Robot Vision for Depalletizing of Mixed Pallet Loads

Stephan Wienand
Research & Development Executive Board

ISRA VISION SYSTEMS AG
Industriestrasse 14
D-64297 Darmstadt
Germany
Tel. +49 (6151) 948-0
Fax +49 (6151) 948140
email swienand@isravision.com
Internet: www.isravision.com

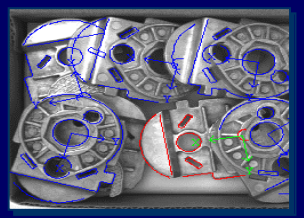
ISRA VISION SYSTEMS INC.
3350 Pine Tree Road
Lansing, MI 48911
USA
Tel. +1 (517) 8 87 8878
Fax +1 (517) 8 87 8444
email info.usa@isravision.com
Internet: www.isravision.com

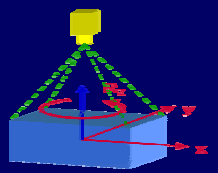
Robot Vision for Depalletizing of Mixed Pallet Loads

Depalletizing – Standard Applications

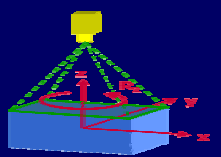
Robot Guidance – Application Types

2-D Guidance

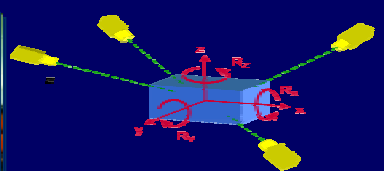




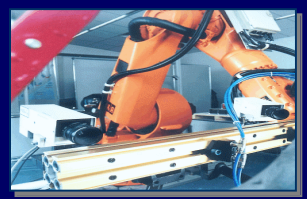
21/2 –D Guidance

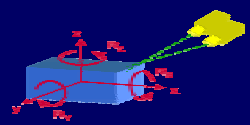


3 –D Guidance

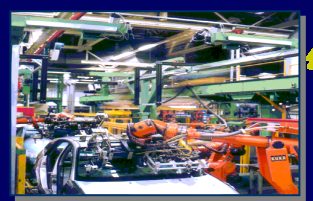


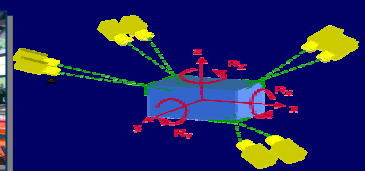
3-D Stereo Vision Sensor





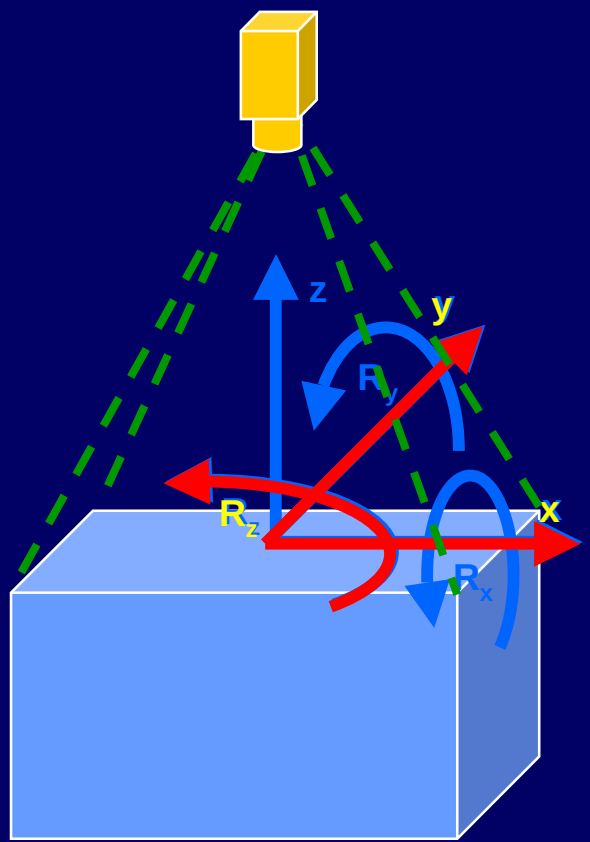
3-D Stereo Vision System



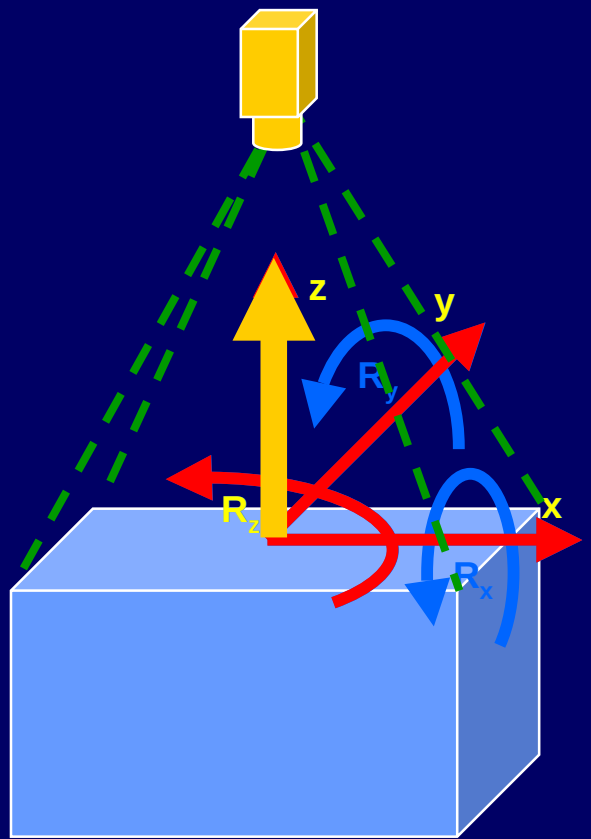


Robot Guidance – 2D and 2 ½ D

2-D Guidance

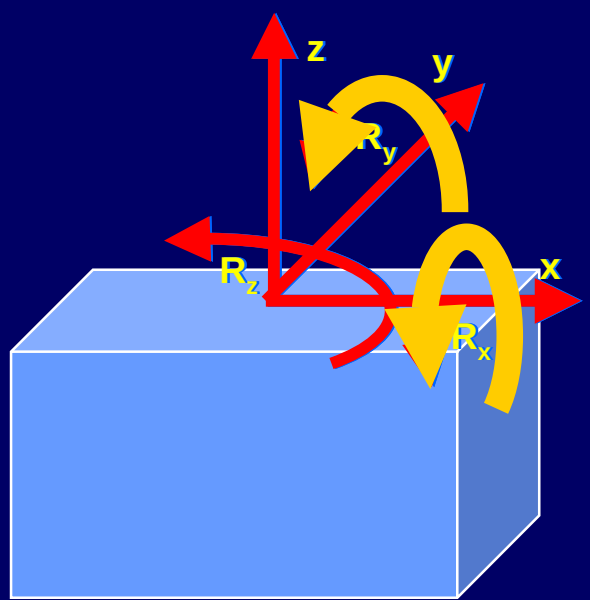


