Akshar Chavan

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EAS Lab, The Ohio State University

Department of Electrical and Computer Engineering

Columbus, OH 43210

EDUCATION

The Ohio State University   Jan 2024 - Present
Ph.D. in Electrical and Computer Engineering
Dissertation: *Maximizing battery lifespan of autonomous systems*
Advisor: Dr. Marco Brocanelli

Wayne State University   Aug 2020 - Dec 2023
Ph.D. in Computer Science *(Transferred)*
Advisor: Dr. Marco Brocanelli

Wayne State University   Aug 2018 - May 2020
Masters in Industrial Engineering

Saraswati College of Engineering, Mumbai University   Aug 2011 - May 2014
B.E. in Mechanical Engineering

RESEARCH INTERESTS

Energy-aware systems, autonomous systems, robotics, parallel and distributed systems, edge computing, graph theory, and cybersecurity.

RESEARCH PROJECTS

- SPEED [6] determines the maximum achievable speed for autonomous ground robots (AGRs) navigating a path while considering their physical limitations. By leveraging centripetal forces to prevent oversteering and understeering, it optimizes speed control. SPEED also dynamically adjusts the computing frequency to balance reactiveness and performance. This approach minimizes deviations from the desired path, enabling AGRs to reach their goals faster with a higher success rate and improved energy efficiency, ultimately enhancing overall performance.

- CPGC [7] is a sequential lossless graph compression algorithm which compresses the graph while preserving path connectivity. The compressed graph can be used to lower the execution time of algorithms such as bipartite matching, edge connectivity, and vertex connectivity.

- PECC [4] minimizes the travel time of AGRs during task execution while ensuring reactivity to unknown obstacles and predictably consuming a specified energy budget. It achieves this by dynamically adjusting the computing frequency and locomotion speed of the AGRs, maximizing energy budget utilization for scheduled tasks, and enhancing overall performance.

- PAR-RCP [5] is a parallel randomized lossless graph compression algorithm which compress the graph in $O(n^{\delta} \log n)$ while preserving path connectivity. The compressed graph can be used to lower the execution time of algorithms such as bipartite matching, edge connectivity, and vertex connectivity.

- BA-LPWAN [1] is a novel Media Access Control (MAC) protocol designed to maximize the minimum battery lifespan of nodes in a Low-Power Wide-Area Network (LPWAN) based on LoRa. It utilizes a battery degradation estimation model to optimize energy regulation, minimizing battery degradation while maintaining data utility. By focusing on sustainable energy management, BA-LPWAN enhances the overall efficiency and longevity of network operations.

- MTC [3] is a maintenance-aware task and charging scheduler is designed for fleets of AMRs in highly automated environments. It uses Linear Programming (LP) to optimize maintenance scheduling and the Kuhn-Munkres (Hungarian) algorithm to finalize task assignments and charging schedules, minimizing the combined costs of downtime and battery degradation.

- TCM [2] is a polynomial-time multi-period combined task and charging scheduling algorithm for high-quality battery life. It employs a greedy approach that periodically adapts its scheduling decisions to ensure robust energy modeling, optimizing energy usage for task execution rather than wasting it on travel without performing tasks. TCM achieves solutions with a performance ratio of 1.15.

FELLOWSHIPS, AWARDS AND HONORS

Thomas C. Rumble University Graduate Fellowship Award, Wayne State University.   Aug 2023

PUBLICATIONS

Conference Papers

[1] A Battery Lifespan-Aware Protocol for LPWAN
S. Fahmida, <u>A. S. Chavan</u>, P. V. Modekurthy, S. Abusayeed, and M. Brocanelli.
Proc. of the IEEE 44th International Conference on Distributed Computing Systems (ICDCS 2024), pp. 1050–1061, Jersey City, NJ, USA, July 23-26, 2024

[2] Towards High-Quality Battery Life for Autonomous Mobile Robot Fleets
<u>A. S. Chavan</u> and M. Brocanelli.
Proc. of the IEEE 3rd International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2022), pp. 61-70, virtual conference, September 19-23, 2022. .

Journal Papers

[3] A Maintenance-Aware Approach for Sustainable Autonomous Mobile Robot Fleet Management
S. T. Atik, <u>A. S. Chavan</u>, D. Grosu, and M. Brocanelli.
IEEE Transactions on Mobile Computing, vol. 23, no. 6, pp. 7394-7407, June 2024.

