BONN-RHEIN-SIEG UNIVERSITY OF APPLIED SCIENCES

Scientific Experimentation and Evaluation - Assignment 03 - Statistical evaluation of previous experiment

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April 25, 2016

CONTENTS

1 Abstract

In this report, a statistical analysis is carried out for the results obtained in the previous experiment described in the last report. In the experiment, the robot is commanded to move in a straight line, right arc and left arc. Each command is repeated 20 times and the end pose is recorded and documented. First, the end position x, y and θ is visualized. Then a multidimensional Gaussian is fitted to the results of each command seperately. The standard deviations of the Gaussians are compared to the expected measurement errors and results are discussed.

2 Part 1: Moving in a straight line

2.1 Expected results

The motion command for each wheel is:

- Left wheel: 1.5 Revolution
- Right wheel: 1.5 Revolution

Given the wheel diameter = 5.6 cm
Distance travelled = π x D x Number of revolutions = 26.4 cm
Since both wheels travelled the same distance, expected θ = 0
Starting position is (-12.35) -> Expected end position (-12.5, 26.4) , θ = 0.0 degree

2.2 Experiment results

Figure 2.1 below shows a scattered view of the landing positions of the robot.

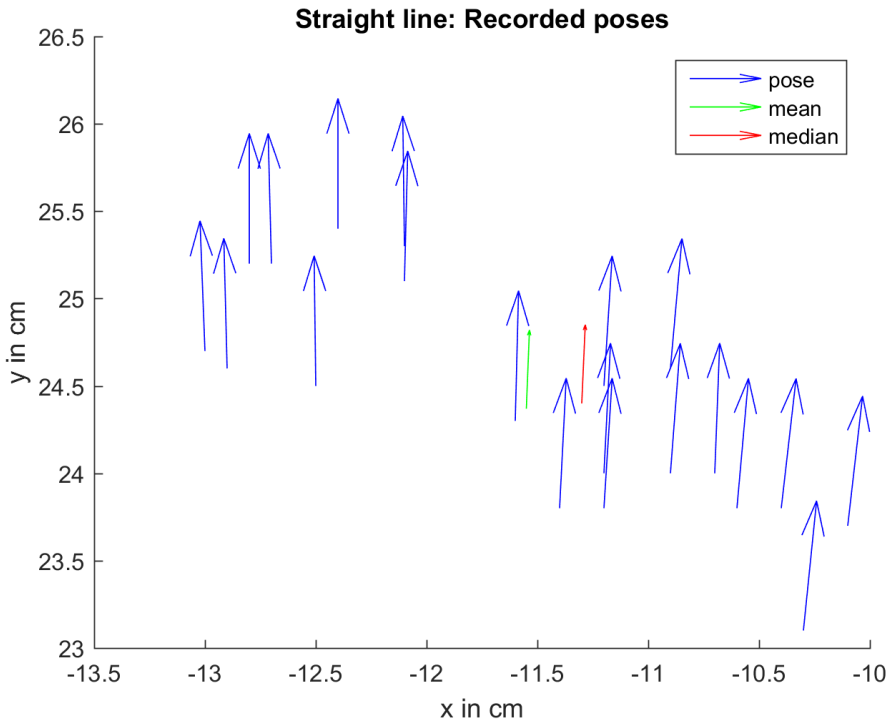

Figure 2.1: Scattered view of end poses for straight line command.

2.3 Fitting a 2D Gaussian to the end position

A 2D multivariate Gaussian distribution was fitted to the final end positions.

$$\mu_{x,y} = \begin{bmatrix} -11.55 \\ 24.37 \end{bmatrix}$$

$$\Sigma_{x,y} = \begin{bmatrix} 0.889 & -0.4583 \\ -0.4583 & 0.4183 \end{bmatrix}$$

The contorus plot of the fitted Gaussian is shown in figure 2.2 below. The contorur lines correspond to propabilities at 1, 2 and 3 standard deviations.

