Kyle Vedder

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Education

- PhD in Computer Science, University of Pennsylvania (in progress) (2019 – Present)
  - Advisors: Eric Eaton, Dinesh Jayaraman, *GRASP Lab*
- BS in Computer Science, University of Massachusetts (2015 – 2019)
  - Advisor: Joydeep Biswas, *Autonomous Mobile Robotics Lab (AMRL)*

Research Interests

I believe the shortest path to getting robust, generally capable robots in the real world is though the construction of systems whose performance scales with compute and data, *without* requiring human annotations. The world is fundamentally 3D, but currently most vision systems focus on 2D data simply due to general availability of RGB images and strong hardware acceleration for standard processing methods (e.g. 2D convolutions). I am interested in building such scalable vision systems on top of 3D sensor data (e.g. LiDAR, Stereo) that reasons natively in 3D, in the hope that these 3D representations are more useful for quickly and robustly learning downstream behavioral tasks compared to their 2D counterparts.

Publications

Conferences/Journals

Peer-reviewed papers

- **Kyle Vedder**, Eric Eaton. *Sparse PointPillars: Maintaining and Exploiting Input Sparsity to Improve Runtime on Embedded Systems.* Proceedings of the International Conference on Intelligent Robots and Systems (IROS), 2022. [website] [pdf]
- **Kyle Vedder**, Joydeep Biswas. *X*: Anytime Multi-Agent Path Finding For Sparse Domains Using Window-Based Iterative Repairs.* Artificial Intelligence (AIJ), 2021. [website] [pdf]
- **Kyle Vedder**, Joydeep Biswas. *X*: Anytime Multiagent Path Planning With Bounded Search.* Proceedings of the 18th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS), 2019. [website] [pdf]

Workshops

- **Kyle Vedder**, Eric Eaton. *Sparse PointPillars: Exploiting Sparsity on Birds-Eye-View Object Detection.* Sparsity in Neural Networks Workshop (SNN), 2021. [poster]
- Spencer Lane, **Kyle Vedder**, Joydeep Biswas. *Augmenting Planning Graphs in 2-Dimensional Dynamic Environments With Obstacle Scaffolds.* Proceedings of the 5th Workshop on Planning and Robotics (ICAPS PlanRob), 2017. [pdf]

Tech Reports

- **Kyle Vedder**. *Current Approaches and Future Directions for Point Cloud Object Detection in Intelligent Agents.* 2021. [pdf] [slides] [video]
- **Kyle Vedder**. *An Overview of SHAP-based Feature Importance Measures and Their Applications To Classification.* 2020. [pdf] [slides] [video]
- **Kyle Vedder**, Edward Schneeweiss, Sadegh Rabiee, Samer Nashed, Spencer Lane, Jarrett Holtz, Joydeep Biswas, David Balaban. *UMass MinuteBots 2018 Team Description Paper.* 2018. [pdf]
- **Kyle Vedder**, Edward Schneeweiss, Sadegh Rabiee, Samer Nashed, Spencer Lane, Jarrett Holtz, Joydeep Biswas, David Balaban. *UMass MinuteBots 2017 Team Description Paper.* 2017. [pdf]

Honors and Awards

- *Goldwater Scholarship Honorable Mention* (2018)
  - One of 281 Honorable Mentions selected from a pool of 1280 national nominees
- *Outstanding Undergraduate Course Assistant (CS220 Programming Methodologies)* (Fall 2017)

