Joe Dinius, PhD

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Summary Statement

I am an experienced lead robotics engineer seeking technical leadership opportunities in the design, development, and deployment of autonomous systems in the wild. I am a fast learner, a motivating force, and a proven technical leader in the fields of 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 the cultivation of safe spaces for interpersonal communication at all levels, 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. Moorpark, CA

Principal Software Engineer (Apps) March 2023 – Present

- Chief Engineer for AV's autonomy software framework product
  * Transitioned R & D software focused on demonstration to a fieldable and maintainable product:
    · **Led technical team of 8-12 individuals**
    · **Performed ground-up redesign to ensure software architecture is performant, extensible, and scalable**
    · **Refactored and rewrote existing software modules to ensure adherence to the new software architecture**
    · **Decreased software deployment time (5x) following methods of Infrastructure-as-Code (IaC)**
    · **Developed comprehensive quality assurance (QA) plan linking systems requirements (in JAMA) to feature descriptions (in Jira) to test cases and execution results (in Jira/Xray)**
    · **Achieved unprecendented release rate (4x per year, compared to 1 release per 1.5-2 years on other software programs within the company) through a high degree of test and release automation**
  * Demonstrated viability of software product through successful integrations on four (4) reference hardware platforms:
    · **Integration achieved with minimal intervention from the core software framework team**
    · **Fast rate of integration due to a high degree of code reuse across integrations**

OffWorld, Inc. Altadena, CA

Head of Robotics Software May 2022 – March 2023

- Leading software development efforts at an early-stage mining technology startup
  * Maintain 1:1 ratio (in terms of time) between technical contribution and functional management
  * Responsible for managing a diverse team of roboticists, software developers, test engineers and UI/UX designers
  * Lead software developer on Surveyor product MVP. Responsibilities include:
    · **Software QA; including build management, automated software deployment, and testing**
    · **Software systems architecture**
    · **Core software development; including teleoperation control, serving heterogeneous streaming data, and plugin service development**
    · **Operator UI/UX development for UGVs**
    · **Serving as Scrum Master in an Agile development workflow**

AeroVironment, Inc. Simi Valley, CA

Manager – Applied Autonomy March 2020 – May 2022

- Transitioned to leadership role shortly after joining the company
    * Maintained 2:1 ratio between technical contribution and functional management
    * Was responsible for managing upwards of 15 full-time engineers and 3 contract employees
    * Developed learning initiatives to grow in-house expertise in autonomy; such areas include:
        · **Visual object detection, classification, localization, & tracking (DCLT)**
        · **Mission design**
        · **Visual navigation; including visual inertial odometry (VIO) and simultaneous localization & mapping (VSLAM)**
    * Initiator and champion of several internal process improvement efforts:
        · **Decreasing complexity and cost by converting legacy configuration management & continuous integration (CM/CI) pipelines using Subversion + Atlassian suite (i.e. Fisheye/Crucible/Bamboo) to Gitlab**
        · **Increasing scalability and portability of applications using Docker and a distributed services system architecture**
    * Technical lead (upwards of 7 team members) of autonomy R & D projects for fixed-wing and multirotor aircraft. Responsibilities include:
        · **Program management**
        · **Software systems architecture**
        · **Visual navigation algorithm development**
        · **3D mapping using Structure-from-Motion (SfM)**
        · **Operator UI/UX development for UAVs**

Senior Staff Engineer – Applied Autonomy December 2019 – March 2020

- Developed robust visual navigation capability for autonomous aerial vehicles with multispectral monochromatic imagers for indoor and outdoor environments

UBTECH Robotics North American R&D Center Los Angeles, CA

Senior Research Engineer – Navigation & Control 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
    * 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 (me) 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 upwards of 5 individuals working on an 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

inVia Robotics Westlake Village, CA

Staff Research Scientist – Perception & Controls 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

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

Full Stack Autonomy Development with a Simulated Fixed Wing Vehicle Platform Dec 2023

- Modeled and implemented key system components including vehicle dynamics, autopilot, and state estimation
- Implemented advanced autopilot and state estimation algorithms combining academic and novel methods
- Implemented autonomous mission planning for urban environments using RRTs with kinematic Dubins paths
- Project Writeup, Github. Technologies Used: Python, OpenGL

Real-Time Face Mask Detection Dec 2020

- Trained YOLOv4 single-stage object detector on a custom dataset using DarkNet framework
- Developed multi-threaded Linux application (in C++) using OpenCV's Deep Neural Network (DNN) API
- Achieved real-time (input frame-rate $\sim=$ output frame-rate) inference using GPU acceleration
- Project Writeup, Github. Technologies Used: C++(14), DarkNet, OpenCV, docker

Pose Error Compensation Using Imprecise Visual Landmarks March 2019

- Created 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, JavaScript, HTML, CSS
Hardware : x86, Raspberry Pi (2/3/4), NVIDIA Jetson (TX1/2, Xavier NX), NVIDIA GPU,
            Xilinx Zynq UltraScale+ MPSoC
Software : Eigen, Armadillo, Scikit-image, Scikit-learn, OpenCV, Fast-DDS, Git(Lab & Hub),
            gdb(pdb), cmake, numpy, scipy, pandas, LaTeX, Boost, IPOPT, ROS(1 *and* 2), fastai, PyTorch, docker,
            Jira, Confluence, Xilinx Vivado/Vitis, Petalinux, CircleCI, Coveralls
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, program management, software
            systems architecture

Selected Publications & Patents

- **Dinius, J.W.**, B.K. Pennington, R.C. Voorhies, L. Elazary, D.F Parks II. *U.S. Patent No. 10946518*, Spatiotemporal controller for controlling robot operation, 16 Mar, 2021

- 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.**, 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

- Non-Minimal Sampling Consensus (NMSAC) - *main contributor*
- Open Source Self Driving Car Initiative (OSSDC)
- PythonRobotics

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
- Community Helpers in Mathematics, Engineering, and Science (CHiMES) – (2014-2015)