer: Spatial-Language Model for 3D Visual Grounding," *Proceedings of the Conference on Robot Learning. (CoRL) 2021.*

C10. Jana Pavlasek, Stanley Lewis, **Karthik Desingh**, and Odest Chadwicke Jenkins. "Parts-based articulated object localization in clutter using belief propagation." *In IEEE/RSJ International Conference on Intelligent Robots and Systems, pp. 10595-10602. (IROS) 2020*.

C9. **Karthik Desingh**, Shiyang Lu, Anthony Opipari, and Odest Chadwicke Jenkins. "Factored pose estimation of articulated objects using efficient nonparametric belief propagation." *In International Conference on Robotics and Automation, pp. 7221-7227. (ICRA) 2019*.

C8. Zhen Zeng, Yunwen Zhou, Odest Chadwicke Jenkins, and **Karthik Desingh**. "Semantic mapping with simultaneous object detection and localization." *In IEEE/RSJ International Conference on Intelligent Robots and Systems, pp. 911-918. (IROS) 2018*.

C7. Mehran Maghoumi, Joseph J. LaVioia, **Karthik Desingh**, and Odest Chadwicke Jenkins. "Gemsketch: Interactive image-guided geometry extraction from point clouds." *In IEEE International Conference on Robotics and Automation, pp. 2184-2191. (ICRA) 2018*.

C6. Sai R. Gouravajhala, Jinyeong Yim, **Karthik Desingh**, Yanda Huang, Odest Chadwicke Jenkins, and Walter S. Lasecki. "Eureca: Enhanced understanding of real environments via crowd assistance." *In Sixth AAAI conference on human computation and crowdsourcing. (HCOMP) 2018*.

C5. Nediyana Daskalova, **Karthik Desingh**, Alexandra Papoutsaki, Diane Schulze, Han Sha, and Jeff Huang. "Lessons learned from two cohorts of personal informatics self-experiments." *In the proceedings of the ACM on interactive, mobile, wearable and ubiquitous technologies 1, no. 3 : 1-22. (UbiComp) 2017*.

C4. **Karthik Desingh**, Odest Chadwicke Jenkins, Lionel Reveret, and Zhiqiang Sui. "Physically plausible scene estimation for manipulation in clutter." *In IEEE-RAS 16th International Conference on Humanoid Robots, pp. 1073-1080. (Humanoids) 2016*.

C3. Zhiqiang Sui, Odest Chadwicke Jenkins, and **Karthik Desingh**. "Axiomatic particle filtering for goal-directed robotic manipulation." *In IEEE/RSJ International Conference on Intelligent Robots and Systems, pp. 4429-4436. (IROS) 2015*.

C2. **Karthik Desingh**, K. Madhava Krishna, Deepu Rajan, and C. V. Jawahar. "Depth really Matters: Improving Visual Salient Region Detection with Depth." *In British Machine Vision Conference, pp. 1-11. (BMVC) 2013*.

C1. **Karthik Desingh**, Akhil Nagariya, and K. Madhava Krishna. "Viewpoint based mobile robotic exploration aiding object search in indoor environment." *In Proceedings of the Eighth Indian Conference on Computer Vision, Graphics and Image Processing, pp. 1-8. (ICVGIP) 2012*.

Journal Articles

J3. Thomas Cohn, Odest Chadwicke Jenkins, **Karthik Desingh**, and Zhen Zeng. "TSBP: Tangent Space Belief Propagation for Manifold Learning." *In IEEE/RSJ International Conference on Intelligent Robots and Systems. (RA-L) 2020, Presented at IROS 2020*.

J2. **Karthik Desingh**, Shiyang Lu, Anthony Opipari, and Odest Chadwicke Jenkins. "Efficient nonparametric belief propagation for pose estimation and manipulation of articulated objects." *Science Robotics 4, no. 30 (2019)*.