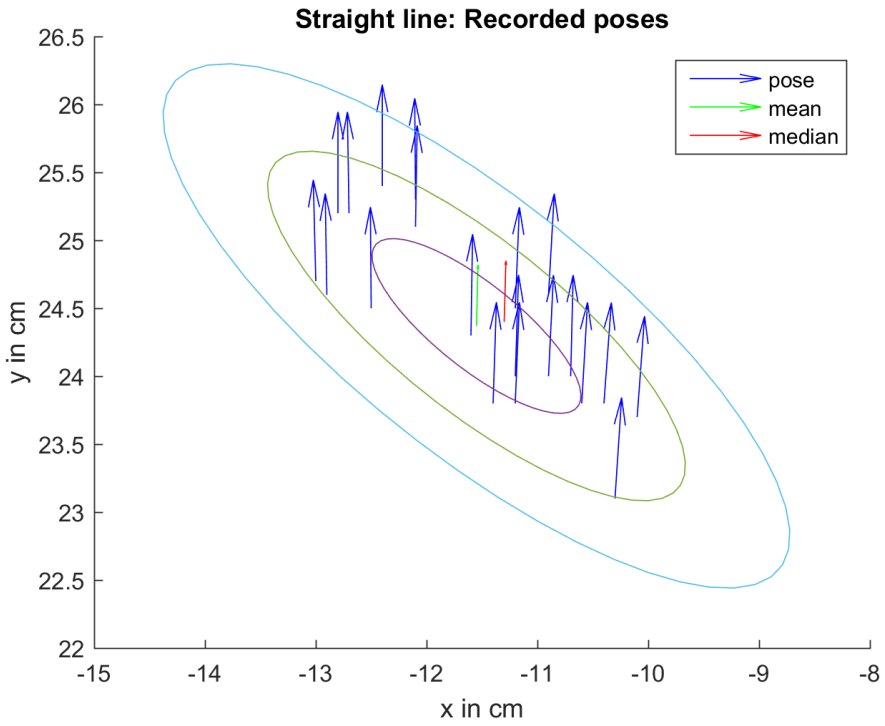

Figure 2.2: Scattered view of end poses for straight line command with contours of fitted Gaussian.

2.4 Fitting a 1D Gaussian to the orientation θ

A 1D Gaussian distribution was fitted to the final orientation

$$\mu_\theta = -1.85$$

$$\Sigma_\theta = 2.183$$

The fitted Gaussian is plotted against the a histogram of 3 pins in figure 2.3 below

