Perception made easy in industrial applications

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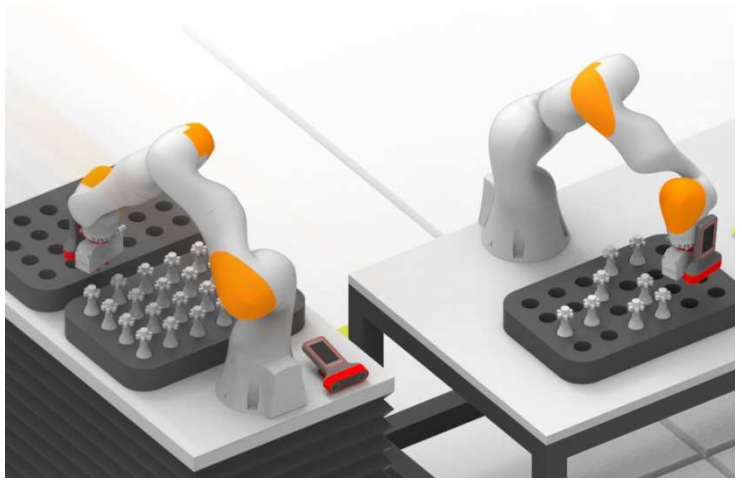
Perception Challenges in Times of Deep Learning and Cognition

ERF 2017

Market demands precise, low-cost robots

3D Vision reduces robot costs

- Many applications require high precision
- High **absolute** accuracy is limited and leads to high robot cost
- Manipulation and grasping require precision **relative** to the work piece
- Robot base and object location remain flexible (no classical teach-in possible or necessary)



„New paradigm change in programming robots, suitable for learning?“

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Requirements

User Perspective

- Easy set-up
- Simple configuration, limited set of parameters
- Flexibility in the solution
- Reliability
- High cycle time
- Partial automation (still humans on the production line)

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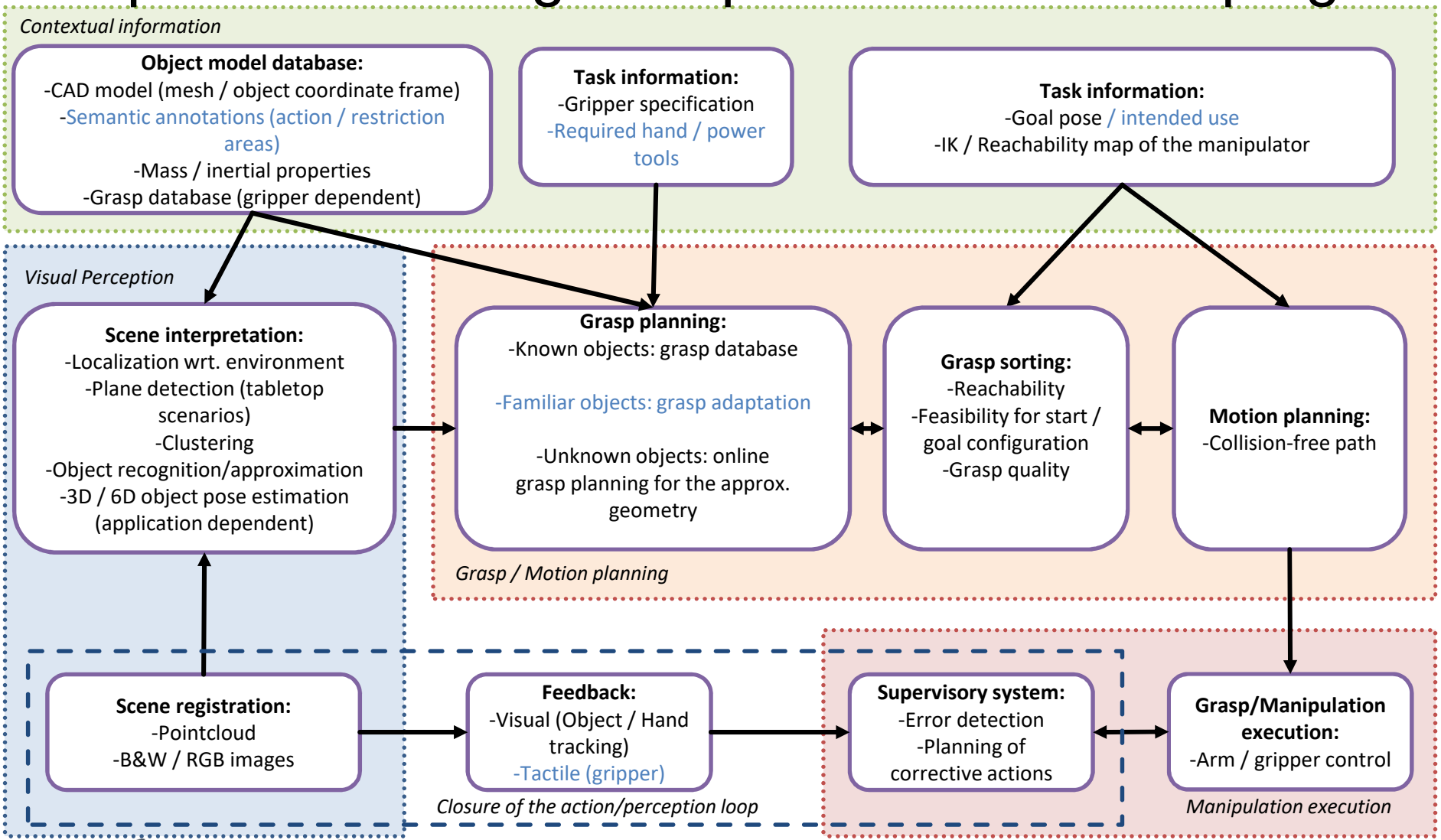
Constraints

