KI-Waste - Combining Image Recognition and Time Series Analysis in Refuse Sorting

H. Gursch - hgursch@know-center.at

H. Ganster, A. Rinnhofer, G. Waltner, Ch. Payer, Ch. Oberwinkler, R. Meisenbichler, R. Kern

Mensch & Computer 2021 - MCI-WS04: Smart Collaboration – Employee-Centric Information Systems in Product Creation

Agenda

- KI-Waste Project objectives
- Image Capturing
- Image Classification
- Data Analysis and Services
- Outlook

KI-Waste - Objectives

- Current Situation
  - Waste compositions changes seasonally
  - Refuse sorting facilities currently not adapting to these changes
  - Separation quality differs for fractions
- Vision
  - Monitor refuse composition in sorting facilities
  - Increase sorting performance and therefore also recycling rate

KI-Waste - Method

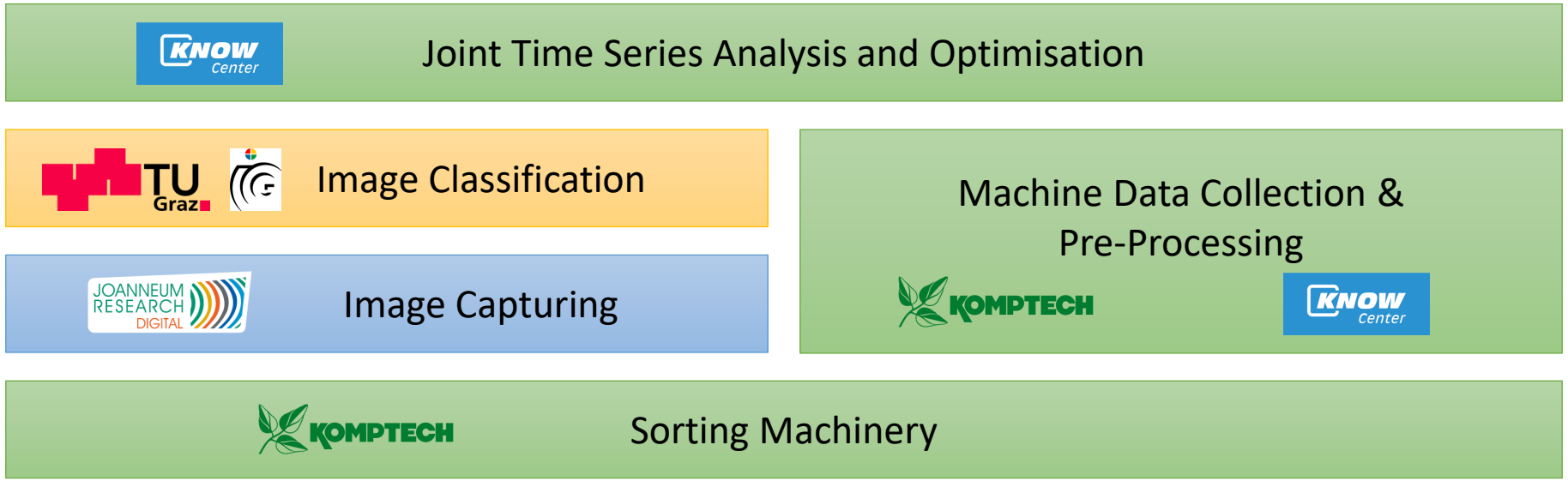
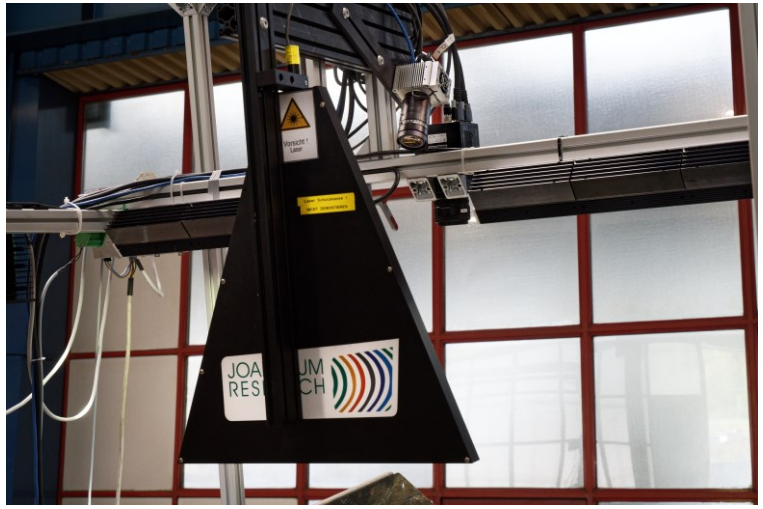


