Sofiya Semenova

CONTACT
INFORMATION

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Website: https://sofiya.io   LinkedIn: https://linkedin.com/in/novasofiya

I am a **Computer Science Ph.D. Candidate** at the University at Buffalo with interests in *mobile systems*, *autonomous systems*, *AR/VR*, and *spatial computing*. My Ph.D thesis focuses on the impact of system design on the performance and reliability of Visual Simultaneous Localization and Mapping (SLAM) in real-world environments. I'm currently seeking opportunities where I can continue developing high-performance systems, especially in Rust.

EDUCATION

University at Buffalo, Buffalo, NY   **Aug 2018 - May 2026**
Ph.D. in Computer Science and Engineering

Thesis: "Putting the 'Systems' in Visual SLAM Systems: System Design for Robust and Reliable Visual Simultaneous Localization and Mapping"
Advised by Dr. Karthik Dantu

Brandeis University, Waltham, MA   **Aug 2013 - May 2017**
B.S. in Computer Science with High Honors, Minor in Physics

Thesis: "Clouds That Think: Applications of Machine Learning Techniques for Elastic Databases"
Advised by Dr. Olga Papaemmanouil

WORK
EXPERIENCE

Research Assistant   **Aug 2018 - Current**
Drones Lab, University at Buffalo, Buffalo, NY

Modular and Memory-Safe Visual SLAM — *Rust, C++, OpenCV, g2o, GTSAM, Foxglove*
– Developed a Rust framework for Visual Simultaneous and Mapping (SLAM) systems, prioritizing memory safety and modularity
– Implemented ORB-SLAM3 in Rust using our framework. Our version achieves comparable or better performance to the original ORB-SLAM3 C++ implementation on the EuRoC dataset, with stronger memory safety guarantees and modular interoperability with alternative SLAM systems
– Implemented Kimera-VIO in Rust using our framework. This pipeline uses optical flow, inertial measurements, and fixed-lag smoothing for state estimation. Our version achieves comparable performance to the original Kimera-VIO implementation, and can be used for alternative performance/ accuracy tradeoffs in resource-constrained systems
– Implemented foreign function interface bindings from Rust to C++ for a variety of popular robotics libraries: GTSAM and g2o (graph optimization), DBoW2 (bag-of-words), Foxglove (visualization)
– See publications [1] and [4]. This work is comprised of over 42,000 lines of Rust code and is available here: https://github.com/droneslab/bauhaus

Quantitative Analysis of Visual SLAM Systems Challenges — *C++, Python*
– Performed an extensive quantitative analysis of three popular Visual SLAM/VINS systems – ORB-SLAM3, Kimera, and OpenVINS – on a Jetson TX2 and a Linux desktop computer
– Identified and investigated three systems challenges that cause suboptimal operation in resource-constrained scenarios
– See publications [2] and [3]

Edge-Offloaded, Multi-Client Visual SLAM — *C++, OpenCV, ROS, AWS*
– Developed a Visual SLAM system based off ORB-SLAM3 that offloads the Local Mapping and Loop Closing modules to the edge
– Scaled our system to enable multiple clients connected to the same edge server, enabling collaborative mapping and localization
– Developed a garbage collection scheme to delete memory for unused map objects, enabling long-term operation on the edge
– See publications [5]

Software Engineering Intern   **Jun 2019 - Aug 2019**
Google, Seattle, WA

– Decreased user-perceived web page load latency in Chromium by developing a logistic regression model to predictively prefetch the page(s) that a user will likely navigate to next
– *C++, Python, Scikit-Learn, TensorFlow*

Software Engineer   **Jun 2017 - Aug 2018**
edX, Cambridge, MA
– Improved the performance, reliability, and maintainability of edX's video encoding and delivery pipeline, mainly by implementing an API for AWS SNS notifications for video processing tasks, creating a local testing environment with Docker, and parallelizing video processing tasks
– Increased user first-week engagement by developing an API that tracks and displays user course completion data and running A/B tests on features that use the data
– Assisted with GDPR compliance
– Trained and mentored a summer intern
– *AWS {RDS, ec2, SNS }, Terraform, Docker, Python, SQL, MongoDB, Django, Javascript*

Research Assistant   **Aug 2016 - May 2017**
Department of Computer Science, Brandeis University, Waltham, MA
– Developed an adaptive data distribution framework to automatically balance the supply and demand of data fragments, replicas, and cluster nodes in cloud databases. See publication [7]
– Developed a demo for WiseDB, a machine learning approach for cost/performance management of cloud databases. See publication [8]
– *Java, AWS, PostgreSQL*