Process and production perspective

- Training data is limited
- Realistic simulation data is difficult to get (Example: Digital Factory)
- On-site setup time is crucial and valuable
- Physical constraints and integration in larger processes must be considered
- Expert knowledge on process is available
- Self-contained modules to reduce complexity

Pipeline Including Manipulation and Grasping



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Key issues

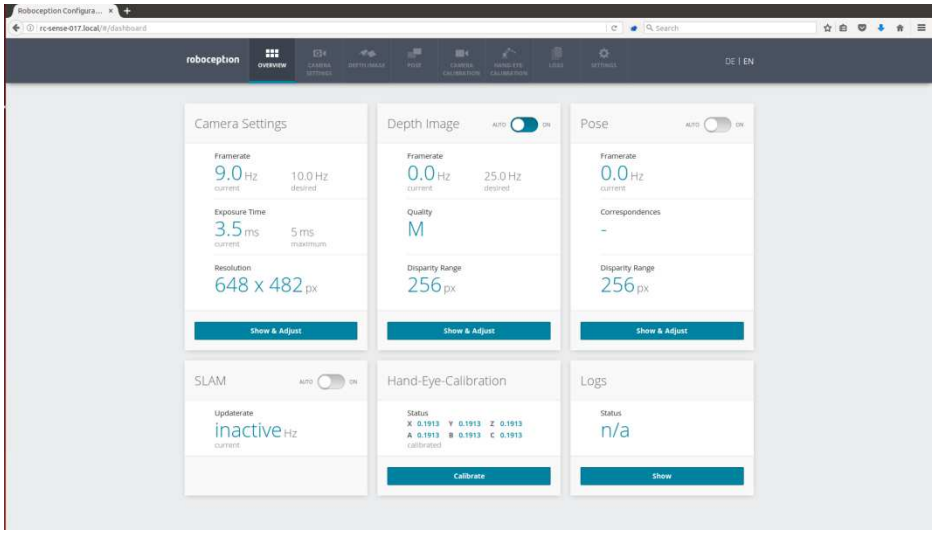
Perception Solution

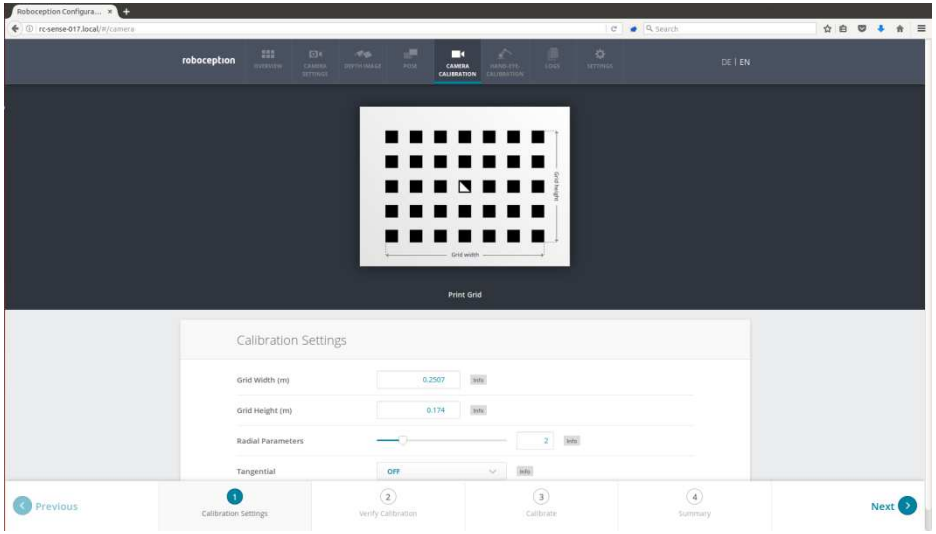
