Project Proposal
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Problem

In the world today there are tasks and situations that are not suitable for humans. It would be ideal if robots could preform these tasks and enter these situations in our stead. Even more ideally would be if the robots could be autonomous, meaning that they would preform without being controlled by a human. This would require the robot to be able to think and learn on its own. It would have to make decisions.

For this problem we will be looking at a quadrotor and how it deals with delivering a suspended load. Suspended loads are tricky because they swing and undulate based on the length of the tether and the motion of the quadrotor. The goal is for the quadrotor to fly to a specific location and learn how to minimize the swing of its suspended load. This is accomplished through a decision making method for motion planning called action selection through axial projection (ASAP). When dealing with ASAP there is the ideal action and motion for the quadrotor and then there is what the action that the quadrotor actually takes. The ideal action is achieved when

$$dz/dx=0,\ dz/dy=0,\ \text{and}\ dz/dz=0$$

or in other words, when the local maximum occurs (an ideal space). We want to know about the relationship between the ideal action and the action that the quadrotor actually takes (an approximate action). These actions lead to states for the quadrotor system. These states are position, velocity, load, swing, etc. We have a formula

$$\{Z=xval*(X-1).\hat{}2+ yval*(Y-2).\hat{}2 + rotval*X.*Y\} \qquad (1)$$

that models the transition from one state to the next. We want to look at *xval*, *yval*, and *rotval* to see how these values effect the ultimate distance between the ideal state and the state taken.

Method

My first step will be to attempt to understand the relationship between the ideal state and the actual state by looking at the distance between the two. Both of these outcomes are effected by the values in our transition model function (1), i.e. *xval*, *yval*, and *rotval*. These values model the isolines that encompass the ideal and actual states. I will be using Matlab to create a large sample space of these distances by manipulating these values. The *xval* will be fixed and the *yval=rxval*, where *r* is some stretch factor from 0 to 100 on *xval*. The *xval* and *yval* dictate the semi-minor and semi-major of our isoline ellipses. The *rotval* is our rotational value and is between 0° and 90°. It rotates the isoline ellipses about the ideal state. The sample space will be in the form of a multidimensional matrix. I will be able to access every permutation of the manipulated values. This will allow me to examine the relationship between the distance and the values of the formula. There will be a lot of data to look at and analyze.

Initially I will be working with Sandra Faust's equation (1) which describes the transition model function in quadratic space. From there I will use other formulas, potentially of higher dimensional spaces, to examine the same ideal vs. actual state relation. It would be desirable if we could come up with a cubic function that models the transition states in cubic space. Hopefully we will be able to observe equations that will be able to model this relationship.

Hypothesis

At this point I do not have much of a hypothesis. It would seem logical to guess that if the values in the system were minimal to none that the ideal state and the actual state would be close if not the same. The greater the variation between the values the more likely it would seem that the distances between the two states would be greater.