Personal Statement

MIT Department of Physics · Doctoral Program · Fall 2024

Publication History

As a graduate aerospace engineering student, I wrote two academic papers which are pending publication: a paper on robot kinematics solvers, and a paper on differential correction methods in three-body astrodynamics contexts.

As a graduate student researcher in the Space Systems Lab, I developed novel code generation tools which produced analytical Jacobian and forward-kinematics solutions for lab robots. I presented these codes in an academic paper, along with benchmarks showing a 2× performance improvement relative to standard iterative solvers for low-DOF arms. I worked with my advisor, Dr. Dave Akin, to submit the paper for consideration for an upcoming AIAA Conference. We withdrew the paper after the research funding export control review process passed the conference submission deadline.

As a graduate astrodynamics (Interplanetary Navigation & Guidance) student, I replicated elements of Megan Rund's **thesis** on manifold-based interplanetary transfer designs within the Circular Restricted Three Body Problem. Specifically, I implemented a differential correction algorithm for finding periodic orbits within the Circular Restricted Three Body Problem, and I computed manifolds about halo orbits for low-cost interplanetary transfer designs; a bug in the manifold computations was corrected post-graduation. After finding three flavors of the same differential correction algorithm in literature — each flavor used different state variables for the correction term — I presented a novel decision tree in my final term paper. This decision tree provided guidance for selecting each particular algorithmic flavor, depending on the desired halo orbit characteristics. This paper is publicly available on **GitHub**. Due to my employment with the federal government, the paper must be reviewed by my employer before it can be submitted for publication.

Open Source Software

I have released over one dozen open-source scientific software packages. I am particularly active in the Julia Programming Language community. All are hosted on my GitHub profile, `@cadojo`. My personal website, `loopy.codes`, lists and summarizes each open-source project. My aerospace engineering research benefitted greatly from open-source scientific software. I believe open-source scientific software can similarly benefit the computational astrophysics research I aspire to undertake as a graduate physics researcher.