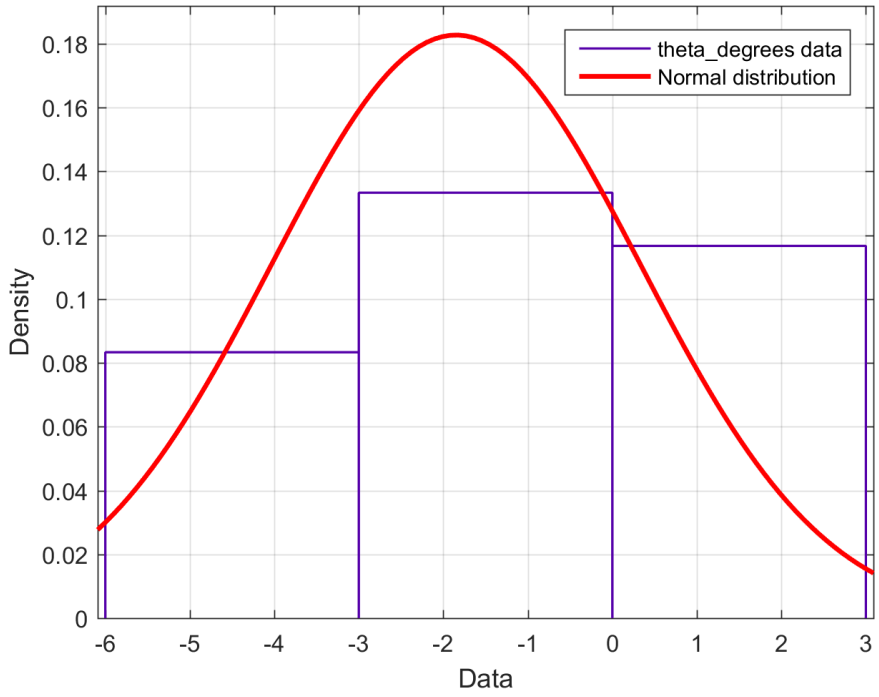

Figure 2.3: Fitted Gaussian for final orientation agains a a 3 bins histogram

3 Part 2: Moving in a right arc

3.1 Expected results

The motion command for each wheel is:

- Left wheel: 1 Revolution
- Right wheel: 2 Revolutions

Given the wheel diameter = 5.6 cm
To be calculated.

3.2 Experiment results

Figure 3.1 below shows a scattered view of the landing positions of the robot.

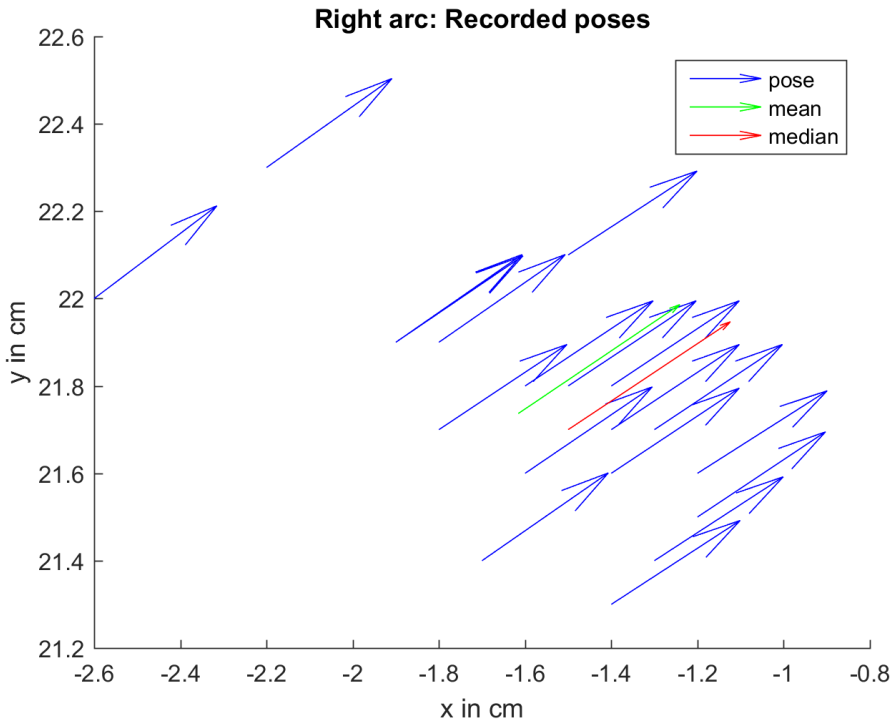

Figure 3.1: Scattered view of end poses for right arc command.

3.3 Fitting a 2D Gaussian to the end position

A 2D multivariate Gaussian distribution was fitted to the final end positions.

$$\mu_{x,y} = \begin{bmatrix} -1.6158 \\ 21.7368 \end{bmatrix}$$

$$\Sigma_{x,y} = \begin{bmatrix} 0.1281 & -0.0566 \\ -0.0566 & 0.0636 \end{bmatrix}$$

The contorus plot of the fitted Gaussian is shown in figure 3.2 below. The contorur lines correspond to propabilities at 1, 2 and 3 standard deviations.