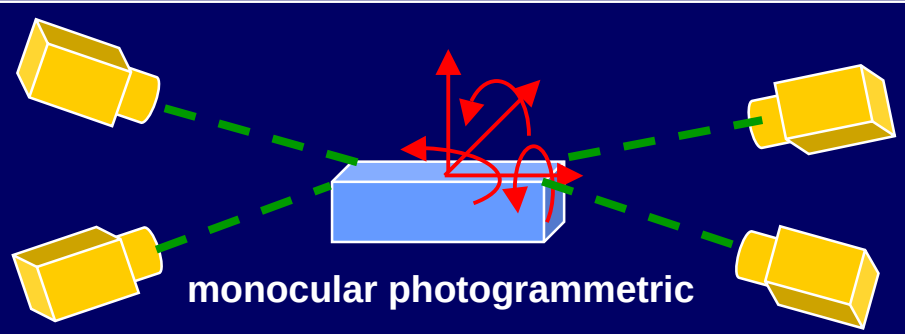
2 ½ -D Guidance

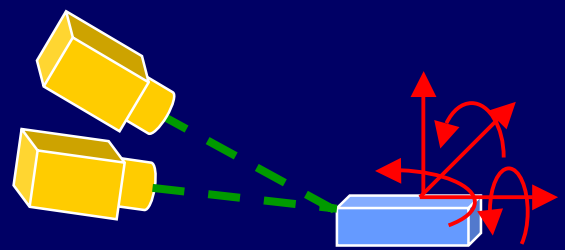


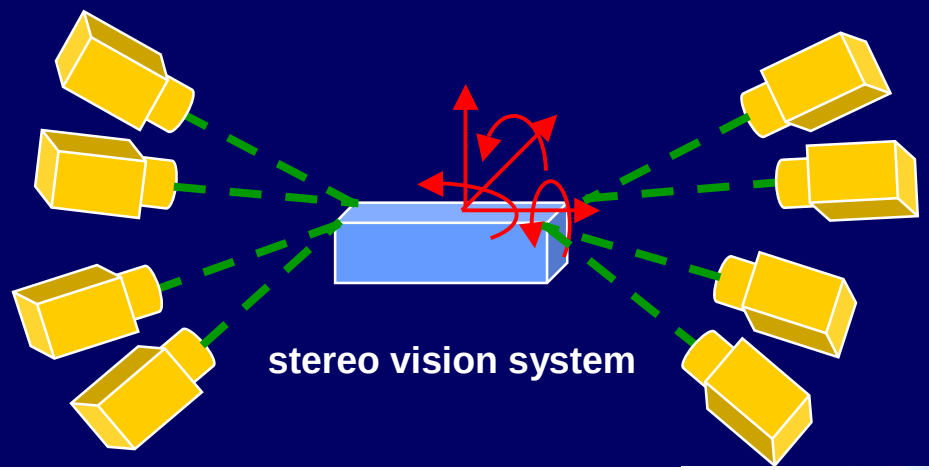
Robot Guidance – 3D

3-D Guidance

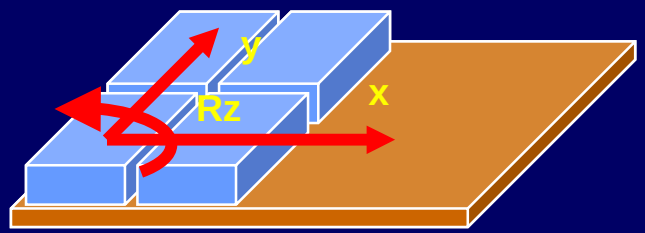






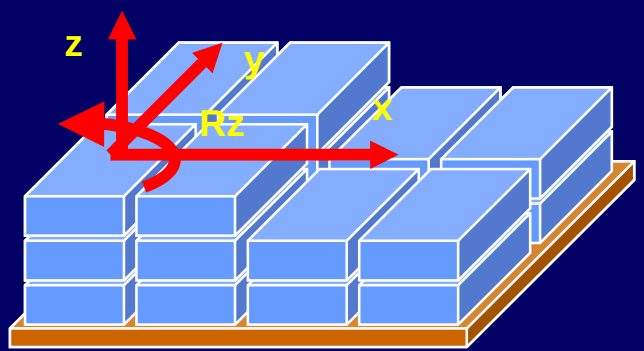


Depalletizing – Standard Applications



1 layer depalletizing

2D robot guidance



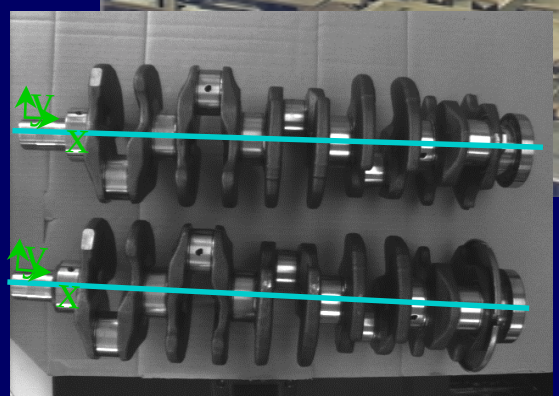
multi-layer depalletizing

2 ½ D robot guidance

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

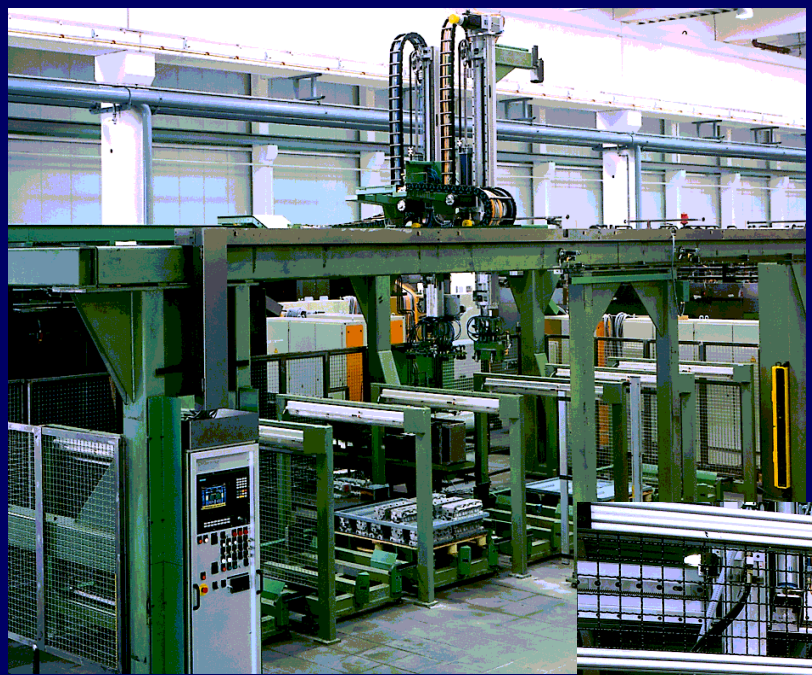
- **State of the art**
- **Solved by one camera robot vision systems**