- Calibration of the system
- Configuration of the system
- Definition of the Vision Pipeline to Action
- Testing concept
- Error supervision and error correction
- Reliability and robustness

Intuitive Configuration & Calibration

Web Interface

- Configuration
  - Gain & Exposure
  - Visual Control
- Calibration
  - Intrisic and stereo calibration (factory setting)
  - Self-calibration during operation (automatic)
  - Hand-eye calibration by using wizards





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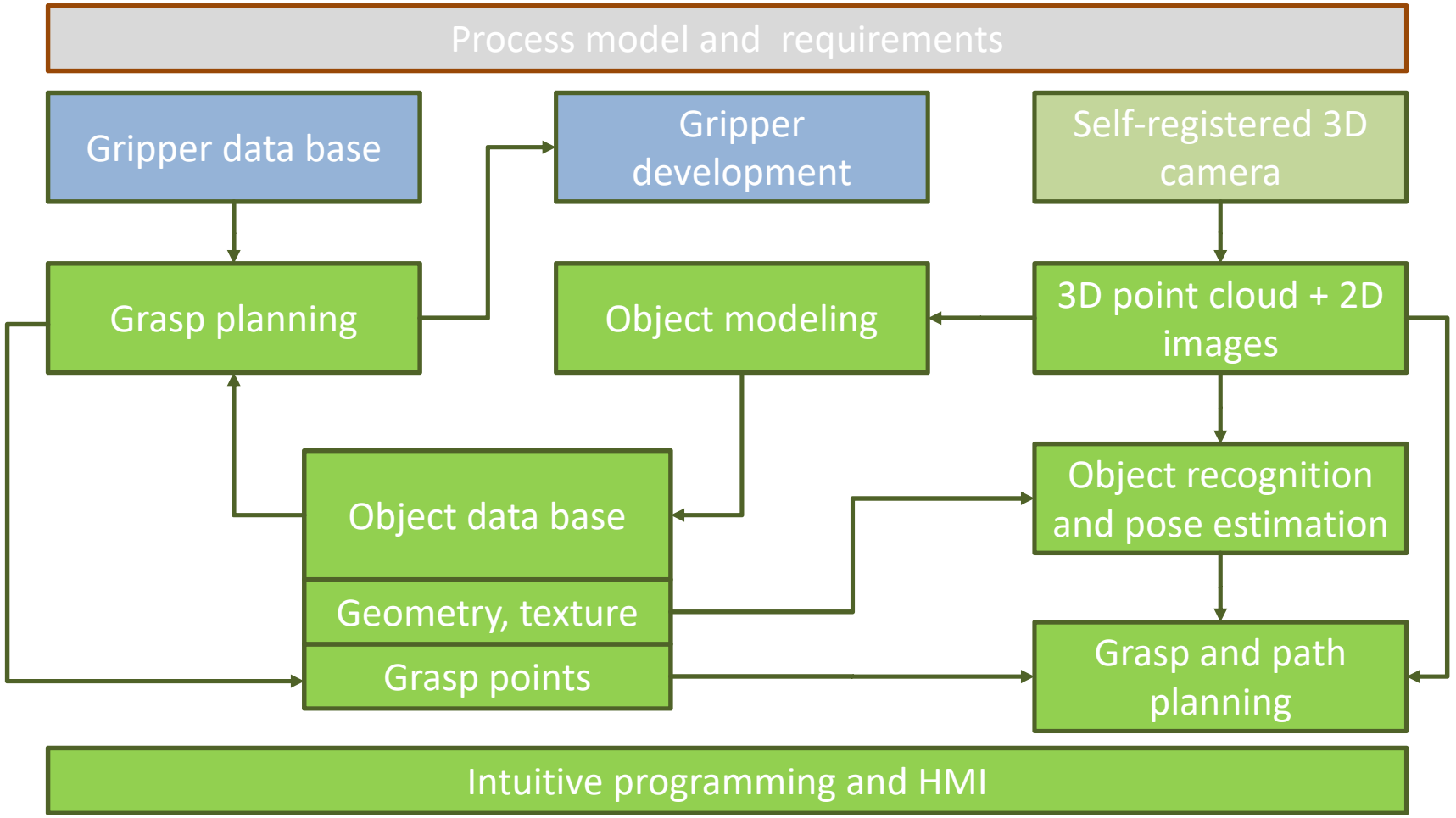
Application Software