J1. Zhiqiang Sui, Lingzhu Xiang, Odest Chadwicke Jenkins, and **Karthik Desingh**. "Goal-directed robot manipulation through axiomatic scene estimation." *In the International Journal of Robotics Research 36, no. 1 : 86-104. (IJRR) 2017.*

Peer Reviewed Workshops

W8. Wentao Yuan, Chris Paxton, **Karthik Desingh**, and Dieter Fox, "SORNet: Spatial Object-Centric Representations for Sequential Manipulation," *RSS 2021 Workshop on Declarative and Neurosymbolic Representations in Robot Learning and Control.*

W7. Aaron T. Walsman, Muru Zhang, Adam Fishman, **Karthik Desingh**, Dieter Fox, and Ali Farhadi, "LegoTron: An Environment for Interactive Structural Understanding," *CVPR 2021 Embodied AI Workshop.*

W6. **Karthik Desingh**, Jana Pavlasek, Cigdem Kokenoz, and Odest Chadwicke Jenkins, "Tracking Large Scale Articulated Models with Belief Propagation for Task Informed Grasping and Manipulation," *RSS 2019 Workshop: Task-Informed Grasping (TIG-II): From Perception to Physical Interaction* - Best workshop paper.

W5. Jana Pavlasek , **Karthik Desingh**, Odest Chadwicke Jenkins, "Scene Understanding using Part-Based Object Affordances," *RSS 2019 Workshop: Women in Robotics.*

W4. Sina Masnadi, Joseph J. LaViola, Jana Pavlasek, Xiaofan Zhu, **Karthik Desingh**, and Odest Chadwicke Jenkins, "Sketching Affordances for Human-in-the-loop Robotic Manipulation Tasks," *ICRA 2019 Workshop: 2nd Robot Teammates Operating in Dynamic, Unstructured Environments (RT-DUNE).*

W3. **Karthik Desingh**, Anthony Opipari, and Odest Chadwicke Jenkins, "Analysis of Goal-directed Manipulation in Clutter using Scene Graph Belief Propagation," *ICRA 2018 Workshop: Multimodal Robot Perception - Perception, Inference and Learning for Joint Semantic, Geometric and Physical Understanding.*

W2. **Karthik Desingh**, Mehran Maghoumi, Joseph J. LaViola, and Odest Chadwicke Jenkins, "Object Manipulation in Cluttered Scenes Informed by Physics and Sketching," *RSS 2016 Workshop: Geometry and Beyond - Representations, Physics and Scene Understanding for Robotics.*

W1. Zhiqiang Sui, Odest Chadwicke Jenkins, and **Karthik Desingh**, "Axiomatic Scene Estimation for Robotic Manipulation," *ICRA 2015 Workshop: Robotic Hands, Grasping and Manipulation.*

Preprints

P3. Anthony Opipari, Chao Chen, Shoutian Wang, Jana Pavlasek, **Karthik Desingh**, and Odest Chadwicke Jenkins, "Differentiable Nonparametric Belief Propagation," *arXiv 2021.*

P2. Sina Masnadi, Joseph J. LaViola, Xiaofan Zhu, **Karthik Desingh**, Odest Chadwicke Jenkins, "A Sketch-Based System for Human-Guided Constrained Object Manipulation," *arXiv 2019.*

P1. **Karthik Desingh**, Anthony Opipari, and Odest Chadwicke Jenkins, "Pull Message Passing for Nonparametric Belief Propagation," *arXiv 2018.*

Grant Writing Experience

- Authored a research proposal for undergraduate research project "Spatial and Geometrical Reasoning of Objects for Robot Task Planning" to UW Allen School Postdoc Research Award, Autumn 2021 cycle, *Under review - $10,000*.
- Co-authored a grant proposal for REU program with Dieter Fox (PI) as a supplement to an existing *NSF-NRI Award #2024057*, titled "Collaborative Research: NRI: FND: Graph Neural Networks for Multi-Object Manipulation," *2021, $8,000*.
- Co-authored NSF-NRI grant proposal with Chad Jenkins (PI) and Joseph J. LaViola (PI) on "NRI: Collaborative Research: Sketching Geometry and Physics Informed Inference for Mobile Robot Manipulation in Cluttered Scenes," *Award #1638047, 2016-2019, $400,000*.
- Co-authored NSF-NRI grant proposal with Chad Jenkins (PI) and Joseph J. LaViola (PI) on "NRI: Collaborative Research: Sketching and Inferring Affordances for Mobile Robot Manipulation in Cluttered Scenes," *Reviewed, 2019.*

