

# 1 Test of implemented distance method

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## 1.1 Introduction

The purpose of this test is to determine the reliability of the implemented way to determine the distance to a marble.

An error of 5% is an acceptable error.

## 1.2 theory

Using the intrinsic parameters and the known diameter of a marble the distance can be calculated. The theory for this calculation is described further in the report in the section "3D localization of marbles".

## 1.3 Experiment

### 1.3.1 Setup

The test will put the robot at different distances from the marble in the premade environment `smallworld.world` in the Gazebo folder. Multiple versions of this world, all with different start positions of the robot, have been made. A C++ program (`gzserver_manager.cpp` in the TEST folder) has been written to start and stop the gazebo server with the different worlds. For this test it also starts and terminates the `robot_control` executable, which is configured to log the detected distance from the `distanceToMarble()` function. It is called with the average radius from the Hough Transform called a 100 times.

The distance to the marble is 1 - 10 m, with a stepsize of 0.5, 19 tests in total.

The actual test is performed by the `testDistance.hpp` in the folder `fuzzy_and_CV >` `scr`. This program calls the `distanceToMarble()` function and logs the distance.

### 1.3.2 Procedure

Make sure the line `testDistance(cam);` is uncommented in `main.cpp`. Navigate to the folder `fuzzy_and_CV >` `CMake` and write the command `cmake`, then `make` in the terminal.

Navigate to the folder `fuzzy_and_CV >` `TEST`, and compile the source file `gzserver_manager.cpp` (`g++ gzserver_manager.cpp`) and run the executable. This will perform the test and log the results in `distanceData.csv`.

## 1.4 Results

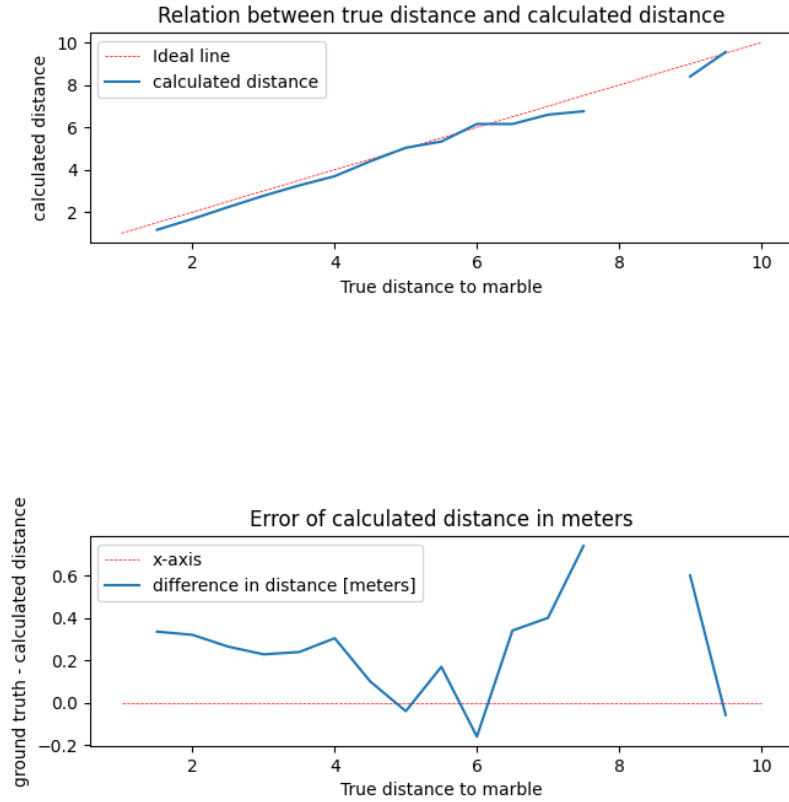


Figure 1: Calculated distance plotted against the true distance (top plot). The difference between the calculated- and true value (bottom plot)

It is seen from figure 1 in the bottom plot, the error is relatively stable before it reaches the 6 meter mark. The distance is dependent on the detection of a marble from the Hough Transform, which is reliable in the range from 2- to 7.5 meters, as described in appendix A1. As seen in the plot this correlates well with the accuracy of the distance. The area where there is no line is at distances where no marble was detected.

The top plot illustrates that the calculated distance is close to the actual distance.

In the range between 2- and 7.5 meters the average error is 0.24 meters, with an average error in percentage of 6.51%. An error of 5% would be considered accurate.

Thus this method can give a rough estimation of the distance to a marble, but is not an accurate representation, due to the error in the Hough Transform method.

The python script `plotCSV_distance` is used to plot the results.

## **1.5 Conclusion**

As expected the distance is most accurate when the Hough Transform is, which is in the range of 2- to 7.5 meters.

But due to errors in the Hough Transform, the distance can not be accurately represented, but can give a rough estimation.

## **2 Appendix**

A1 Journal - Hough, can be found in folder "Journals".