University of Technology, Sydney
Faculty of Engineering and Information Technology

Learning Repetitive Gestures By Demonstration Using Nonlinear Oscillators

William bond

Student Number: 10555163
Project Number: S11-006
Major: Mechanical and Mechatronic Engineering

Supervisor: Dr Alen Alempijevic

RobotAssist

ARC Centre of Excellence for Autonomous Systems

UNIVERSITY OF TECHNOLOGY SYDNEY

A 12 Credit Point Project submitted in partial fulfilment of the requirement for the Degree of Bachelor of Engineering

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Statement of Originality

I declare that I am the sole author of this report, that I have not used fragments of text from other sources without proper acknowledgment, that theories, results and designs of others that I have incorporated into my report have been appropriately referenced and all sources of assistance have been acknowledged.

Abstract

Shape Based Recognition and Fast Learning Techniques For Autonomous Robots William Bond, S11-006.

My Abstract WILL be written here... maybe.

Acknowledgements

I would like to thank my supervisor XXXX for his help and guidance throughout this whole project, he has been a tremendous help towards making this thesis possible. Special thanks also to XXX for lending their experience and knowledge, and helping me out when I needed third party input. I would especially like to thank my family for their enending support in my academic progression.

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Contents

List of Figures

Nomenclature

Term	**Definition**
HRI	Human-robot interaction
RGB	Red Green Blue
3D	Three dimensional
DOF	Degree Of Freedom
GUI	Graphical User Interface
RPY	Roll, Pitch and Yaw
PCL	Point Cloud Library
RA	RobotAssist

Chapter 1

textools

1.1 uasable tools

Citing something Here I will cite something - Nehaniv et al (**?**)

Dot Points

- Dot point
- etc
- etc

Italics (emphasis) *Here the text will be in italics, then will cite something* (**?**).

Referring to other sections of the report. Referring to something in a section like **??**. Anything with a label can be referred to again later as in Fig **??**.

Image insertion

Table insertation

Equation insertation

$$\ddot{x} + \epsilon(x^2 - 1)\dot{x} + x = 0 \tag{1.1}$$

$$\dot{x} = \alpha(\mu - (x^2 + y^2))x - \omega y \tag{1.2}$$

$$\dot{y} = \alpha(\mu - (x^2 + y^2))y + \omega x \tag{1.3}$$

$$\dot{\omega} = -\epsilon F(t)\frac{y}{\sqrt{x^2 + y^2}} \tag{1.4}$$

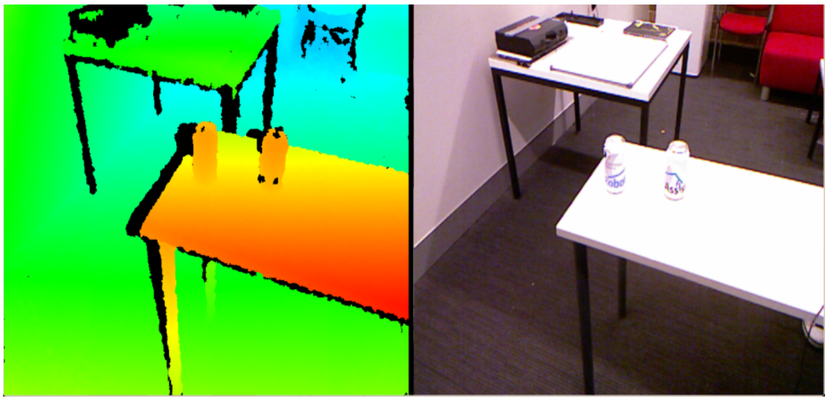


Figure 1.1: Image insertation is annoying, it puts the image onto the start of the new page only. This could probably be fixed though...

	SwissRanger 4000	Kinect
Range (m)	10	3
Frame Rate (Hz)	50	30
Output Resolution (Pixels)	176x144	640x480
Precision (mm)	10	1.3

Table 1.1: Comparison of SwissRanger and Kinect camareas

$$\dot{r} = \alpha(\mu - r^2)r \tag{1.5}$$

$$\dot{\phi} = \omega \tag{1.6}$$

Here is an UNREFERENCED MATRIX.

$$\begin{pmatrix} n & \theta_{n+1} & d_{n+1} & a_{n+1} & \alpha_{n+1} \\ 0 & \theta_1 & 0 & 0 & 90 \\ 1 & \theta_2 & -175 & 400 & 0 \\ 2 & \theta_3 & 75 & 0 & 90 \\ 3 & \theta_4 & 330 & 0 & 90 \\ 4 & \theta_5 & 0 & 0 & -90 \\ 5 & \theta_6 & 0 & 0 & 0 \end{pmatrix} \Rightarrow \begin{pmatrix} c\theta_{n+1} & -s\theta_{n+1}c\alpha_{n+1} & s\theta_{n+1}s\alpha_{n+1} & a_{n+1}c\theta_{n+1} \\ s\theta_{n+1} & c\theta_{n+1}c\alpha_{n+1} & -c\theta_{n+1}s\alpha_{n+1} & a_{n+1}s\theta_{n+1} \\ 0 & s\alpha_{n+1} & c\alpha_{n+1} & d_{n+1} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Referring to an equation refer like this - **??**.

Symbols inserted into a sentance like this ϵ. And $x = r\cos(\phi)$ and $y = r\sin(\phi)$.

PAGEBREAK

LANDSCAPE MODE ON NEXT PAGE!