Invited Talks & Presentations

Nov 2021 **Invited research talk**, "Learning Object-centric Representations for Robot Manipulation,"
Cornell Robotics Seminar, Host: Tapo Bhattacharjee, *Ithaca, NY (online)*

Sept 2021 **Invited research talk**, "Learning Object-centric Representations for Robot Manipulation,"
IROS 2021, 5th Workshop on Semantic Policy and Action Representations for Autonomous Robots (SPAR), *Prague, Czech Republic (online)*

Aug 2021 **Research presentation**, "Object Pose Estimation and Tracking for Curiosity-Driven Object Exploration,"
Curious Minded Machines final project meeting, funded by Honda Research Institute *(online)*

Nov 2019 **Invited research talk**, "Efficient Belief Propagation for Robot Manipulation in Clutter,"
Host: Dieter Fox, *University of Washington, Seattle, WA*

Aug 2019 **Invited research talk**, "Efficient Belief Propagation for Robot Manipulation in Clutter,"
Hosts: Gaurav Sukhatme and Joseph Lim, *University of Southern California, Los Angeles, CA*

Aug 2019 **Invited research talk**, "Efficient Belief Propagation for Robot Manipulation in Clutter,"
Host: Aaron Dollar, *Yale University, New Haven, CT*

Apr 2019 **Invited research talk**, "Robots working in human environments,"
ML Conference, *East Michigan University, Ypsilanti, MI*

Jun 2019 **Poster presentation**, "Efficient nonparametric belief propagation for pose estimation and manipulation of articulated objects,"
New England Manipulation Symposium, *Columbia University, New York*

May 2019 **Paper presentation**, "Factored pose estimation of articulated objects using efficient nonparametric belief propagation,"
ICRA 2019, *Montreal, Canada*

Mar 2019 **Invited research poster**, "Factored pose estimation of articulated objects using efficient nonparametric belief propagation,"
Amazon Graduate Research Symposium, *Seattle, WA*

Nov 2018 **Poster presentation**, "Factored pose estimation of articulated objects using efficient nonparametric belief propagation,"
Michigan AI symposium, *Ann Arbor, MI*

Oct 2018 **Research talk**, "Factored pose estimation of articulated objects using efficient nonparametric belief propagation,"
Michigan AI honors competition, *Ann Arbor, MI*

Oct 2018 **Poster presentation**, "NRI: Collaborative Research: Sketching Geometry and Physics Informed Inference for Mobile Robot Manipulation in Cluttered Scenes,"
NSF-NRI PI meeting, *Arlington, VA*

May 2018 **Paper presentation**, "GemSketch: Interactive Image-Guided Geometry Extraction from Point Clouds,"

	ICRA 2018, *Brisbane, Australia*
Nov 2017	**Poster presentation**, "A Nonparametric Approach to Scene Estimation with Inter-object Relations towards Goal-directed Manipulation," Engineering Graduate Symposium, *Ann Arbor, MI*
Jun 2017	**Poster presentation**, "A Nonparametric Approach to Scene Estimation with object-object interactions towards Goal-directed Manipulation," New England Manipulation Symposium, *North Eastern University, Boston, MA*
Nov 2016	**Paper presentation**, "Physically Plausible Scene Estimation for Manipulation in Clutter," IEEE Humanoids Conference, *Cancun, Mexico*
Jul 2016	**Poster presentation**, "Object Manipulation in Cluttered Scenes Informed by Physics and Sketching," RSS 2016 Workshop: Geometry and Beyond - Representations, Physics and Scene Understanding for Robotics, *Ann Arbor, MI*
May 2015	**Poster presentation**, "Axiomatic Scene Estimation for Robotic Manipulation," ICRA Ph.D. forum, *Seattle, WA*
May 2015	**Poster presentation**, "Axiomatic Scene Estimation for Robotic Manipulation," New England Manipulation Symposium, *North Eastern University, Boston, MA*

