Carnegie Mellon
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Motion primitive in airboat control system

Introduction (Motion primitive)

My understanding on motion primitive is it's some kind of "open-loop hard coded" input-output relationship/transfer function data from the experiment which can be used to control a robot, e.g. the airboat. The motivation for using motion primitive is mainly to address the nonlinear dynamics of the airboat system since the airboat model is very difficult to obtain. The advantage of motion primitive is it makes the control "simple and robust" as it does not rely much on the approximated modeling but is from the real world data.

Objective

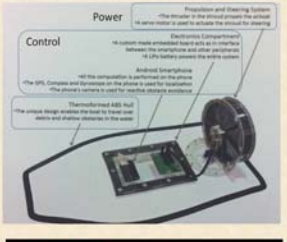
1、 Building a motion primitive library.

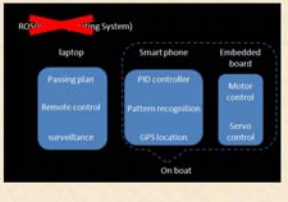
2、 All the elements should begin and end with the same velocity.

3、 Applying motion primitive in the airboat's control system.

4、Adding the close-loop feedback to fix the deviation made by disturbance.

Structure of airboat

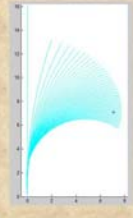


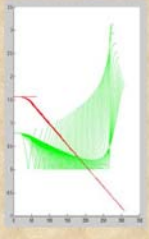


Design strategy

- Since each motion primitive element should have the same velocity and the element begin with only Y velocity(assuming the boat heading Y axis), the latter half of the trajectory must be a straight line.
- In a straight line the current will finally offset the X velocity.
- In the first half the boat will turn a round to find the desirable direction.

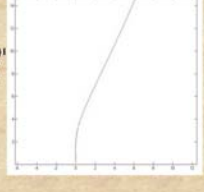
Trajectory of different control signal



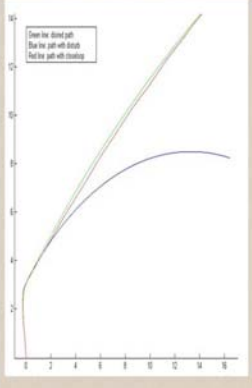


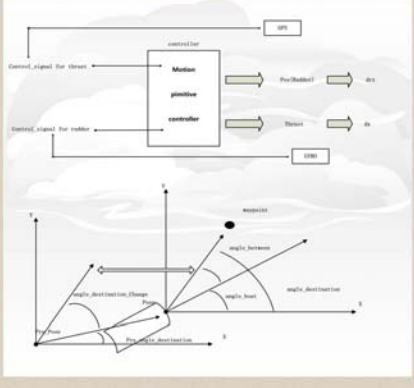
Once the direction of the boat correspond to the angle between the boat and destination(the intersection point of green and red line), we change the control signal to make the boat moving a straight line.

In the latter half(red line) I only need some micro adjustment to keep the heading of airboat



Motion primitive with close loop





Information gotten from gyro and GPS help to fix the deviation

Structure of close loop control system

Client interface of the boat