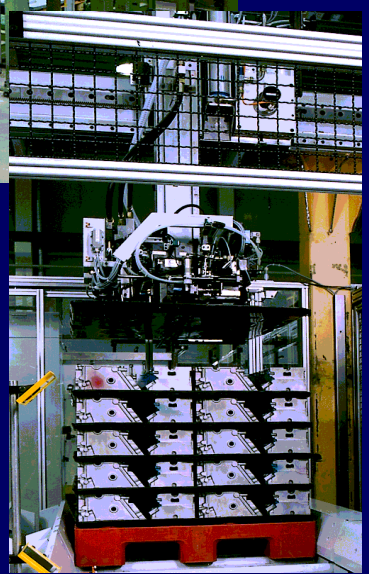
Depalletizing 2D - Example



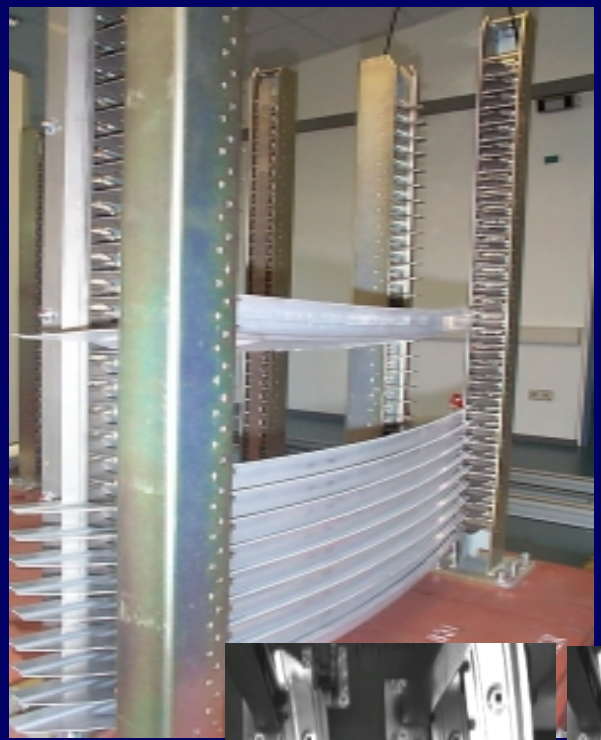
Depalletizing crankshafts

Depalletizing 2 ½ D - Examples

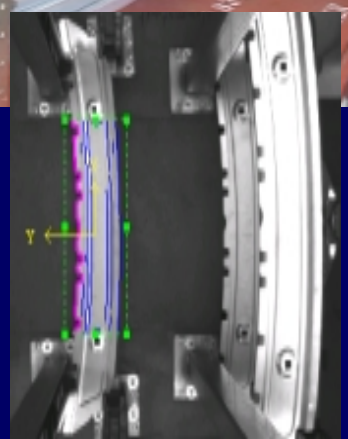


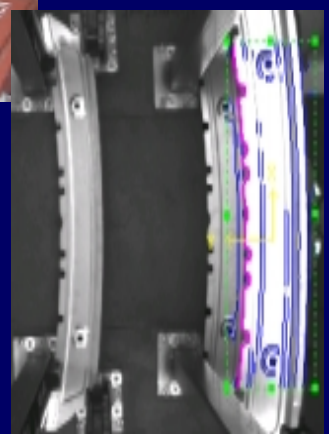


Depalletizing
motor blocks

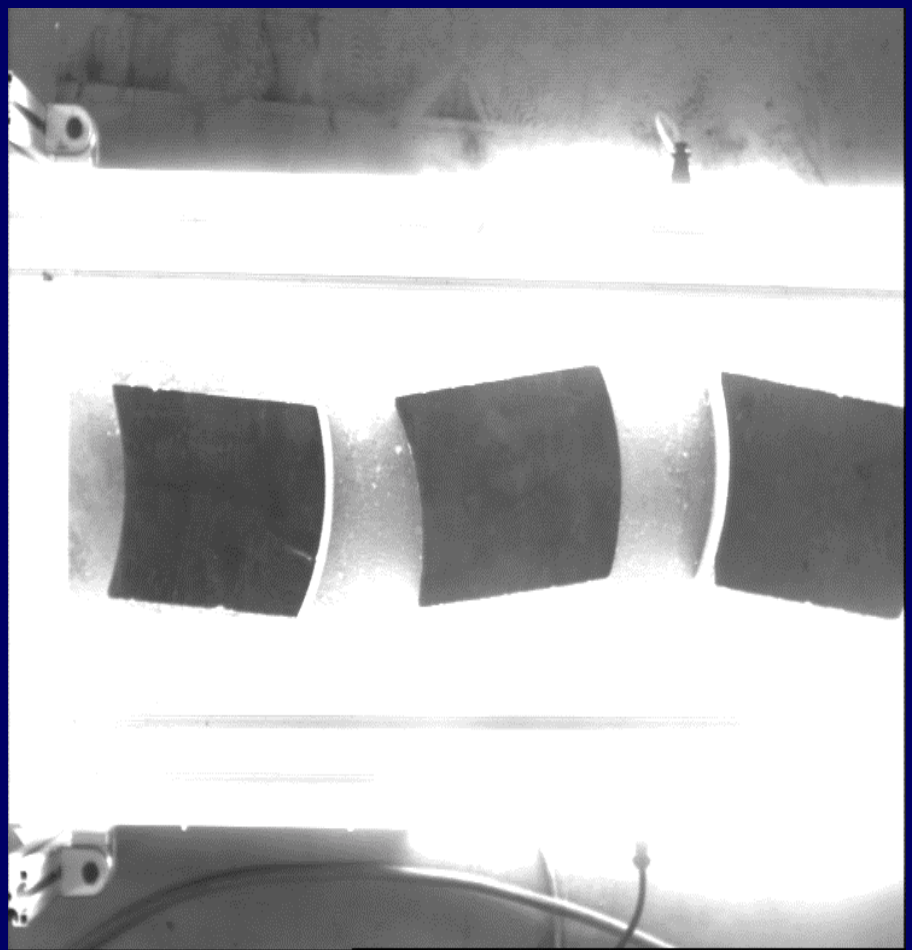


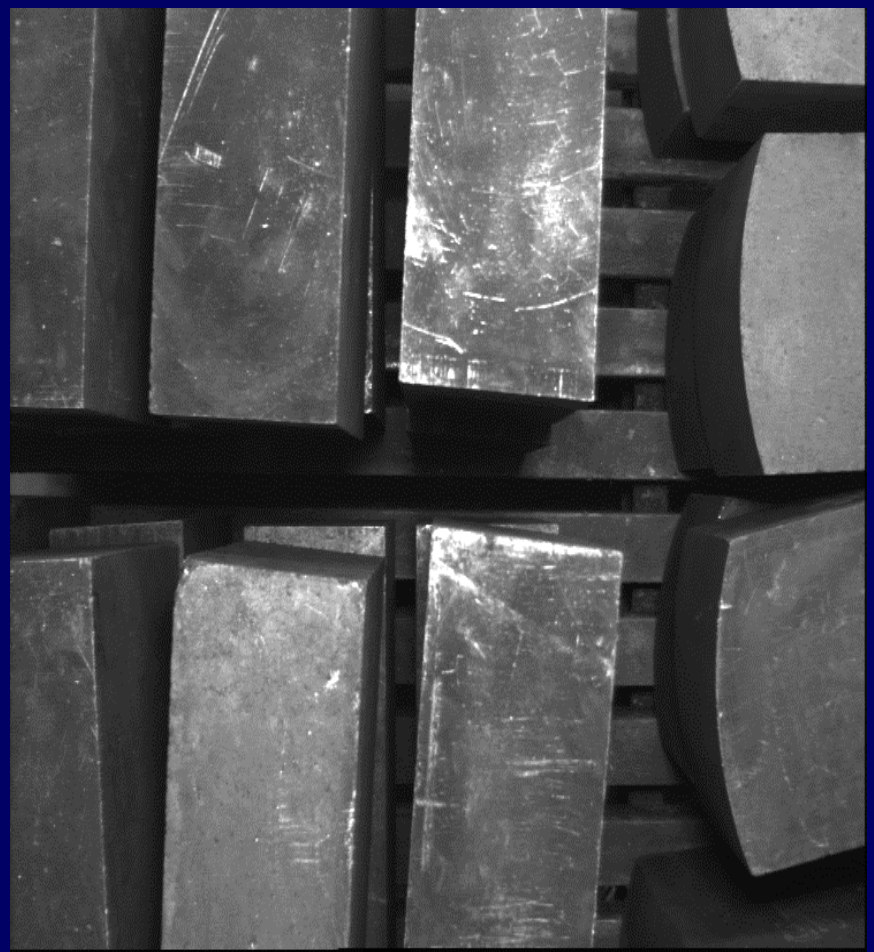
Unloading
racks



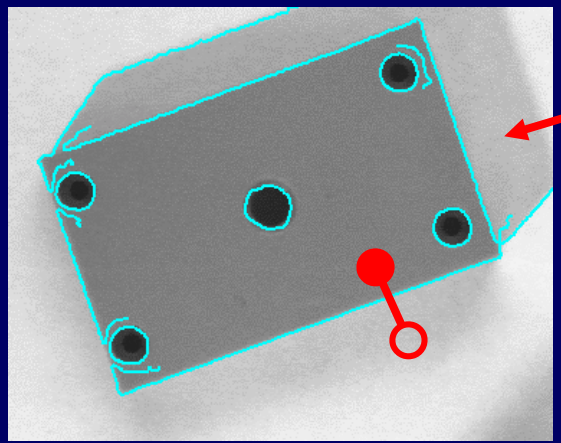


Typical: Lighting not Stable