Mentoring

*Mentees who co-authored above listed publications/articles are indicated with *.*

2020-	Aaron T. Walsman*	Ph.D., Univ of Washington	
2020-	Junha Roh*	Ph.D., Univ of Washington	
2020-	Xiangyun Meng	Ph.D., Univ of Washington	
2018-2020	Jana Pavlasek*	Ph.D., Univ of Michigan	
2018-2020	Anthony Opipari*	MS, Univ of Michigan	*now Ph.D., Univ of Michigan*
2019-2020	Chao Chen*	MS, Univ of Michigan	*now Ph.D., at NYU*
2020-2020	Shoutian Wang*	MS, Univ of Michigan	
2019-2020	Neha Pusalkar	MS, Univ of Michigan	*now Ph.D., Oregon State Univ*
2018-2019	Shiyang Lu*	MS, Univ of Michigan	*now Ph.D., Rutgers*
2018-2019	Xiaofan Zhu*	MS, Univ of Michigan	
2017-2018	Yunwen Zhou*	MS, Univ of Michigan	*now at Google*
2017-2018	Chandana Neerukonda	MS, Univ of Michigan	*now at Ford Motor Company*
2020-	Muru Zhang	Undergrad, Univ of Washington	
2021-	Rachel Soto-Garcia	Undergrad (REU), Rensselaer Polytechnic Institute	
2021-2021	Ruthvik S. Mondreti	Undergrad, Univ of Washington	
2021-2021	Yi Ru (Helen) Wang	Undergrad (Inclusion@RSS), Univ of Toronto	
2021-2021	Julia Chae	Undergrad (Inclusion@RSS), Univ of Toronto	
2019-2020	Thomas Cohn*	Undergrad, Univ of Michigan	
2019-2019	Zhiming Ruan	Undergrad, Univ of Michigan	*now at Vicarious*
2019-2019	Cigdem Kokenoz*	Undergrad, Univ of Michigan	*now MS, Univ of Michigan*
2017-2018	Anthony Opipari*	Undergrad, Univ of Michigan	*now Ph.D., Univ of Michigan*
2012-2013	Akhil Nagariya*	Undergrad, IIIT-Hyderabad	*now Ph.D., Texas A&M*

Teaching Experience

Spr 2021	**CSE 571: AI-Based Mobile Robotics**, Guest Lecturer & Course Staff Faculty Instructor(s): Dieter Fox	*Univ of Washington*
2020-2021	**CSE 590R: Robotics Seminar**, Co-instructor - Fall'20, Win'20, Spr'21, Fall'21 Faculty Instructor(s): Dieter Fox, Maya Cakmak	*Univ of Washington*
Win 2021	**TECHIN 516 Robotics Lab 1: Robotic Sensing And Mobility**, Guest Lecturer Faculty Instructor(s): Maru Cabrera	*Univ of Washington*
F'19-Sp'20	**EECS 280: Programming and Intro Data Structures**, Graduate Student Instructor Faculty Instructor(s): Jonathan Beaumont, James Juett, Sofia Saleem, Nicole Hamilton	*Univ of Michigan*
Spr 2019	**EECS 467: Autonomous Robotics Laboratory**, Graduate Student Instructor	*Univ of Michigan*

Faculty Instructor(s): Chad Jenkins

Fall 2015 **CS 1951-C: Designing Humanity Centered Robots**, Teaching Assistant — *Brown University*
Faculty Instructor(s): Michael Littman, Ian Gonsher

Fall 2014 **CS 2951-P: Human Robot Interaction Seminar course**, Teaching Assistant — *Brown University*
Faculty Instructor(s): Chad Jenkins

Fall 2012 **CSE 478: Mobile Robotics**, Teaching Assistant — *IIIT - Hyderabad*
Faculty Instructor(s): K Madhava Krishna

Service, Outreach & Professional Development

Professional Memberships

- Program Committee Member - International Joint Conferences on Artificial Intelligence (IJCAI) 2020-2024.
- Program Committee Member - International Conference on Robot Learning (CoRL) 2020-2021.