Software Engineering Intern   **Jun 2016 - Aug 2016**
edX, Cambridge, MA
– Improved accessibility of the edX platform for screen-reader and keyboard-only users, mainly through creating a new, entirely keyboard-accessible essay-writing module
– *Python, Django, Javascript*

Software Engineer   **Apr 2015 - May 2016**
Western Jihadism Project, Brandeis University, Waltham, MA
– Created a relational schema design, a user interface to access, search, and modify data, and a data visualization dashboard for the Brandeis Western Jihadism Project – a research project cataloging Al-Qaeda-inspired terrorist offenders in Western Europe, the Antipodes, Canada, and the United States
– *Python, Django, PostgreSQL*

PUBLICATIONS

1. (In submission) **Sofiya Semenova**, Nitin Vinod, Steven Ko, Yu David Liu, Lukasz Ziarek, Karthik Dantu. "Bauhaus: A Modular, Memory-Safe Framework for Next-Generation Visual SLAM Systems."

2. **Sofiya Semenova**, Steven Y. Ko, Yu David Liu, Lukasz Ziarek, and Karthik Dantu. "A Comprehensive Study of Systems Challenges in Visual Simultaneous Localization and Mapping Systems." ACM Transactions on Embedded Computing Systems (TECS). 2024.

3. **Sofiya Semenova**, Steven Y. Ko, Yu David Liu, Lukasz Ziarek, and Karthik Dantu. "A Quantitative Analysis of System Bottlenecks in Visual SLAM." ACM International Workshop on Mobile Computing Systems and Applications (HotMobile). 2022. — *Best Poster Award*

4. **Sofiya Semenova**, Pranay Meshram, Timothy Chase, Steven Y. Ko, Yu David Liu, Lukasz Ziarek, and Karthik Dantu. A Modular, Extensible Framework for Modern Visual SLAM Systems. (Poster)" International Conference on Mobile Systems, Applications and Services (MobiSys). 2022.

5. Ali J. Ben Ali, **Sofiya Semenova** and Marziye Kouroshli, Zakieh Sadat Hashemifar, Steven Y. Ko, and Karthik Dantu. "Edge-SLAM: Edge-Assisted Visual Simultaneous Localization and Mapping." ACM Transactions on Embedded Computing Systems (TECS). 2022.

6. Ali J. Ben Ali, **Sofiya Semenova**, and Karthik Dantu. "Platform Variability in Edge-Cloud Vision Systems. (Poster)" ACM International Workshop on Mobile Computing Systems and Applications (HotMobile). 2019.

7. Ryan Marcus, Olga Papaemmanouil, **Sofiya Semenova**, and Solomon Garber. "NashDB: An End-to-End Economic Method for Elastic Database Fragmentation, Replication, and Provisioning." ACM Special Interest Group in Data Management (SIGMOD). 2018.

8. Ryan Marcus, **Sofiya Semenova**, and Olga Papaemmanouil. "A Learning-based Service for Cost and Performance Management of Cloud Databases. (Demo)" IEEE International Conference on Data Engineering (ICDE). 2017.

SERVICE	– International Conference on Robotics and Automation (ICRA) *Reviewer*	2024
	– Transactions on Sensor Networks *Reviewer*	2024
	– University at Buffalo Computer Science & Engineering Diversity Committee *Graduate Student Representative*	2023 - 2024
	– MobiSys *Artifact Evaluation Committee*	2023
	– SenSys *Shadow Program Committee*	2022
	– SEMI (Workshop on Simplifying Edge and Mobile Intelligence) @ MobiSys *Web Chair*	2020
	– University at Buffalo Computer Science & Engineering Diversity Committee *Graduate Student Representative*	2019 - 2020
	– University at Buffalo Computer Science & Engineering Graduate Student Association *Secretary*	2019 - 2020
	– University at Buffalo Robotics Day *Volunteer*	2018
	– Microsoft Student Partner Program *Senior Student Partner*	2016-2017
	– Microsoft Student Partner Program *Student Partner*	2015-2016
	– Brandeis University Computer Science Department *Undergraduate Department Representative*	2015-2016
	– BITMAP (Brandeis University Computer Science Club) *President*	2014-2016
	– Codestellation (Brandeis University's Hackathon) *Lead Hackathon Organizer, Web Developer, and Designer*	2014-2016
HONORS & AWARDS	– HotMobile *Best Poster Award*	2022
	– MobiSys *Travel Grant*	2022
	– MobiCom *Travel Grant*	2021
	– Symposium on Edge Computing (SEC) *Travel Grant*	2019
	– Brandeis University *High Honors at Graduation*	2017
	– HampHack (Hampshire College Hackathon) *Best Artificial Intelligence Hack*	2016
	– Codestellation (Brandeis University Hackathon) *Best Machine Learning Hack*	2016