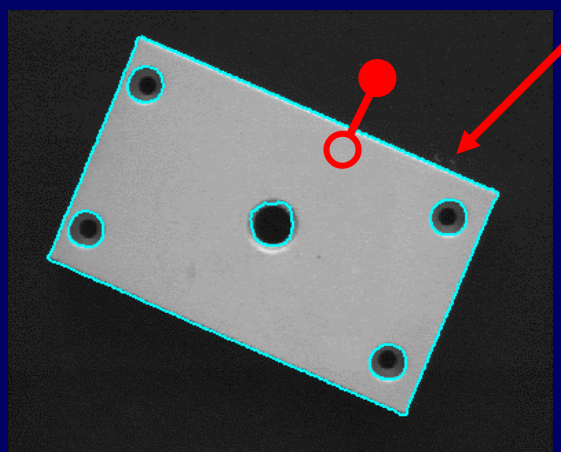
Robust recognition under challenging circumstances

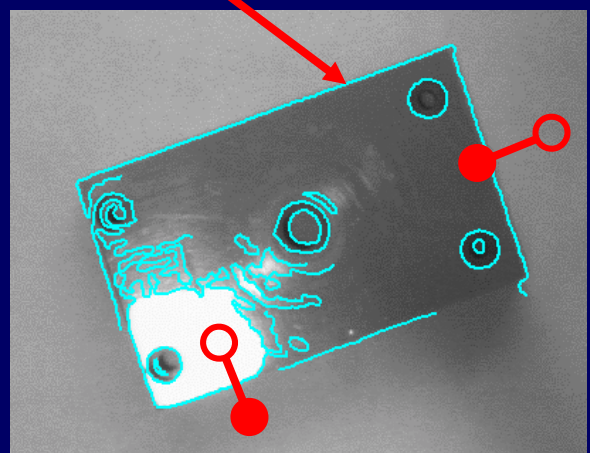


object dark - background bright

object bright - background dark

varying, non linear illumination

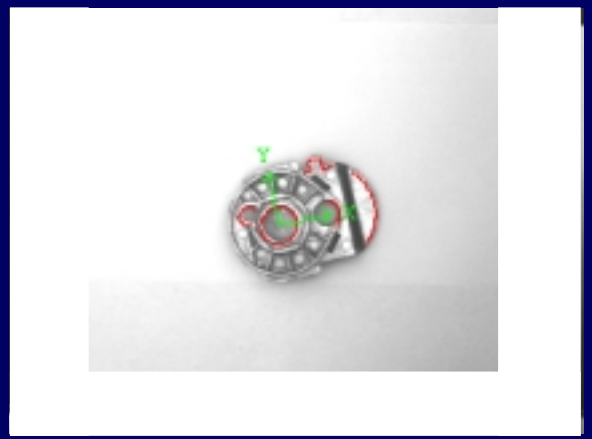




Contours - robust under illumination variation

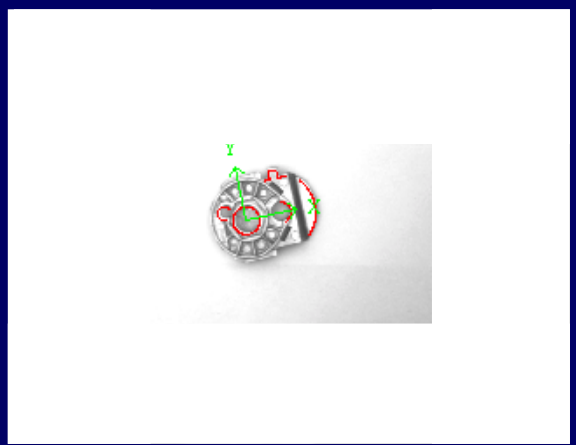
Robust and reliable recognition under dramatic size variations