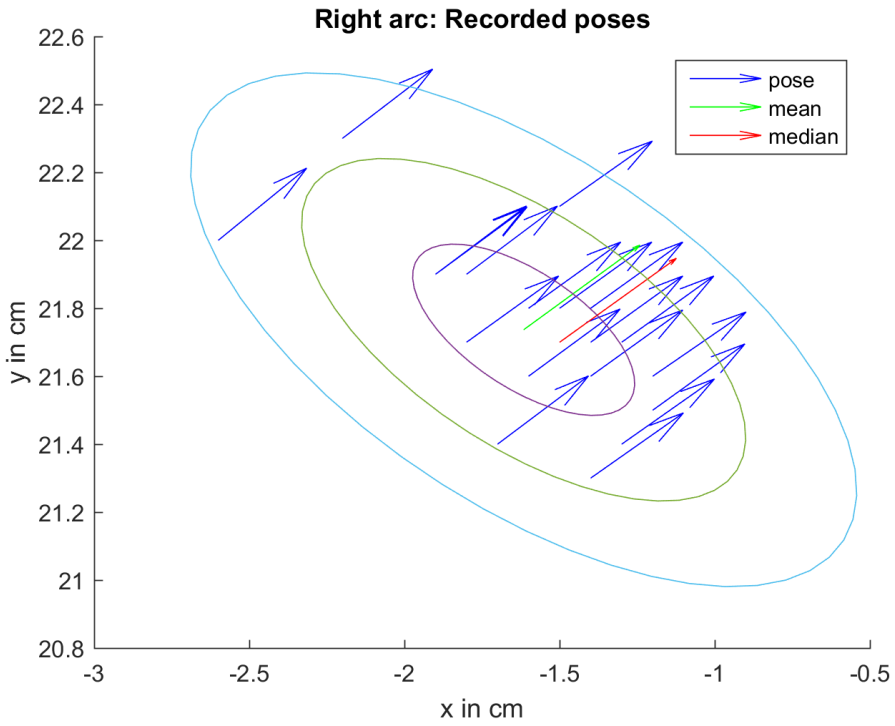

Figure 3.2: Scattered view of end poses for right arc command with contours of fitted Gaussian

3.4 Fitting a 1D Gaussian to the orientation θ

A 1D Gaussian distribution was fitted to the final orientation

$$\mu_\theta = -56.4211$$

$$\Sigma_\theta = 1.1213$$

The fitted Gaussian is plotted against the a histogram of 3 pins in figure 3.3 below

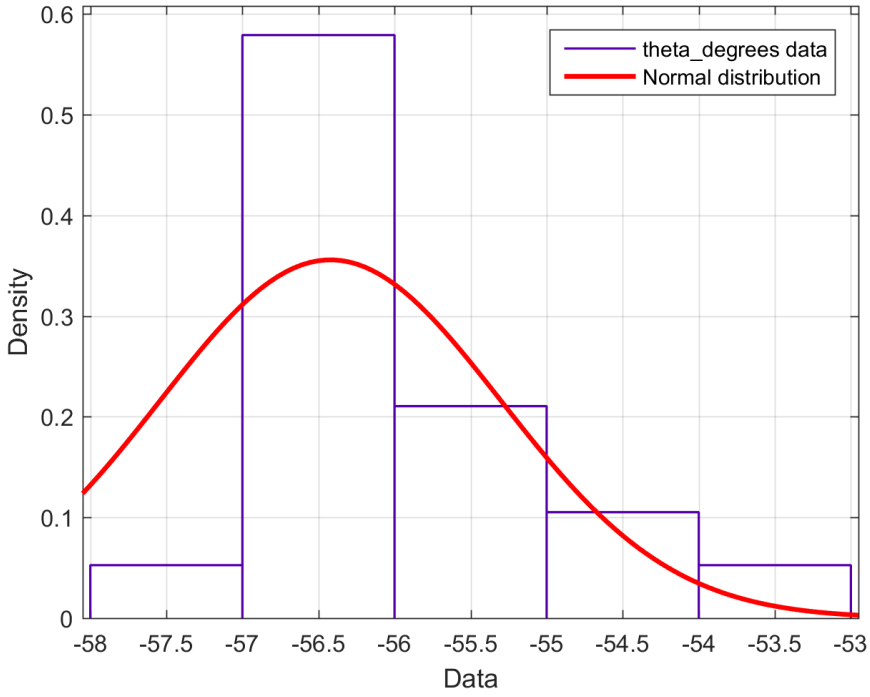

Figure 3.3: Fitted Gaussian for final orientation agains a a 3 bins histogram

4 Part 3: Moving in a left arc arc

4.1 Expected results

The motion command for each wheel is:

- Left wheel: 1 Revolution
- Right wheel: 2 Revolutions

Given the wheel diameter = 5.6 cm
To be calculated.