Papers Under Review and To Be Submitted

[4] Rethinking Energy Management for Autonomous Ground Robots on a Budget
<u>A. S. Chavan</u>, R. Joshi and M. Brocanelli.
IEEE Conference on Robotics and Automation (ICRA 2025), Atlanta, USA. **(under review)**

[5] A Parallel Randomized Clique Partitioning-Based Algorithm for Graph Compression
<u>A. S. Chavan</u>, S. Rabinia, D. Grosu, and M. Brocanelli.
IEEE 39th International Parallel & Distributed Processing Symposium (IPDPS 2025), Milan, Italy. **(under review)**

[6] Speed and Performance Enhancement with Energy Efficiency - Dynamic Window Approach
<u>A. S. Chavan</u>, R. Joshi, and M. Brocanelli.
To be submitted to: **IEEE Robotics and Automation Letters**.

[7] A Clique Partitioning-Based Algorithm for Graph Compression
<u>A. S. Chavan</u>, S. Rabinia, D. Grosu, and M. Brocanelli.
To be submitted to: **ACM Transactions on Algorithms**.

PRESENTATIONS

Conference Presentations

<u>A. S. Chavan</u> and M. Brocanelli. (Sept, 2022). **2022 IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS)**, Virtual Conference.
Towards High-Quality Battery Life for Autonomous Mobile Robot Fleets

Poster Presentations

A. S. Chavan, R. Joshi and M. Brocanelli. (Oct, 2024). **2024 Kraus Memorial Poster Competition**, OSU, OH, USA.
Rethinking Energy Management for Autonomous Ground Robots on a Budget

Workshop Presentations

A. S. Chavan, and M. Brocanelli. (July, 2024), **K-12 Outreach Program**, OSU, OH, USA.
Understanding Robot Perception: Lidar and its Applications

TEACHING EXPERIENCE

- **The Ohio State University**

  Mentor for graduate student Rudra Joshi.   May 2024 - Present
  Rudra is exploring ideas for implementing an energy-efficient approach to AGRs, for optimizing power management, safety, and reliability and building AGR prototypes for the lab, and conducting experiments with them.

- **Wayne State University**, Detroit, MI, USA

  Part-time faculty Instructor for Computer Operating Systems (CSC 4420)   Aug 2023 - Dec 2023
  SET Score (out of 5): mean 3.8; std: 1.3; median: 4.0

  Graduate Teaching Assistant for Computer Operating Systems (CSC 4420)   Aug 2022 - Dec 2022
  Led lab sessions and graded assignments, quizzes, and exams for 30 students.

- **St. John College of Engineering and Management**, Palghar, MH, India   Jun 2015 - May 2018
  Lecturer, Department of Mechanical Engineering (Diploma in Engineering)

- **Government Polytechnic**, Thane, MH, India   Jan 2015 - May 2015
  Visiting Lecturer, Department of Mechanical Engineering (Diploma in Engineering)

OTHER ACTIVITIES

- **Organizer** - State-Level Presentation Competition   Jan 2018

  Organized and led Presentania-2018, a state-level presentation competition with 64 teams from across Maharashtra, India.

- **Team Guide** - (FKDC 2017 & 2018) Team Yunicorn   Jun 2016 - May 2018

  Mentored the team throughout the competition, guiding design and testing.
  Overall 1st place in FKDC - Season 2 (2018)
  Overall 2nd place in FKDC - Season 1 (2017)

- **Team Manager** (FORMULA STUDENT 2014) - Team Prahaar Racing   May 2013 – Feb 2014

  Coordinated cross-functional teams to optimize vehicle performance, reduce delays, and improve time control.

- **Suspension Team Lead** (SAEINDIA BAJA 2013) - Team Prahaar Racing   May 2012 – Feb 2013

  Led the design and optimization of the suspension system, ensuring vehicle stability and performance on diverse terrains.

PROFESSIONAL AFFILIATIONS

- ACM (Association for Computing Machinery)
- IEEE (Institute of Electrical and Electronics Engineers)

SERVICES

- <u>**Reviewer**</u>
  - IEEE Transactions on Cloud Computing
  - IEEE Transactions on Parallel and Distributed Systems

CERTIFICATIONS

- ACM Certified Reviewer   2024

REFERENCES

- **Dr. Marco Brocanelli**
  Assistant Professor
  Department of Electrical and Computer Engineering
  The Ohio State University
  Email: brocanelli.1@osu.edu

- **Dr. Weisong Shi**
  Alumni Distinguished Professor and Chair
  Department of Computer and Information Sciences
  University of Delaware
  Email: weisong@udel.edu

- **Dr. Nathan Fisher**
  Professor and Chair
  Department of Computer Science
  Wayne State University
  Email: fishern@wayne.edu

- **Dr. Daniel Grosu**
  Professor
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  Wayne State University
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