Algorithm Effectiveness Testing

Abstract

The purpose of this test is to determine the effectiveness of the vibration cancellation algorithm. The test consists of setting a standard distance away from a target, then use a long exposure photograph to capture the excursion of the laser point. First the uncompensated laser pointed is held at the target and the photograph taken. Next the system is enabled so that it provides corrections to the NST module to cancel out hand vibrations, and the same picture is taken. These two results can then be compared, and the ratio of maximum excursions taken.

Equipment

- Camera capable of long exposures (or a video camera).
- Tape, to mark distance to target.
- Stabilized laser pointer.
- Target.

Target Specifications

Since the control scheme works by creating angular displacement corrections, the target on the wall should be able to indicate the number of degrees from center the laser travels. To do this a standard distance of 10 ft is to be marked on the ground away from the target so that

$$S = r\Theta$$

can be used to determine the radius of circles at a certain angular displacement. For example an angle of 1 degree corresponds to a displacement of

$$S = r\Theta = 10\ ft\left(\frac{12\,inches}{1\ ft}\right)(1\,degree)\left(\frac{\pi}{180\,Degrees}\right) = 2.0944 \approx 2.1\,inches$$

Therefore, every angular displacement of 1 degree at the laser pointer lies within a circle of radius 2.1 inches on a wall 10 ft away.

The following table lists the degrees on interest that are going to appear on the targert.

Θ (degrees)	S (inches)
1	2.09
2	4.19
3	6.28
4	8.38
5	10.47
8	16.75

10	20.94

Procedure

The tester stands at the line and then points the laser at the target, the second person uses the camera to take a long exposure (1-2 sec) of the dot on the target. Then a few more pictures are taken to ensure that the maximum excursion is not a statistical fluke, and, in general, there is more data to use for analysis. Next the vibration cancellation system is turned on and the same number of pictures, for the same amount of time, for the same reasons.

Analysis

From the pictures the maximum excursion of the laser can be determined by looking at the pictures directly. This is done for both the cancelled and un-cancelled pictures and the ratio of un-cancelled maximum excursion to cancelled maximum excursion can be found and used as a metric for how well the vibration cancellation works.

Getting the average excursion is more difficult to get an accurate analytic measurement, but it can be found easier by estimation. To get a good handle on an estimated value multiple people (the group members) will look at the data and then submit what they think the average value is. This can be done for both the un-cancelled and cancelled data and the same ratio as above is formed.

The more analytic method uses MATLAB to find all of the points of a certain color, namely the color of the laser pointer, then compute the distance to the center of the target. The average of these distances can be computed and compared with the estimated value to see if the analysis algorithm is working correctly. To find the points where the laser has been the R value of RGB for each pixel is extracted from the picture. If this value is above a certain threshold, then the distance from this pixel to the center of the target is computed and stored so that the average can be computed later.