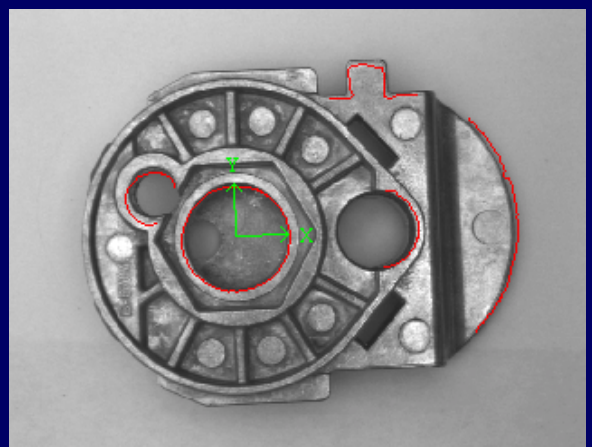
scaling 1.0



scaling 0.63

scaling 0.46





scaling 1.8

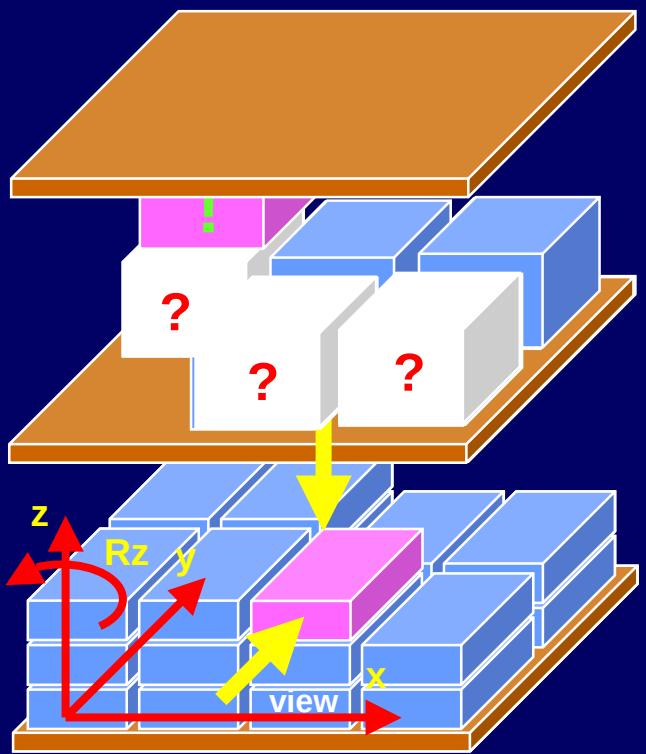
1 model - any scaling

Robot Vision for Depalletizing of Mixed Pallet Loads

Advanced Depalletizing - Requirements

Depalletizing – Multiple Pallets

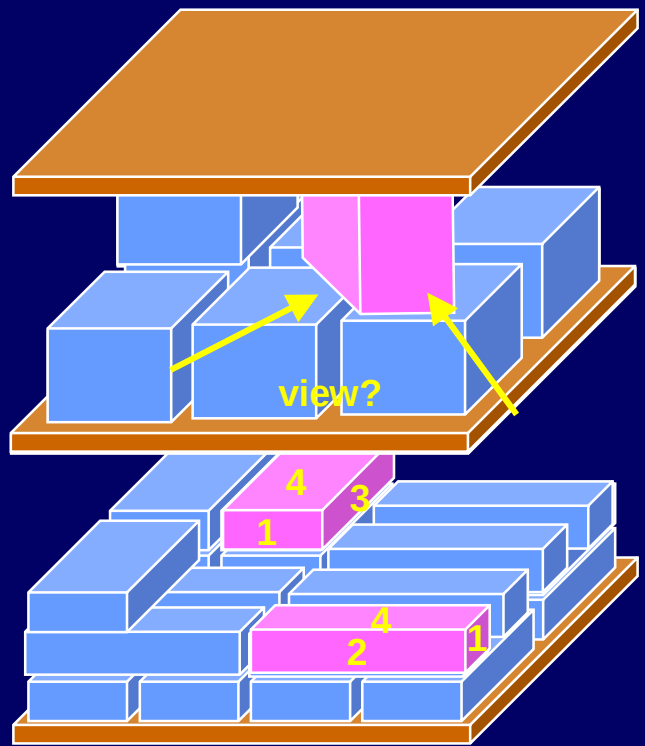
Which part shall be gripped? → Algorithm to determine next part to be gripped