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Deep Learning vs. Model-Based Perception

Interleave Deep Learning and model-based Perception

- Model-based Perception
  - Calibration, kinematics, small data labelling /segmentation
  - Industrial Gripping uses mostly suction or 2-finger grippers
  - Perception-Action Loops
  - Process model in well known e.g. welding

- Deep learning for transferring informal knowledge
  - Process modell is not known or informally available (expert knowledge)
  - Segmentation/labelling of large data sets
  - Supervisory systems

- Modularization allows for testing and certification

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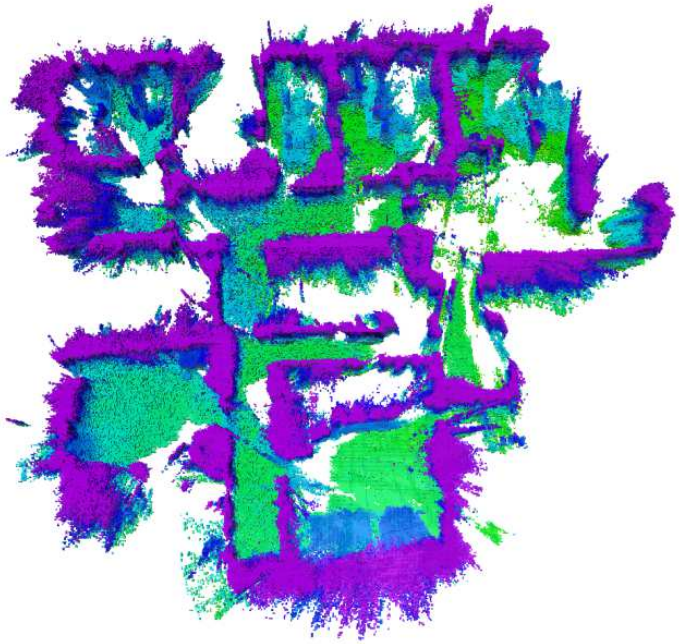
Products

Sensors and Software

- 3D Sensor:
  - COTS components
    - NVIDIA Tegra K1
    - Low-cost IMU
    - 1,2 MPix Cameras
  - Stereo baseline:
    - 160mm / 65mm
  - Measurement range:
    - 0,5m until 3m / 0,2m until 1m
  - **Launched on April 24th, 2017**

