Optimization project solve verification

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*Abstract*— In order to verify the feasibility of finding a transform that fits the data at multiple depths an experiment with moving calibration walls and a stationary projector was conducted. In the cuirrent calibration methods, DAC commands must lie within the field of view of the calibration points. If this is not obeyed, DAC correction cannot be carried out properly. Thus, calibration is done on the main wall in order to find the overall parameters. This is then done and compared to each individual data set.

# What I want to say

We solve using the full wall calibration

We solve using the full set calibration.

Compare the different quaternions and then compare the actual DAC commands.

Q =

# Unit vector generation

To generate unit vectors spherical coordinates are used. This allows the optimization to be done without constraints on vector length.

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|  |  | () |
|  |  | () |

Therefore, two angles can describe any unit vector in 3 space.

# Ray-plane intersection

Laser ray is defined by a point and a vector for some interval of . For some interval the lfinite line describes the light ray in space.

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The mirror plane is defined also with a point and vector by the below equation.

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The intersection between the line and the plane is then given by (7).

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# ray reflection

The final equation to generate the ray output from a mirror is calculated using the ray orientation and the normal vector. The calculation is to reflect across shown in (8).

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# Serial ray generation

Using a ray and a plane, the output ray can be generated. This process can repeated from multiple mirrors. In this case there are only two mirrors defined by . If the ray input is defined by then the following calculations will generate the output of the projector.

The output of , is defined by the ray-plane intersection and ray reflection equations.

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Applying the same equations to using generates in (14).

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# Objective Formulation

The objective used is the average perpendicular distance from the point in space to the corresponding ray generated by the project with corresponding angle pairs.

The perpendicular distance between and line is given by .

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The objective is then the average of over all data points. Currently, the first optimization algorithm takes into account only 8 variables describing the projector. Until dimensions can be verified, these will be the only ones used.

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# Initial conditions

Using an initial conditions generated from the “Explicit method to solving angle calibration functions to dual mirror galvonometers" the seed values for can always be generated consistently. The selection of corresponds with the nominal configuration of the normal vector in the ideal construction of the projector.

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Therefore generates and generates .

# Test results

Using MATLAB’s built in function fminsearch to perform the solve on the data sets, the objective value was roughly 1mm. This is relatively ssmall error assuming a linear mapping between DAC commands and angles