

# Joe Dinius, PhD

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## Summary Statement

I am an experienced robotics engineer seeking technical leadership opportunities in autonomous systems development. I am a fast learner, a motivating force, and have led technical efforts in sensing and estimation, path planning, localization, and computer vision. On the technical side, I enjoy solving hard problems with creativity; employing solutions that others might not consider. On the leadership side, I focus on regular interpersonal communication, making expectations plainly known, and on identifying and providing any support necessary for optimizing team output. In everything I do, I strive to communicate clearly, candidly, and respectfully.

## Professional Experience

### AeroVironment, Inc.

*Senior Staff Engineer – Autonomy & Robotics*

Simi Valley, CA

December 2019 – Present

- Developing visual inertial odometry capability for autonomous aerial vehicles in multiple operational environments
- Defining and helping to implement processes and methodologies for scaling autonomous capabilities within the company's product lines

### UBTECH Robotics North American R&D Center

*Senior Research Engineer – Navigation & Control*

Los Angeles, CA

April 2019 – December 2019

- Was the first team hire for, and a key member in building, the software team
  - \* Developed interview process for software candidates, including coding challenge component and skill set questions for computer vision, navigation, and general software candidate interviews
  - \* Worked with external recruiters to identify screening criteria for candidates
  - \* Conducted ~90% of interviews initially, including technical panel interviews for hardware team candidates, but was able to delegate much of this responsibility as the team grew.
  - \* Grew the team from 1 to 12+ in 8 months. Total team, including hardware and industrial design, grew to 35+
- Led software development for initial vehicle prototype
  - \* Developed SLAM algorithms for operation in dynamic indoor environments using RGB-D cameras and 2d lidar
  - \* Worked closely with hardware design team to do sensor coverage analyses and hardware downselect in early design stages
  - \* Led team of 3-5 individuals working on autonomously navigating mobile platform. Starting from concept-only (no drawings), demonstrated a fully-functional minimum viable product (MVP) in ~6 months
  - \* Created decentralized application infrastructure using Docker and ROS to streamline parallel development efforts within team
  - \* Encouraged short feedback cycles between team and project leadership via daily standups, clear and complete documentation of work, and frequent mini-demonstrations

### inVia Robotics

*Staff Research Scientist – Perception & Controls*

Westlake Village, CA

December 2017 – April 2019

- Responsible for development of control, navigation, and localization algorithms for wheeled mobile robots deployed in a warehouse automation application
  - \* Increased coarse navigation speed 2.5x in 2 months with a novel method
  - \* Increased navigation accuracy on precision maneuvers by 5x while simultaneously increasing speed by 2x; *reduced inventory drops due to navigation failures >5x*
- Introduced processes that greatly increased system robustness
  - \* Integrated obstacle avoidance, both static and dynamic, into robot control algorithm
  - \* Built automated test procedure, including physical setup, for evaluating navigation performance (both control and localization accuracy) on precision approaches
  - \* Statistical experimental design for controller tuning based on Latin Hypercube sampling (coarse resolution) and Full-Factorial design (fine resolution)
  - \* Refactored trajectory planner, which resulted in *>20x reduction in network traffic and memory consumption*, and added a scalable automated test suite
  - \* Safe and automatic recovery of robots after throwing and logging exceptions
  - \* Automatic wheel calibration procedure during final robot manufacturing checkout led to *significant reduction in path-related errors observed at customer deployments*
- Worked with Operations team to monitor and correct issues while running the system live at customer deployments
- Organized ongoing efforts for personal and professional growth of team members: book club, game nights, and technical journal club

## Walt Disney Imagineering R & D

Glendale, CA

Senior R & D Imagineer – Contract Position

July 2017 – October 2017

- Responsible for developing scene segmentation and state estimation algorithms for multiple object tracking using 2D laser rangefinders
- Created a simple multi-vehicle collision-free path planner using the Hybrid A\* algorithm

## Ford Motor Company

Dearborn, MI

Senior Research Engineer

December 2015 – June 2017

- Responsible for conceptualizing and interpreting advanced algorithms for multiple object tracking for the Next Generation Vehicle (NGV), including state estimation, data fusion, and data association

## Raytheon Missile Systems

Tucson, AZ

Senior Systems Engineer II

June 2006 – December 2015

- Led small teams, composed of 2-5 individuals, in simulation, control, and signal/image processing disciplines
  - \* Worked with team members to define performance targets for yearly reviews and contributed to performance reports
  - \* Worked with team members' and their functional management to define performance improvement plans (PIP) when performance was unsatisfactory; worked with team members to increase likelihood of successfully executing the PIP
- Directed analyses of flight test failures, operational safety, requirements development, and system performance
- Designed and developed simulation architectures for new product development efforts (DARPA/MDA/IR&D)
- Developed guidance, navigation, and control (GNC) algorithms in simulation, Computer-in-the-Loop (CiL) and Hardware-in-the-Loop (HiL) environments