Image Capturing

- Line Camera
  - Near-infrared + RGB spectrum
  - 2048 pixels per line
- Laser Scanner
  - Height Information
  - Capturing 3D envelope
- LED lighting
- Extraneous light blocking



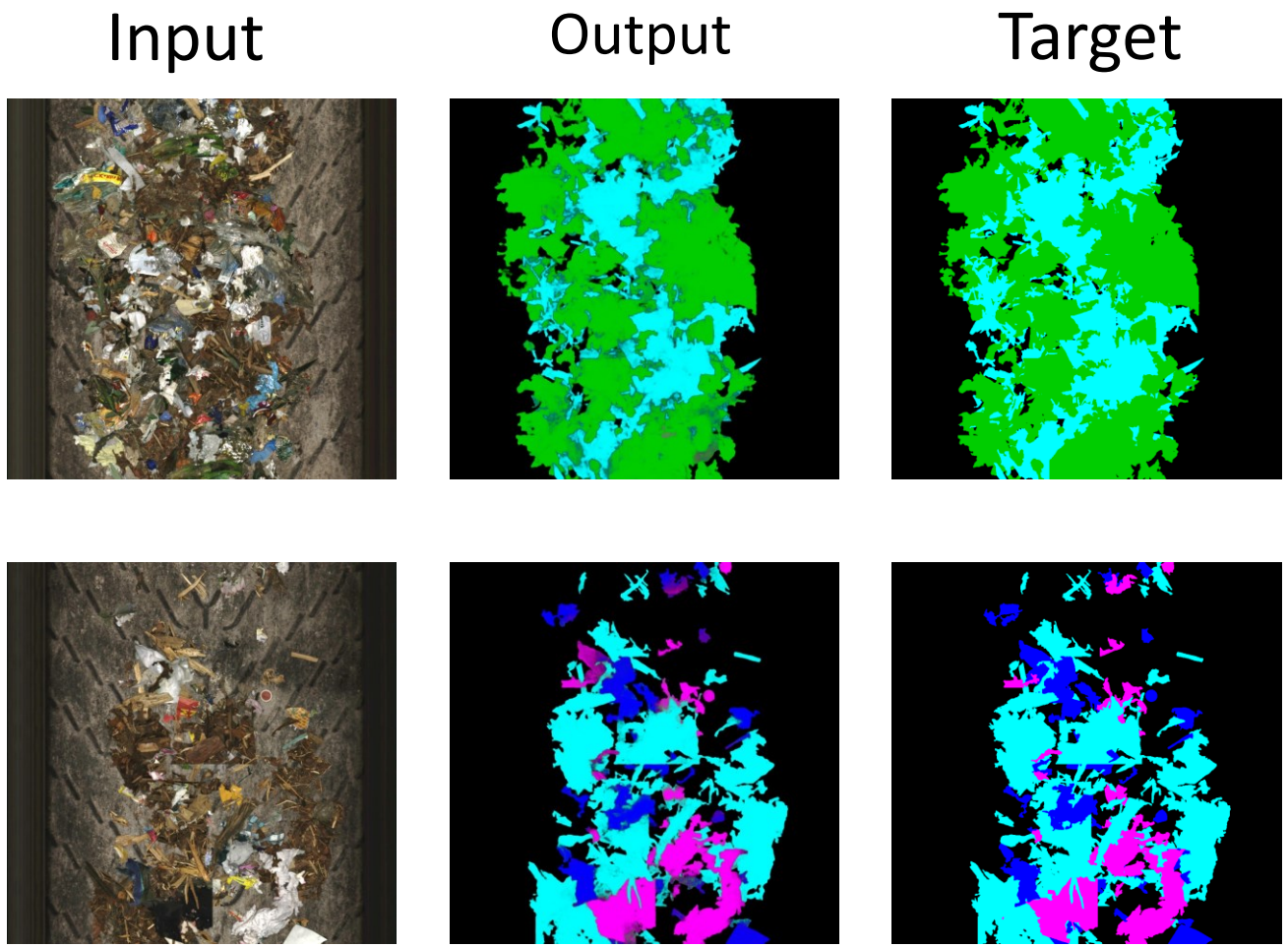
Shredder - Terminator 5000

Examples

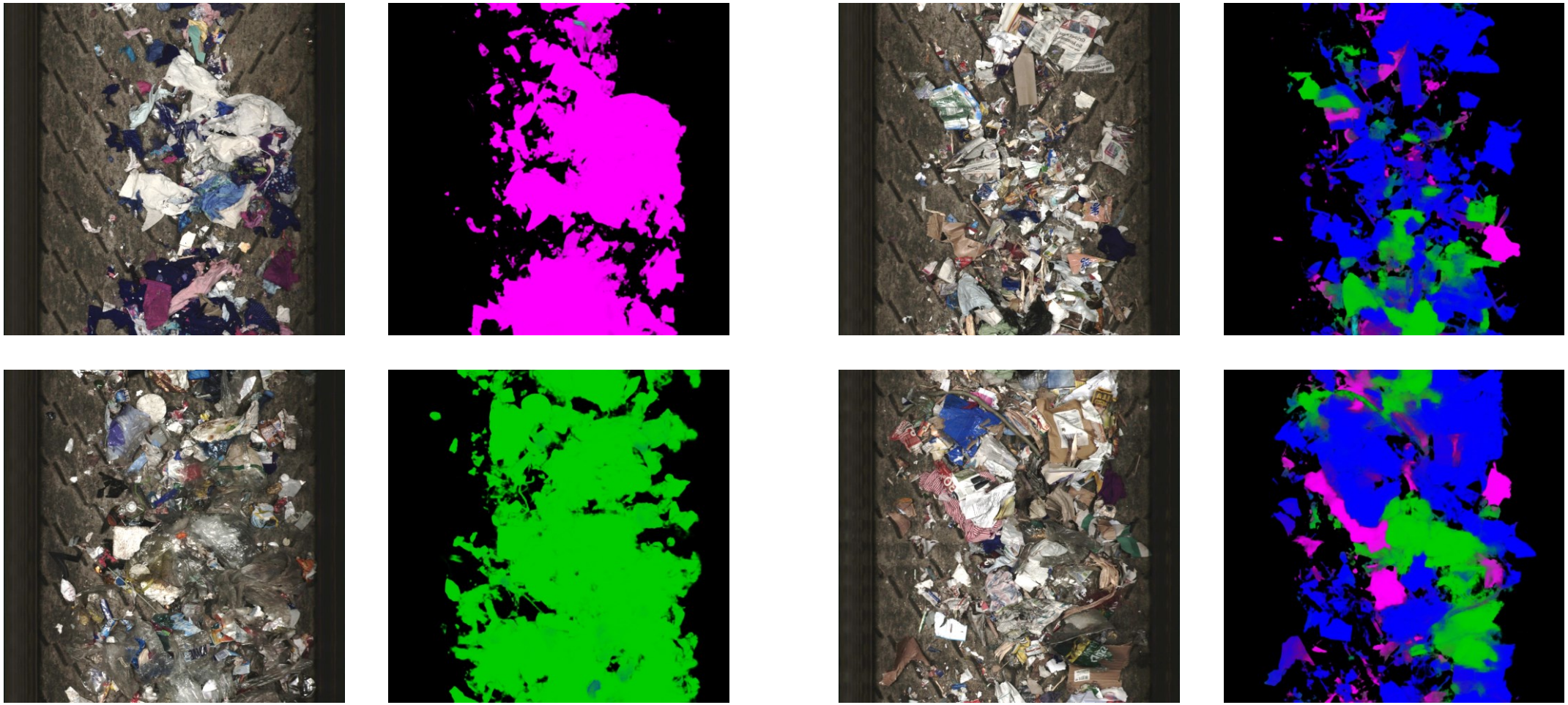
Image Classification

- Pixel-wise semantic segregation
  - Refuse categories (paper/cardboard, plastic, textile, wood + background)
  - Height
- Fully-convolutional Neuronal Networks (DeepLabv3+)
- Mono-material images for training
  - Synthetic mixed images created from mono-material images
- Evaluation with manually labelled mixed images
  - Manual labelling supported by initial segmentation

