

Curriculum Vitae

Joseph D. Carpinelli

Abstract

I am a research software engineer who is interested in extending current research capabilities with computational methods. I am currently an engineer in The AI Institute's Robot API Development team. In personal time, I explore physical concepts through open-source software development.

Professional Experience

The AI Institute

Software Engineer: February 2024 — Present

- Designed and developed motion planning and execution framework within ROS 2
- Designed and developed kinematics & dynamics solvers, and inverse-dynamics impedance controller within the `ros2_control` framework

NASA Johnson Space Center

Integrated GN&C Analyst: July 2021 — January 2024

- FTE in July 2021; supported Orion's Launch Abort System GN&C development, analysis, verification
- Integrated flexible structure model with linear and nonlinear simulation frameworks (MATLAB, C++)
- Frequent dynamical studies through large-scale monte-carlo simulations; 150 pages of technical reports written in 2022
- Used linear analysis to analyze vehicle performance, verify stability margins; validates linear models
- Served as backup regression data approver for simulated Orion Launch Abort System performance
- Led development for polarity tests; created novel 6DOF kinematics simulation (Julia, Python); represented Orion GN&C at multiple lab tests in three states: Texas, Colorado, Florida
- Developed LaTeX packages and classes to improve technical writing workflows
- Cooperative internships across avionics, flight operations, and flight dynamics groups: 2017 — 2020

Space Systems Laboratory

Graduate Research Assistant: August 2019 — May 2021

- Led core robot software development (C++, Orocos, ROS, CAN) as Graduate Assistant under Dr. Dave Akin
- Developed novel Julia package to generate symbolic manipulator kinematics models; implemented and merged required changes to `Symbolics.jl`; intermediate Jacobian performance substantially improved over [Orocos](#) iterative solvers; implemented improved inverse-kinematics algorithm

- Created C++ interfaces (templates) and implementations for control, including force/torque control
- Maintained operator GUI (Python); diver for Neutral Buoyancy Research Facility Maintenance
- Undergraduate research assistant: 2017 — 2019

Harris Corporation

Electrical Engineering Intern: May 2016 — August 2016

- Implemented rain attenuation ITU Propagation Model components; MATLAB functions written to implement model calculations, C# used to gather terrain data
- Developed VBA workflows for automatic data processing procedures

SRI International

Data Annotation Intern: May 2015 — December 2015

- Annotated images and videos for deep learning research applications
- Designed LED Array and circuit layouts for gaze tracking project using Eagle CAD

Education

M.S. Aerospace Engineering

University of Maryland, College Park

- Research assistant under Dr. Akin; space robotics (manipulator) software lead, primary operator
- Halo orbit & invariant-manifold research project with Instructor Barbee; now [open source](#)
- Research emphasis in space robotics systems, prioritized dynamics & controls in coursework

B.S. Electrical Engineering

University of Maryland, College Park

- Four control theory courses, four computer science courses; major emphasis in control theory
- Undergraduate Research Assistant under Dr. Akin at SSL; ROS/Orocos software lead in third year
- Implemented inertial and viscous friction compensation for SSL's MGA Exoskeleton (Galil, UART)

Open Source Software

Nonlinear Dynamics

[GeneralAstrodynamics.jl](#)

- Metapackage for three sub-packages; provides general calculations, visualizations, halo orbit solvers, and invariant manifold solvers
- Models are integrated with the [SciML](#) Julia ecosystem
- Presented at JuliaCon 2021: [Going to Jupiter with Julia](#)
- Hosted in the [JuliaAstro](#) GitHub organization

[EphemerisSources.jl](#)

- Metapackage for four sub-packages; provides utilities for fetching and parsing ephemeris data from [Horizons](#) and JPL's publicly available [Generic Kernels](#)
- Related paper published in the Journal of Open Source Software: *[EphemerisSources.jl: Idiomatic Ephemeris Sourcing and Parsing in Julia](#)*
- Hosted in the [JuliaAstro](#) GitHub organization

[GalacticPotentials.jl](#)

- Provides select scalar potential field equations commonly used in galactic dynamics research
- Models are integrated with the [SciML](#) Julia ecosystem
- Selected potentials are ported from two popular galactic dynamics Python packages: [gala](#) and [galpy](#)

[PolynomialGTM.jl](#)

- Provides approximate polynomial model for longitudinal flight dynamics of a passenger plane
- Model is integrated with the [SciML](#) Julia ecosystem
- Model equations are sourced from a nonlinear dynamics [publication](#) by Chakraborty, Seiler, and Balas (2011)

Utilities

[DocumenterQuarto.jl](#)

- Integrates [Documenter.jl](#) syntax with [Quarto](#) for automatic package documentation

[CommonLicenses.jl](#)

- Provides commonly-used licenses within Julia for use in interactive notebooks, and scripts

[rich-admonitions](#)

- Extends [rich](#) (Python) with *callout* or *admonition* blocks

[module-hygiene](#)

- Provides an `__export__` key for namespace hygiene in Python

[block-scopes](#)

- Allows for *local* or *block* scoping in Python through the `with` keyword

Publications

Journal of Open Source Software

[EphemerisSources.jl: Idiomatic Ephemeris Sourcing and Parsing in Julia](#)

First Author: Published October 10th, 2024

- Describes four independently published Julia packages, and the `EphemerisSources.jl` metapackage

- Provides ephemeris sourcing and parsing utilities for interacting with common solar system ephemeris platforms

ArXiv

Advancing The Robotics Software Development Experience: Bridging Julia's Performance and Python's Ecosystem

Second Author: Submitted June 6th, 2024

- Describes contributions to the use of Julia for robot teleoperation in [The AI Institute](#)
- Accompanying poster presentation at [ICRA 2024](#)

Chakraborty, Abhijit, Peter Seiler, and Gary J Balas. 2011. "Nonlinear Region of Attraction Analysis for Flight Control Verification and Validation." *Control Engineering Practice* 19 (4): 335–45.