

# Experimental Outline

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## What will I be collecting?

- 4 x sets of LiDAR data
  - o 2 indoors in a structured environment
    - 1 to create a map
    - 1 to use for localisation
  - o 2 outdoors in an unstructured environment
    - 1 to create a map
    - 1 to use for localisation
  - o Each will have a different starting point: this is so that the LiDAR scans are not in the same order for the map and the localisation sets, to test if the code can actually localise correctly

## Why am I collecting this?

- I need experimental data to test my data processing pipeline
- The pipeline works for the initial data given, but it needs to be applied to multiple environments - the robot should be able to conduct a survey run of its environment and use that data on a run through to localise itself
- The experiment is to collect different sets of LiDAR point cloud data of a robot travelling through different paths (1 structured, 1 unstructured) and then using it to test processing pipeline (segmatch in matlab) and whether the processing can successfully localise to a given map

**Purpose:** evaluate the effectiveness of a processing pipeline in localizing a robot using LiDAR point cloud data as it travels through different types of paths.

**Hypothesis:** the processing pipeline can accurately localise the robot in both structured and unstructured paths. This hypothesis is based on the initial processing survey done on data from the African Robotics unit (1st segmatch trial)

## Variables:

- Independent: path type or the mapping data set
- Dependent: Accuracy of the localisation
- Controlled variables:
  - o size of data set (measured in # of point clouds being used to map and localise)
  - o Robot speed
  - o Environmental conditions
  - o Lighting
  - o LiDAR settings (remains the same through all)
  - o Comparison metrics - all need to be compared to the initial results with the seen data

## Key performance Indicators (KPIs):

- Localisation accuracy: closeness of estimated position to actual position
- Precision: repeatability, consistency, reliability of results
- Processing time (for each part of the processing pipeline)
- Path complexity: qualitative

## Methods & tools:

MATLAB & timestamp data - use tic&toc as well as an interview with researchers on husky for the environmental qualitative data

Data collected continuously throughout path

**Baseline Measurements:**

- ICP: PCL ICP timings
- Use timings from initial data: between 1-4 seconds to process: graph it
- Processing time without and with segmatch
- Processing on the initial data:
  - o Processing time with ground plane & comparison to without - 10 trials
  - o Processing time without down sampling and a comparison to with - do on 10 trials
- ICP distance graphs x4
- ICP distance graphs without pre-processing and down sampling x2

**Success criteria**

- Accuracy threshold: within 0.5m
- Maximum acceptable processing time for localisation (map building time not necessary) = 4seconds
- Maximum acceptable time for ICP verification: not needed as just for experimentation
- Use statistical analysis in MATLAB to interpret results

**Insights**

Develop insights into the effectiveness, limitations and comparisons

**SUGGESTIONS:**

- Automate collection for consistency