4.2 Experiment results

Figure 4.1 below shows a scattered view of the landing positions of the robot.

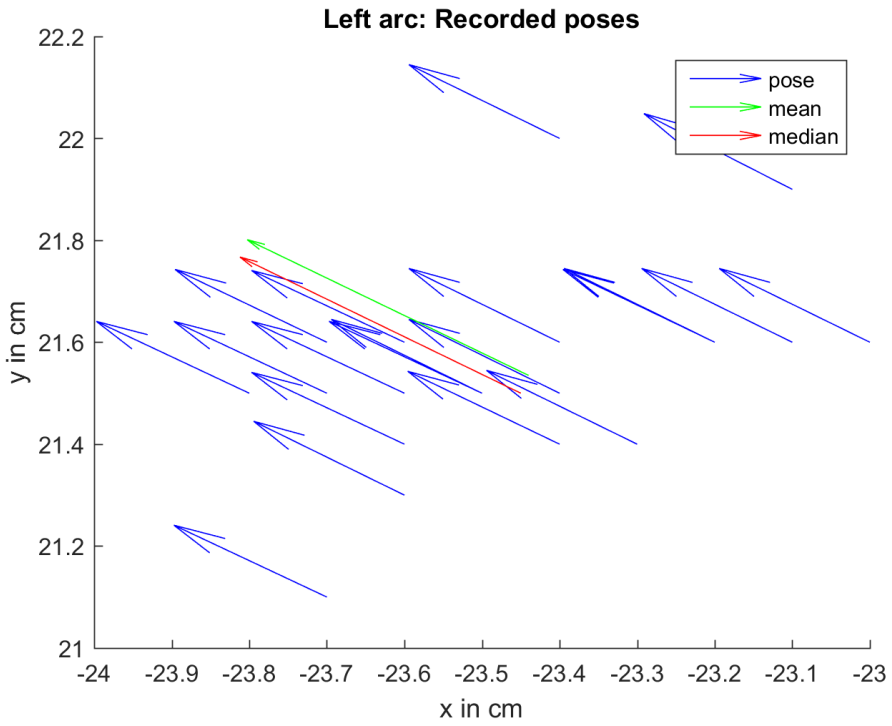

Figure 4.1: Scattered view of end poses for a left arc command.

4.3 Fitting a 2D Gaussian to the end position

A 2D multivariate Gaussian distribution was fitted to the final end positions.

$$\mu_{x,y} = \begin{bmatrix} -23.44 \\ 21.535 \end{bmatrix}$$

$$\Sigma_{x,y} = \begin{bmatrix} 0.0531 & 0.0199 \\ 0.0199 & 0.0361 \end{bmatrix}$$

The contorus plot of the fitted Gaussian is shown in figure 4.2 below. The contorur lines correspond to propabilities at 1, 2 and 3 standard deviations.

