AKADEMIA GÓRNICZO-HUTNICZA IM. STANISŁAWA STASZICA W KRAKOWIE

**WYDZIAŁ ELEKTROTECHNIKI, AUTOMATYKI,
INFORMATYKI I INŻYNIERII BIOMEDYCZNEJ**

KATEDRA AUTOMATYKI I INŻYNIERII BIOMEDYCZNEJ

Praca dyplomowa magisterska

Rozpoznawanie obiektów na obrazach RGB-D pod kątem zastosowań w robotyce

Object recognition in RGB-D images for robotic applications.

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Kraków, 2016

Oświadczam, świadomy(-a) odpowiedzialności karnej za poświadczenie nieprawdy, że niniejszą pracę dyplomową wykonałem(-am) osobiście i samodzielnie i nie korzystałem(-am) ze źródeł innych niż wymienione w pracy.

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Master of Engineering Thesis

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Kraków, 2016

Many thanks to all the people and beware global warming

Contents

Introduction

The aim of this work is to survey modern RGB-D image processing algorithms for model-based object recognition. Analysis of each method is focused on their usability in time and resource constrained robotic environment. Based on provided performance tests, selected methods will be used to develop a complete object recognition system applicable in robotics.

The first chapter provides background on the RGB-D imaging. A brief introduction to depth acquisiton techniques is provided. Finally, implementation and testing details are provided, including software tools, hardware platforms and example datasets. Second chapter introduces popular representation formats of combined color and depth data. Plain RGB-D images, point clouds and TSDF are discussed. For each format, its features and applicability is described. Efficient data storage, conversion algorithms and processing overhead are tested. Third chapter's content is focused on popular keypoint detection algorithms. Analysis of SUCH and SUCH and SUCH is provided. In fourth, point cloud segmentation is considered. Fifth chapter touches problems such as normal estimation, data alignment and matching methods. Comparative survey of the most popular descriptor types is provided in the sixth chapter. Their descriptive capabilites are tested against matching algorithms. A complete solution is proposed followingly, its performance is analysed with hypothesis verification methods, such as SUCH, and stessed on the sample datasets. Online performance tests are also provided. In the final chapter, robotic application scenarios are proposed. Developed system is implemented in a robotic simulator, to test its performance.

1. Background

1.1. What is RGB-D

why bother, methods of acquisition

1.2. Software tools

1.3. Test hardware

1.4. Sample datasets

1.5. Related work

2. Preprocessing

rgb-d, point clouds, tsdf algos for conversion, timing

2.1. Representation

segmentation

2.2. Neighbourhood

segmentation

2.3. Transformations

segmentation

2.4. Noise filtering

segmentation

2.5. Segmentation

segmentation

2.6. Keypoints

segmentation

3. Recognition

keypoints

3.1. Alignment

alignment

3.2. Matching

matching

3.3. Descriptors

descriptors

3.4. Verification

verification

4. Classification

4.1. Neural network

convolutional neural network

4.2. Training

training

4.3. Results

descriptors

5. Applications

5.1. Scenario 1

something simple with recognition
simulation of something simple

5.2. Scenario 2

something simple with classification
simulation of something simple

5.3. Scenario 3

Robocup@Work
simulation of Robocup@Work?

5.4. Scenario 4

APC?
simulation of APC?

Summary