NAVIGATION TO ARRAKIS USING SLINGSHOT

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Abstract.

1. Problem Statement and Motivation

The Guild Navigators tasked with delivering House Atreides to Arrakis are unsure what the best path is to get from Caladan to Arrakis, but they know of a planet in another universe, Earth, where there are smart ACME students learning about optimal control. They want to be able to figure out with a given travel time what the optimal path and control is, and they want to know what the optimal final time would be to see if they have enough feasible fuel with that optimal control. Since the ACME students are from another universe and solar system they have decided to focus on getting from their home planet, Earth, to other planets in their own solar system.

2. State Equations

We derived our state equations using kepler's law of motion.

$$\ddot{\mathbf{x}} = -G\sum_{p\in P}\frac{m_p}{||\mathbf{x}_s - \mathbf{x}_p||_2^3}(\mathbf{x}_s - \mathbf{x}_p) + \mathbf{u}$$

And the following cost functional

$$J[u] = \int_0^{t_f} ||\mathbf{u}||_2^2 dt$$

The following state equation

$$\begin{pmatrix}\dot{x}_s\\ \dot{y}_s\\ \ddot{x}_s\\ \ddot{y}_s\end{pmatrix} = \begin{pmatrix}\dot{x}_s\\ \dot{y}_s\\ -G\sum_{p\in P}\frac{m_p(x_s-x_p)}{((x_s-x_p)^2+(y_s-y_p)^2)^{3/2}} + u_x\\ -G\sum_{p\in P}\frac{m_p(y_s-y_p)}{((x_s-x_p)^2+(y_s-y_p)^2)^{3/2}} + u_y\end{pmatrix}$$

Date: April 9, 2024.

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