Robot Vision for Depalletizing of Mixed Pallet Loads

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Robot Vision for Depalletizing of Mixed Pallet Loads

Depalletizing – Standard Applications
Robot Guidance – Application Types

2-D Guidance

21/2 –D Guidance

3 –D Guidance

3-D Stereo Vision Sensor

3-D Stereo Vision System
3-D Guidance

- Monocular photogrammetric
- Stereo vision sensor
- Stereo vision system
Depalletizing – Standard Applications

1 layer depalletizing
2D robot guidance

multi-layer depalletizing
2 ½ D robot guidance

- Pallets loads are single type
- Pallet layers are known
- Pallets can be seen from above

• State of the art
• Solved by one camera robot vision systems
Depalletizing 2D - Example

Depalletizing crankshafts
Depalletizing 2 ½ D - Examples

Unloading racks

Depalletizing motor blocks
Typical: Lighting not Stable
Robust recognition under challenging circumstances

Contours - robust under illumination variation

- Object dark - background bright
- Object bright - background dark
- Varying, non-linear illumination

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Robust and reliable recognition under dramatic size variations

1 model - any scaling

scaling 1.0

scaling 0.63

scaling 0.46

scaling 1.8

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Advanced Depalletizing - Requirements
Depalletizing – Multiple Pallets

Which part shall be gripped?

Algorithm to determine next part to be gripped

Parts which are extremely missaligned

Recognition of tilted objects

Requirements

No top view possible

Depth information necessary

Multiple view recognition

Requirements

Different views possible

Recognition of tilted objects

Depth information necessary

Algorithm to determine next part to be gripped

Parts which are extremely missaligned

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Recognition of tilted objects

Requirements
Depalletizing – Mixed Pallet Loads

Different types of loads

Depth information necessary

Multi model recognition

Requirements
Multiple Pallets – Requirements

- Recognition of tilted objects
- Depth information necessary
- Algorithm to determine next part to be gripped
- Multiple view recognition
- Multi model recognition

- Independent of illumination variation
- Scale independent
- Rotation independent
- Location independent

- RELIABLE, ROBUST SOLUTION!

- Automated calibration including robot
- Automated teaching / learning of recognition models
- Algorithm for coordination of robot and vision system
• Alignement of all components to one reference frame

• Automated calibration → determination of camera frame

• Automated alignement procedure camera – robot

• Automated check procedure

• Automated recovery procedure after crash
Automatic Model Generation

- Automated recognition of relevant features
- Multi-view model
- Tolerance against slight deformations
- Generic model adaptation
- Minimum user interaction
- Automated verification of model
Strategies for Coordination Camera - Robot

- Top view and side view strategies
- Zoom in strategies
- Search window strategies
Strategies

- Multiple view 2D / 2½D
- Combined 2½D / 3D
- Direct 3D
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Applications - Examples
Loading and Unloading of Suitcases
Application Examples

Plain boxes  Palletizing from belt  Depalletizing from multiple pallets
Commissioning of Consumer Goods

- trays
- bags
- boxes
Commissioning of Technical Goods
Vision for Logistics: Example Automation for Distribution Center (DC)

Highly complex with respect to different goods and packages
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End of Presentation