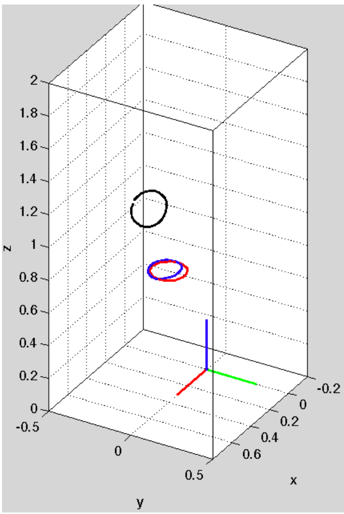
$$\begin{pmatrix} c_1 & 0 & s_1 & 0 \\ s_1 & 0 & -c_1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} c_2 & -s_2 & 0 & 400c_2 \\ s_2 & c_2 & 0 & 400s_2 \\ 0 & 0 & 1 & -175 \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} c_3 & 0 & s_3 & 0 \\ s_3 & 0 & -c_3 & 0 \\ 0 & 1 & 0 & 75 \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} c_4 & 0 & s_4 & 0 \\ s_4 & 0 & -c_4 & 0 \\ 0 & 1 & 0 & 330 \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} c_5 & 0 & -s_5 & 0 \\ s_5 & 0 & c_5 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} c_6 & -s_6 & 0 & 0 \\ s_6 & c_6 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$=$$

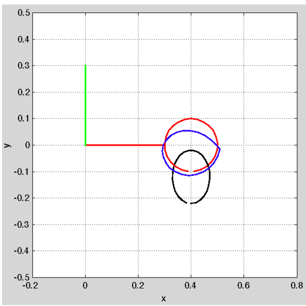
$$\begin{pmatrix} s_6(A) + c_6(B) & c_6(A) - s_6(B) & c_5(c_{12}s_3 + c_{13}s_2) - s_5(G) & 400c_{12} - 100s_1 + 330c_{12}s_3 + 330c_{13}s_2 \\ -s_6(c_{14} - s_4(C)) - c_6(c_5(EC) - s_5(D) & s_6(c_5(EC) - s_5(D)) - c_6(c_{14} - s_4(C)) & s_5(EC) + c_5(D) & 100c_1 + 400c_2s_1 + 330c_2s_{13} + 330c_3s_{12} \\ -c_6(F) - s_{46}(c_2s_3 + c_3s_2) & s_6(F) - c_6s_4(c_2s_3 + c_3s_2) & -c_5(c_{2+3}) - c_4s_5(s_{2+3}) & 400s_2 - 330c_{23} + 330s_{23} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Landscape mode will end in 3...2...1..

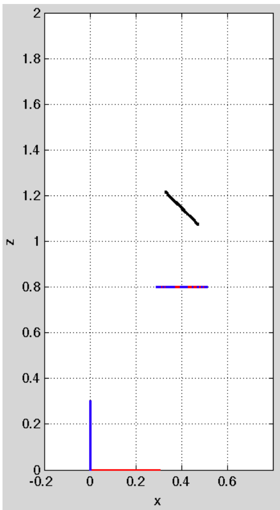
Compounded images.



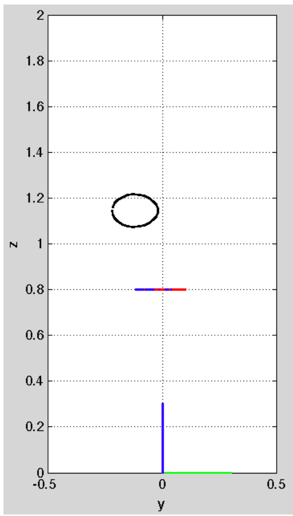
(a) 1st figure



(b) 2nd figure



(c) 3rd fig



(d) 4th fig

Figure 1.2: Explain your picture with a quick and simple explanation

Let's try two side by side with Fig.**??** or Fig.**??** or I can just refer to Fig.**??** I'll also talk later in Sec.**??** on Object Separating.

Chapter 2

Introduction

2.1 The Development and need for Autonomous Robots in the Home

2.2 The Development of a Robust and Efficient method of Object Detection

2.3 The Robotic Recognition Problem

2.4 Proposed Method Validation Using The RobotAssist Platform

2.5 Relevent Publications To This Capstone

2.6 Capstone Project Report Guideline

2.7 Scope

Chapter 3

Literature Review

3.1 Getting a Physical 3D Space into a Computer

3.2 Separation of Object of Interest

3.2.1 A SUBSECTION - HOW AWESOME!

3.2.2 Subsections don't NEED a label

3.3 Recognition and Learning

3.3.1 Exportation of Usable Data

3.3.2 Sub2

3.4 Recommendations

Chapter 4

Object Recognition and Primitive Feature Classification

4.1 How does my code collect point clouds

4.2 How does my code recognise object from a blank point cloud

4.3 How does my code find the basic classification of an object based on primitive features

Chapter 5

Fast Object Learning and Associative matching

5.1 How does my code store object specific features

5.2 How does my code create associations between previously collected specific features, in the effort to recognise a previously found object.

5.3 How does my code associate similar matches of objects to determine different orientations of a same object.

Chapter 6

Future Work and Conclusion

6.1 Future Work

6.1.1 Something I want to do in future

6.1.2 another thing I wanted to do

6.2 Conclusion

The next bit will be BIBLIOGRAPHY.

Chapter 7

Appendix

7.1 Appendix :A

7.2 Another Appendix bit

7.3 Last Appendix