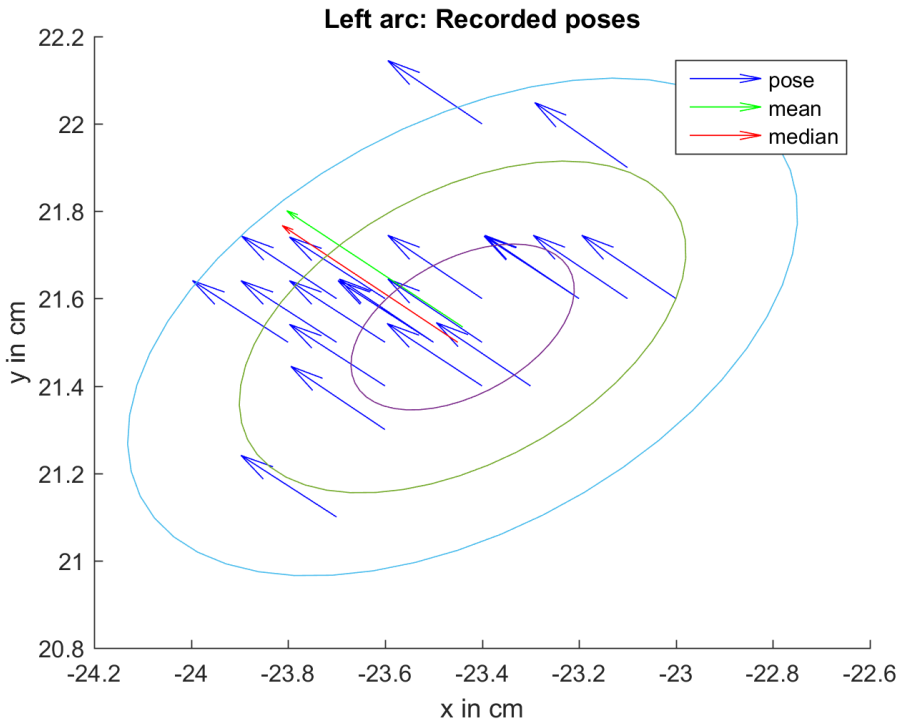

Figure 4.2: Scattered view of end poses for left arc command with contours of fitted Gaussian

4.4 Fitting a 1D Gaussian to the orientation θ

A 1D Gaussian distribution was fitted to the final orientation

$$\mu_\theta = 53.65$$

$$\Sigma_\theta = 0.812728$$

The fitted Gaussian is plotted against the a histogram of 3 pins in figure 4.3 below

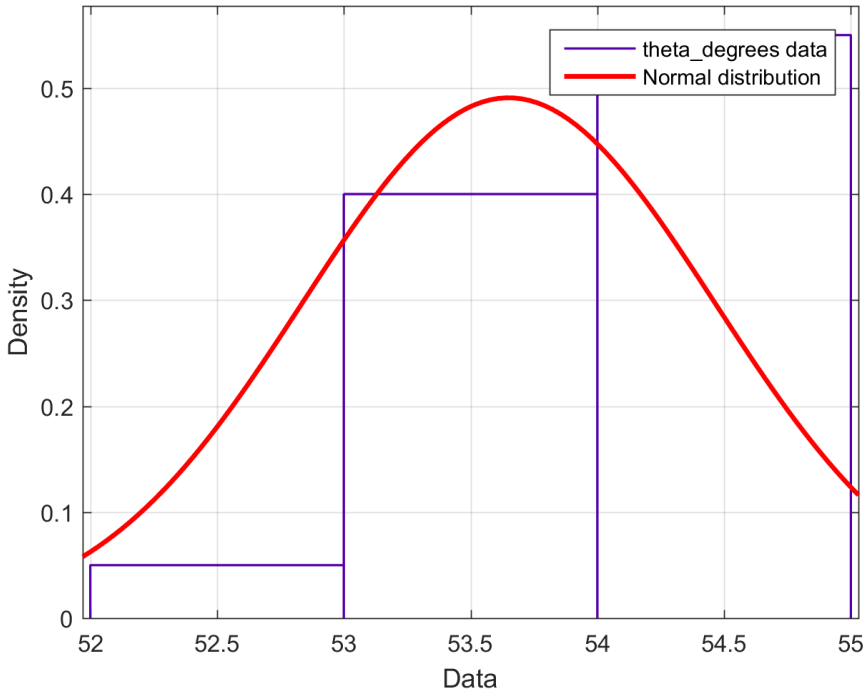

Figure 4.3: Fitted Gaussian for final orientation agains a a 3 bins histogram