Requirements

No top view possible → Depth information necessary

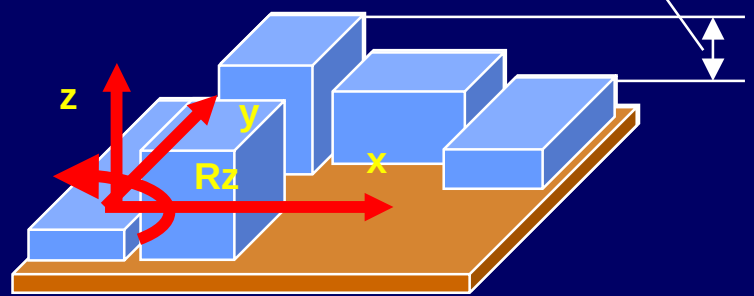
Parts which are extremely missaligned → Recognition of tilted objects

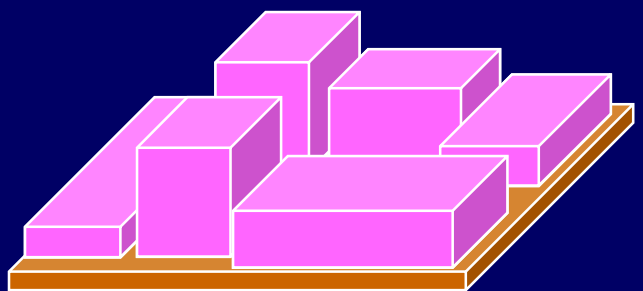


Requirements

Different views possible → Multiple view recognition

Depalletizing – Mixed Pallet Loads



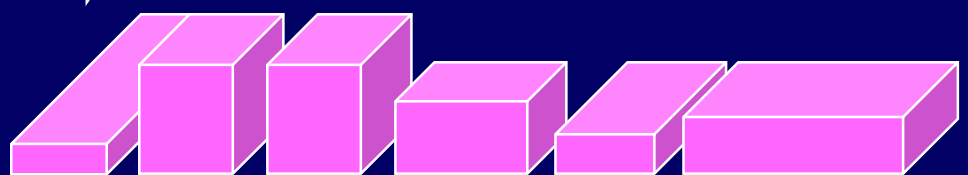


different types of loads

Depth information necessary

Requirements

Multi model recognition



Multiple Pallets – Requirements

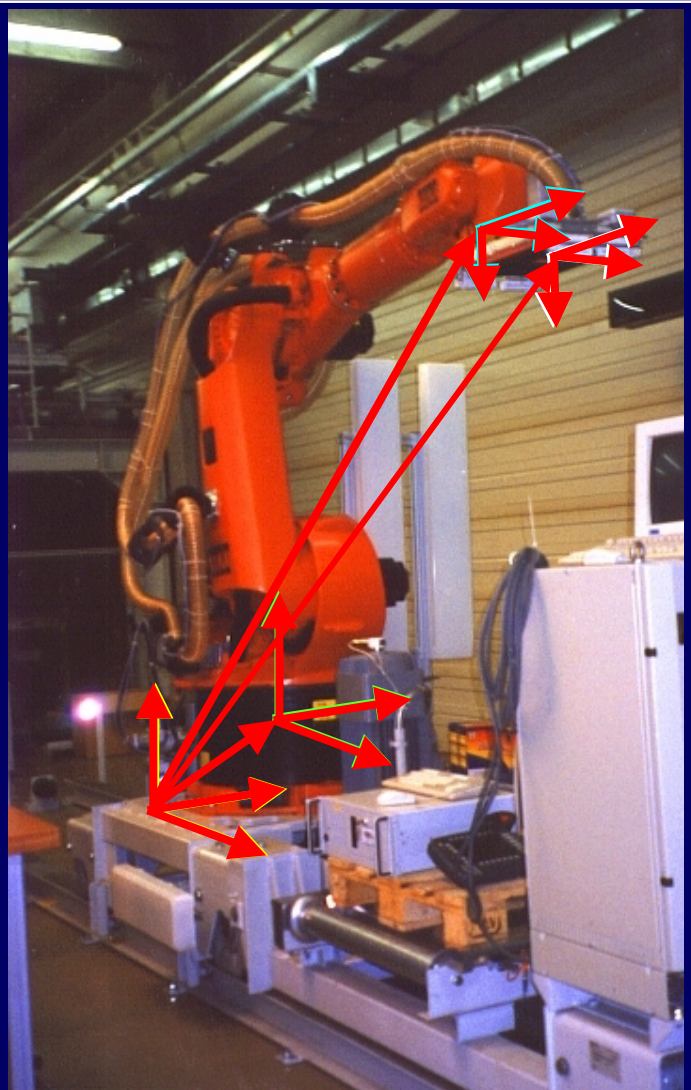
- Recognition of tilted objects
- Depth information necessary
- Algorithm to determe next part to be gripped
- Multiple view recognition
- Multi model recognition

- 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**

Automatic Calibration



- 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

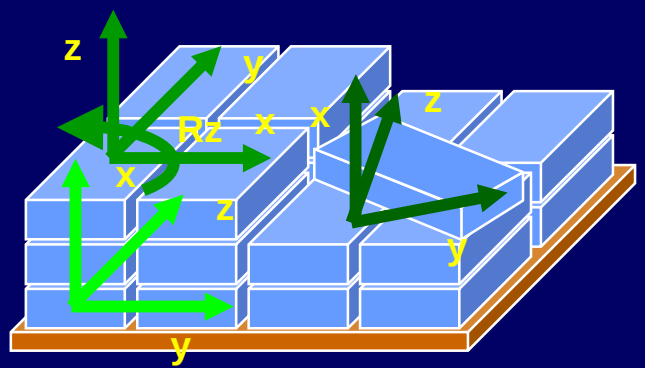
Strategies for Coordination Camera - Robot