## Sample Projects

### Traffic Sign Recognition using fastai

July 2019

- Built an end-to-end pipeline for performing classification on the German Traffic Sign Recognition Benchmark dataset
- Used modern techniques – including use of a residual network (ResNet34) as the back-bone architecture and learning rate annealing
- Achieved SOTA accuracy on a holdout set – 99.95% vs. competition winning 99.46% of a few years ago
- Project Writeup, Github. Technologies Used: Python, PyTorch, fastai, docker

### Pose Error Compensation Using Imprecise Visual Landmarks

March 2019

- Created and integrated a simple SLAM-inspired algorithm to increase precision navigation terminal accuracy 5x. *The net effect was a >5x decrease in inventory drops.*
- Visual landmarks imprecisely placed on stationary warehouse objects were used to create stable, robot-centric map markers for estimating accumulated robot localization error.
- Technologies Used: Python, OpenCV / AprilTags, Redis

### Extended Object Tracking

April 2018

- Developed a performant representation of a cutting-edge algorithm for extended object tracking using elliptical primitive shapes
- Built a simulation and multi-threaded infrastructure layer for testing the algorithm in a representative environment
- Project Writeup, Github. Technologies Used: C++, JUCE

## Technical Skills

OS : Windows, OS X, Ubuntu

Languages: Modern C++ (11/14/17 standards), Python, Fortran (77 & 90/95)

Software : Eigen, Armadillo, Scikit-image, Scikit-learn, Tensorflow, Keras, OpenCV, Matlab/Simulink, git, gdb(pdb), cmake, numpy, scipy, pandas, L<sup>A</sup>T<sub>E</sub>X, Boost, IPOPT, ROS, fastai, PyTorch, docker

Other : Kalman filtering, particle filtering, SLAM, computer vision, signal processing, optimization, machine learning (including deep learning), state-space control design, optimal control, design-of-experiments (DoE), data exploration & visualization

## Selected Publications & Patents

- Sakai, A., D. Ingram, **J. Dinius**, K. Chawla, A. Raffin, A. Paques. PythonRobotics: a Python code collection of robotics algorithms. *arXiv e-print: submitted 31 Aug, 2018*. Available: <https://arxiv.org/abs/1808.10703>
- **Dinius, J.W.**, B.K. Pennington. Spatiotemporal Controller for Controlling Robot Operation. *U.S. Nonprovisional Pat. Ser. No. 16/044,344*, filed 24 July, 2018
- **Dinius, J.**, R. Furfaro, F. Topputo, and S. Selnick. Near Optimal Feedback Guidance Design and the Planar Restricted Three-Body Problem. In: *Proceedings of the AAS 24th Spaceflight Mechanics Meeting*, January 26–30, 2014.
- **Dinius, J.**, Adv. J. Lega. Dynamical Properties of a Generalized Collision Rule for Multi-Particle Systems. *Doctoral Dissertation*. Available: <http://arizona.openrepository.com/arizona/handle/10150/315858>.

## Education

**University of Arizona**, MS/PhD Applied Mathematics

- Raytheon Advanced Scholar's Fellowship

**Northern Arizona University**, BS Mathematics and Physics

- University Honors Program
- Dean's List

## Related Activities

### Open-Source Software Projects

*Contributor*

2017 – Present

I regularly contribute to open-source projects, some of which include

- PythonRobotics
- Open Source Self Driving Car Initiative (OSSDC)

Check out my GitHub for more details.

### Student Engineering Projects

*Mentor*

2014 – Present

After finishing my doctorate, I regularly serve as mentor on different student-led engineering projects, including

- Udacity Self-Driving Car Nanodegree Session Mentor – 2019
  - \* Led class discussions for session comprised of 12 students
  - \* Ran weekly live video webinars to cover course modules more in-depth
  - \* Conducted weekly one-on-one discussions with students to address individual concerns
- Community Helpers in Mathematics, Engineering, and Science (CHiMES) – (2014-2015)
  - \* Partnership with University of Arizona College of Engineering and local high schools
  - \* Served as mentor, along with two colleagues, for student team from Canyon Del Oro High School in Oro Valley, AZ
  - \* Helped students to scope the project definition and requirements development for a community-enriching engineering project