- Received award for contributions to course development

Academic Experience

- *PhD Candidate – Lifelong Machine Learning group (LML), UPenn* (2019 – Present)
  - Developed *Sparse PointPillars*, a point cloud 3D object detector for embedded systems
    - Based on popular detector *PointPillars*, with modified backbone to maintain and exploit input sparsity using end-to-end submanifold convolutions, significantly reducing model FLOPs
    - Contributed bugfixes and improvements to Open3D implementation of *PointPillars* [commits]
    - Workshop paper at Sparse Neural Networks Workshop; in submission to IROS 2022
  - Core Team Lead for Phase 2 of DARPA Lifelong Learning Machines (L2M) program
    - Led multi-University team to develop core infrastructure for RL and Perception subgroups atop the AIHabitat sim using Matterport3D, a dataset of 3D indoor scans of real houses
    - Worked with DARPA SETAs and other performers to refine fundamental cross-domain definition of lifelong learning systems along with domain agnostic evaluation approaches
    - Worked with subcontractors to develop concrete tasks for lifelong learning for an embodied agent in Matterport3D
    - Coordinated RL and Perception subgroups to provide system diagrams and metrics for evaluation by JHU APL, DARPA's independent evaluator, using APL's metrics definitions
    - Worked on adapting and tuning our group's Lifelong RL algorithm, LPG-FTW, for AIHabitat
  - Developed from scratch open-source control stack for LML Service Robots in C++14 [code]
    - Provides efficient implementation of particle filter-based localization on vector maps, velocity space obstacle avoidance, hierarchical path planning for real-time performance, visualization support via ROS, and integration with a multi-agent robot simulator
    - Basis for getting started homework assignment and several final group projects in CIS700 Integrated Intelligence, Fall 2020
- *Research Assistant – Autonomous Mobile Robotics Lab (AMRL), UMass* (2016 – 2019)
  - Developed *X**, an anytime multiagent planner for realtime systems
    - Designed, proved correct, implemented, and evaluated all novel algorithms
    - Performed literature review and wrote paper with high level editing input from coauthor
  - Developed *Obstacle Scaffolds*, an extension to roadmap planners for finer near-obstacle navigation
    - Implemented baseline and experimental planners
    - Evaluated planner characteristics across multiple scenarios
  - Founding member of the UMass Minutebots, the RoboCup Small Size League team that serves as AMRL's research platform for autonomous multiagent systems
    - Architected and implemented majority of the core software infrastructure for the control stack
    - Implemented state-of-the-art realtime path planning, low level collision avoidance, and portions of the motion planning system
- *Academic Reviewer* (2019 – Present)
  - AAAI 2020 – 2022, AAMAS 2021, JMLR (Secondary) 2021, ICRA 2022
  - Reviewed articles on topics across robotics, vision, machine learning, and classical AI
- *Teaching Assistant – CIS 519 Applied Machine Learning, UPenn* (Spring 2021)
  - Head TA managing 14 TAs doing homework assignment creation, running office hours, and performing small group cohort sessions
- *Teaching Assistant – CIS 700 Integrated Intelligence, UPenn* (Fall 2020)
  - Developed assignments, led paper discussions, led technical lessons on ROS and C++1X, and helped students with ideation and execution of final project
- *Undergraduate Course Assistant – CIS 220 Programming Methodologies, UMass* (2016 – 2017)
  - Led discussion sections, held office hours, answered Q&A forum questions, overhauled course material, and restructured discussion sections to better suit student needs

Industry Experience

- *Argo AI – Research Intern* (Summer / Fall 2022)
  - Exploring 2D and 3D methods for generalizing object detectors to the long tail of objects

- *Amazon Lab126 – Software Development Intern* (Summer 2019)
  - Worked on Amazon Astro, a small mobile service robot, doing novel classical multi-modal IR camera and ToF sensor fusion for detecting small obstacles such as wires or boxes to avoid collisions
- *Google – Software Engineering Intern* (Summer 2017)
  - Worked on Ads Quality Metrics team to deliver statistics about bad ads. Developed information theoretic optimization approach to aquire maximally diverse training data for automated detectors
- *Google – Software Engineering Intern* (Summer 2016)
  - Worked on AdWords Next Overview, the homepage of redesigned AdWords. Developed offline pipelines to do statistical analysis over entire customer dataset to provide automated insights
- *Unidesk Corporation – C++ Development Intern* (Summer 2015)
  - Designed and implemented testing framework for proprietary Windows registry manipulation APIs, ensuring bug-for-bug compatibility with Windows' implementation of fixed width UTF-16
- *Unidesk Corporation – Robotics Intern* (Summer 2014)
  - Worked with CTO and CMO to implement a trade show display using a 6DOF robot arm controlled via high level pick-and-place commands. Wrote Java backend to maintain world state and dynamically generate FORTH written over a serial bus to execute robot trajectories requested from high level RESTful API