

## Industrial Tubes Classification Using Machine Learning Techniques

In the context of Industry 4.0 and joint co-operation with PFW Aerospace, the automatic recognition of industrial tubes and anomaly detection are required. Depending on the end application, these industrial tubes are manufactured in different geometrical shapes and forms. Typically, these tubes are irregular in shapes and are three-dimensional. These tubes can measure up to 3m long and have cross-section diameter of up to 10 cm. Mostly they have smoother outer surfaces and are monochromatic except at the edges. Many of the industrial tubes are mirrored along one of the axes. For the former case of automatic recognition, machine learning techniques can be applied. For the latter case of anomaly detection, statistical shape modelling is necessary.

In this framework, several thesis topics are offered with the following subtasks.

- Explore various shape measures such as Euclidean distance, inner distance, etc
- Generate shape descriptors based on Fourier series and wavelet analysis
- Shape space approaches on planar curves and surfaces such as Square Root Velocity Function etc
- Modelling of industrial tubes
  - a. Active shape models and morphable models
  - b. Gaussian process morphable models
- Extending the data acquisition system
  - a. Incorporate either an additional 2D camera or a LiDAR scanner along with the existing 2D camera

At the beginning of the thesis, students are expected to undergo a detailed literature review of the subject. A setup is available to capture the 2D images of industrial tubes.

### Requirements:

Students with a background in computer science, mathematics, electrical engineering, or other engineering majors. Pre-knowledge in machine learning, image processing, and statistics is welcome. Strong self-motivation, reliability, and critical mind are expected.

### Emphasis:

Theoretical Study	
Software Implementation	
Hardware Implementation	

### We offer:

- excellent support and advice
- highend infrastructure
- contact to industry and research partners

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