Top view and side view strategies

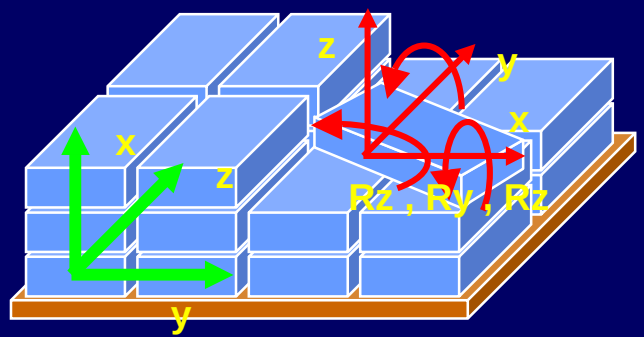
Zoom in strategies

Search window strategies

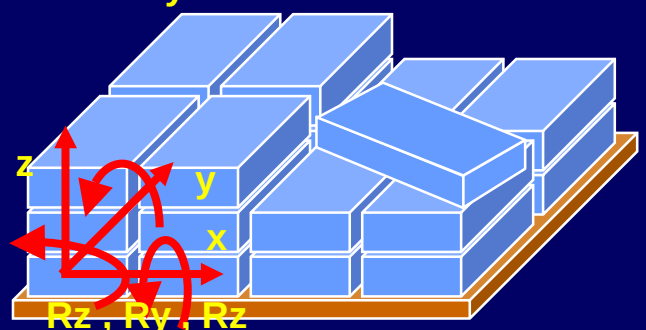
Strategies



multiple view 2 D / 2 ½ D



combined 2 ½ D / 3 D



direct 3 D

Robot Vision for Depalletizing of Mixed Pallet Loads

Applications - Examples

Loading and Unloading of Suitcases

Application Examples

Plain boxes

Palletizing from belt

Depalletizing from multiple pallets

Commissioning of Consumer Goods

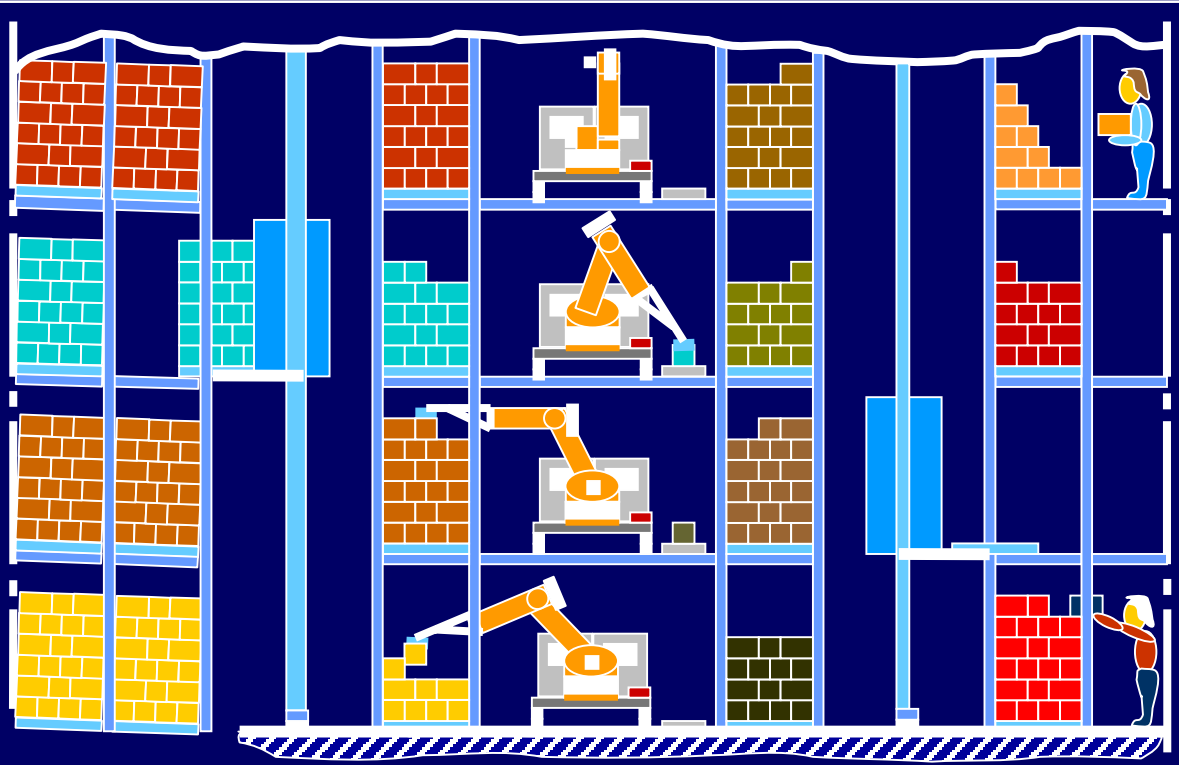
trays

bags

boxes

Commissioning of Technical Goods

Vision for Logistics : Example Automation for Distribution Center (DC)



Highly complex with respect to different goods and packages

Robot Vision for Depalletizing of Mixed Pallet Loads

End of Presentation