Design of SmartGate Technologies for Enhanced Material Handling

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State of the art in cargo handling

- Continuous growth of transported packaged goods
- In Europe, 64% of goods are suitable for automatic cargo handling due to their size, shape and weight *
- Goods can be separated in cubical-, cylindrical-, and sack-shaped
- Manual loading/unloading of containers is still the most popular solution in logistics

Full automatic material handling processes

- Robotic system requires material handling information in order to improve the cognition capabilities:
  - size
  - weight
  - hardness
  - position
  - orientation
  - condition

- Computing of ideal gripping positions is very tricky, for

- Ubiquitous material handling information should contain gripping positions defined by sender
The use of ubiquitous material handling information will improve cargo shipment
Enhanced load and itinerary planning for distribution
Information gathering by SmartGate technologies

![Diagram of SmartGate technologies]

- Radio Device
- Optic Device
- Haptic Device
- Handling Device
- Processing Unit
- Transport Device
- Weighing Device
# Material properties and metrology

## Knowledge about object

### Substance-related properties
- Texture
- Stiffness
- Temperature
- Weight

### Structure-related properties
- Condition
- Volume
- Global shape
- Exact shape

### Functional properties
- Part motion
- Gripping position

### Object identification
- Identification technology

## Exploratory procedure

- Haptic / Optical device
- Haptic device
- Weighing device
- Haptic / Optical device
- Optical device
- Haptic device
- Haptic device
- Haptic / Optical device
- RFID / Optical device
Material handling by Celluveyor
Volume measurement by 3D sensors

- 3D-Sensors deliver relative distances from sensor to objects
- Several measurement principles
  - Time-of-Flight
  - Structured Light
  - Stereo Vision
- Object recognition for image stitching and complete model creation

[SICK LMS 500]  [PMD CamCube 3.0]  [Microsoft Kinect]
Tactile measurement by BioTac

- Fingernail (to hold Skin in place)
- Elastomeric Skin
- Thermistor
- Incompressible Conductive Fluid
- Impedance Sensing Electrodes
- Rigid Core
- Hydro-Acoustic Pressure Sensor (Hydrophone)
Summary and Outlook

- Continuous growth of transported packaged goods
- Ubiquitous material handling information can help to realize automation of logistic process
- Different SmartGate technologies exist in order to gather properties of transport materials and their handling options

Challenges in the future

- Development of integrated demonstrator with application of all SmartGate technologies
- Development of methods for deriving handling information from the measured material properties
- Combination of SmartGate technology and parcel robot in order to realize full automation potential
Thank you
for your attention