- Software
  - Perception and Manipulation Library
  - Robot Application Store



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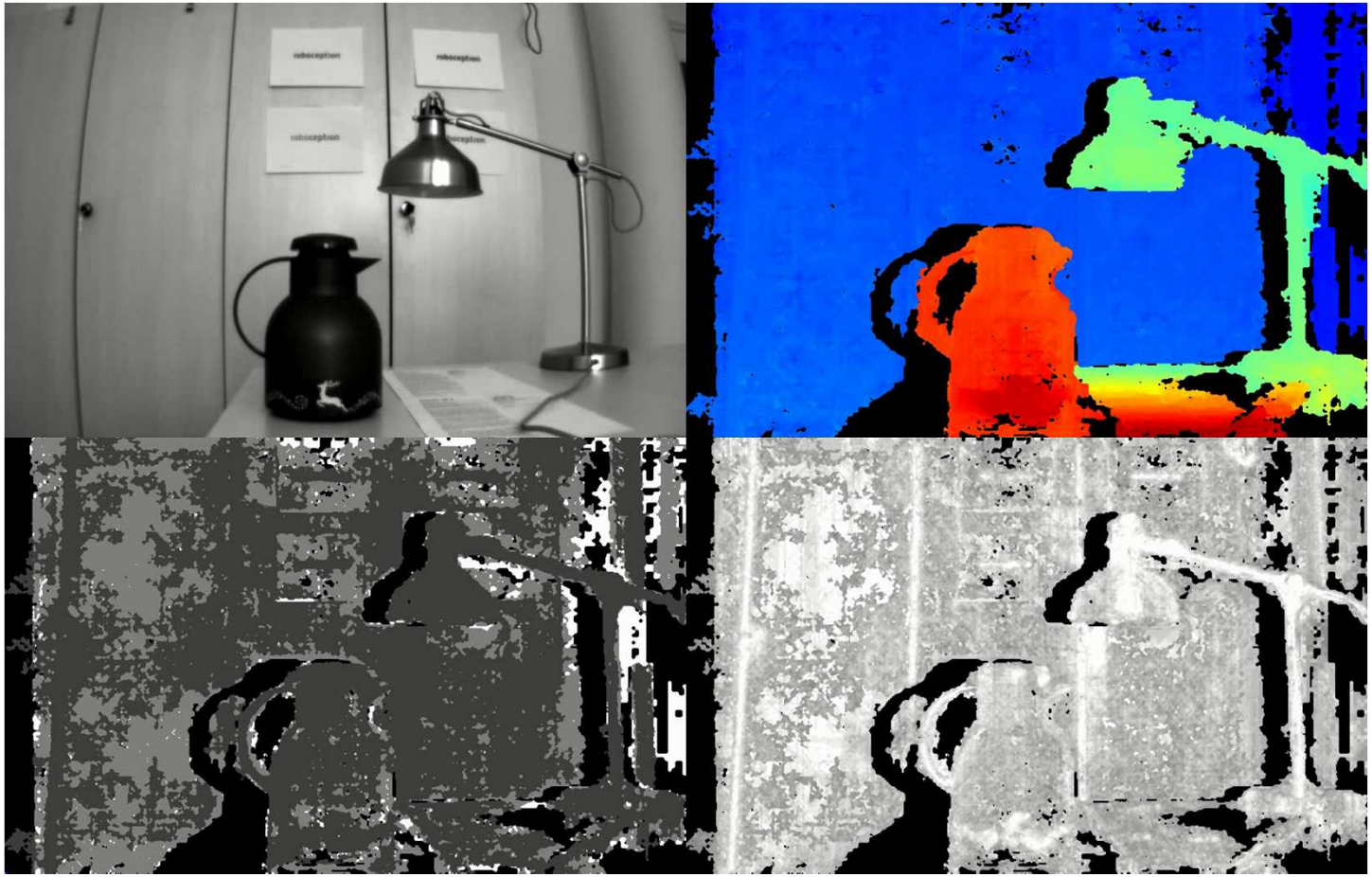
Data

Image, Disparity, Geometric Error and Confidence



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Product Announcement!

Visit us on: www.roboception.de
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