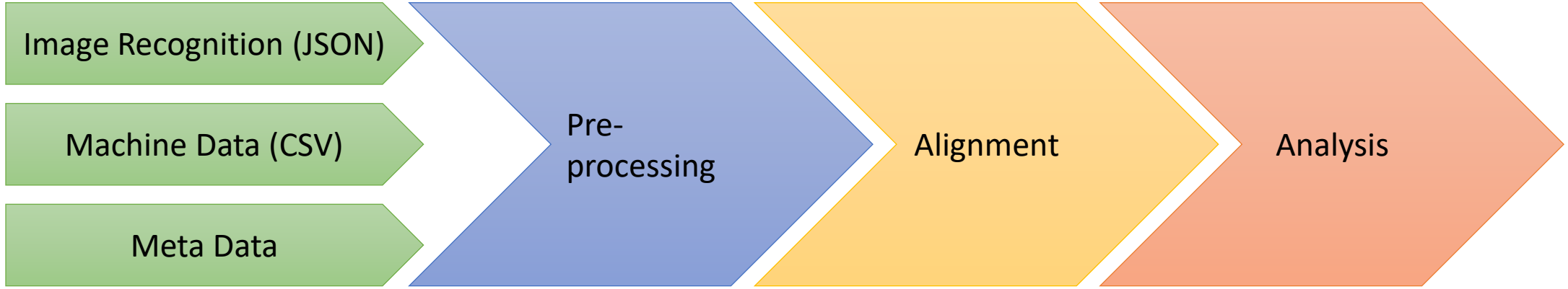
Synthetic Training Examples



Classification Results



Data Analysis Pipeline



Data Analysis Objectives

- Statistical Analysis
  - Key Performance Indicators
- Online Monitoring
- Coherences detection
  - Refuse composition
  - Machine setting
  - Sorting quality
- Optimisation & Adaptation

Operator Perspectives

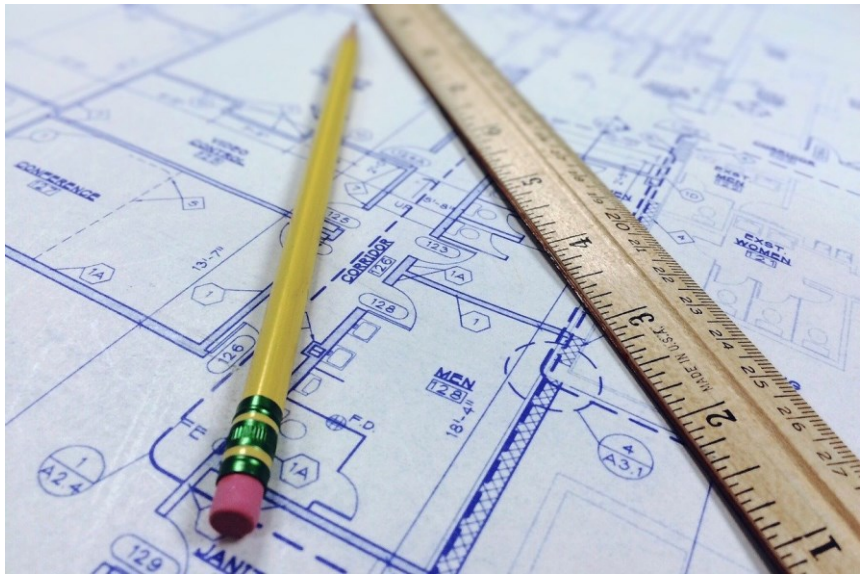
- Reduce exposure
  - Dust
  - Bacteria
  - Fungal spores
  - Noise
- Forecasting & Extrapolation
- Objective quality judgements

Data-Driven Services

- Monitoring
  - Dashboards & online monitoring
  - Check of input material quality
  - Prove of output material quality
- Coherences & models
  - Influences of parameters and input composition
- Critical trends
  - Alarms
- Operation suggestions
  - Adaptations

Summary and Outlook

- Building blocks
  - Image capturing
  - Image classification
  - Data analysis
- Applications
  - Support systems
    - Dashboards
    - Predictive warnings
    - Seasonality and drift
  - Predictive maintenance
  - Sorting quality description



KI-Waste - Combining Image Recognition and Time Series Analysis in Refuse Sorting

H. Gursch - hgursch@know-center.at

H. Ganster, A. Rinnhofer, G. Waltner, Ch. Payer, Ch. Oberwinkler, R. Meisenbichler, R. Kern

Mensch & Computer 2021 - MCI-WS04: Smart Collaboration – Employee-Centric Information Systems in Product Creation