Peer Reviewing

- Journal Reviewer - IEEE Robotics and Automation Letters (RA-L)
- Journal Reviewer - Autonomous Robots Journal (AURO)
- Conference Reviewer - IEEE International Conference on Robotics and Automation (ICRA)
- Conference Reviewer - IEEE/RSJ International Conference on Robots and Systems (IROS)
- Conference Reviewer - Robotics: Science and Systems (RSS)
- Conference Reviewer - IEEE-RAS International Conference on Humanoid Robotics (Humanoids)
- Conference Reviewer - AAAI Conference on Artificial Intelligence
- Conference Reviewer - International Joint Conferences on Artificial Intelligence (IJCAI)
- Conference Reviewer - International Conference on Robot Learning (CoRL)
- Workshop Reviewer - CVPR 2021 Workshop on 3D Vision and Robotics
- Workshop Reviewer - Robotics: Science and Systems (RSS) Pioneers - 2018, 2021

Service and Outreach

- Mentor, **Inclusion@RSS - Robotics: Science and Systems**, 2021
- Organizer, **University of Washington Robotics Colloquium**, *University of Washington,* Fall 2020 - Fall 2021
- Mentor for applicants from historically marginalized groups, **Pre-Application Review Service (PARS)**, *University of Washington,* Fall 2021
- Alumni mentor, **Graduate Rackham International (GRIN) Speed Mentoring Event**, *University of Michigan,* Fall 2020
- Robotics lab tour organizer, **Explore Graduate Studies (EGS) Workshop**, *University of Michigan,* Spring 2019
- Robotics lab tour organizer, **GEECS (Girls in Electrical Engineering and Computer Science)**, *University of Michigan,* Spring 2018
- Student committee member, **Graduate Admission Committee**, *University of Michigan,* Fall 2018
- Staff mentor for freshmen, **University Mentorship Program**, *University of Michigan,* Fall 2018
- Robotics lab tour organizer, **CS Kick Start Program**, *University of Michigan,* Fall 2018
- Robotics lab tour organizer, **CS visit day**, *University of Michigan,* Spring 2017
- Graduate student member, **Graduate Employee Organization (GEO)**, *University of Michigan,* 2016-2020

Professional Development

- Participated in workshop on Anti-Black Racism organized within Robotics Groups in Paul G. Allen School of Computer Science and Engineering, University of Washington, 2020-2021.
- Participated in Mentorship Training Workshop hosted by MolES DEI Committee and the Undergraduate Research Program at the University of Washington, Winter 2021.
- Completed “Cultivating a Culture of Respect” misconduct training facilitated by UM Robotics Institute, Fall 2019.
- Participated in RAS Women In Engineering (WIE) Breakfast as part of IEEE International Conference on Robotics and Automation (ICRA) 2019, at Montreal.

Press and Media Coverage

- **Science Robotics Interview** - “Can computer vision teach robots to think before they act?” - link
- **Michigan News** - “A quicker eye for robotics to help in our cluttered, human environments” - link
- **EEWorld Online** - “A quicker eye for robotics to help in our cluttered, human environments” - link
- **Tech Explore** - “A quicker eye for robotics to help in our cluttered, human environments” - link
- **Futurity** - “A quicker eye for robotics to help in our cluttered, human environments” - link
- **Venture Beat** - “Before we put $100 billion into AI” - link
- **Michigan AI Blog** - “Personal Robots: Why is perception important?” - link