

Title:	Internship proposal.
Document Revision:	1.0
Publication date:	03/02/2021
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3D object registration with deep learning.

1 Context

Euresys is a leading and innovative high-tech company, designer and provider of image and video acquisition components, frame grabbers, FPGA IP cores and image processing software. Euresys is active in the computer vision, machine vision, factory automation, medical imaging, and video surveillance markets.

This internship will take place in the Vision Software team under the supervision of an experienced software engineer.

Euresys is located at Liège Science Park.

3D object registration consists in finding the 3D pose of an object in a point cloud based on a 3D model (CAD file) or a reference scan (point cloud). This technique can be used in belt-picking (Figure 1) and bin-picking (Figure 2).

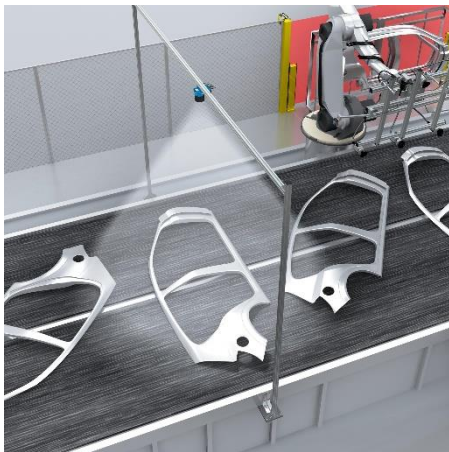


Figure 2 Belt-picking, source:
<https://www.engineerlive.com/content/new-robot-guidance-part-localisation>



Figure 1 Bin-picking, source:
https://www.photonics.com/Articles/Advancements_in_3D_Vision_Software_Bolster_Bin/a65477

Existing techniques are slow and not very robust. Deep learning methods could outperform them. A solution could be to train a neural network to predict the 3D pose of an object:

- From a CAD file, generate synthetic 2.5D image (ZMap) in a multitude of orientations.
- The input of the network would be a ZMap (Grayscale image) and the output would be the 3D pose.
- A possible network architecture could be similar to YOLO (an object detector) but instead of predicting offsets of a bounding box, it would predict offsets of a 3D pose.

- This network would only work with the specific objects it has been trained on (no generalization compared to object detection).

2 Objective

The intern that will join the Euresys Vision Software team will have to:

- Compare state-of-the-art algorithms for 3D object registration and similar problems.
- Choose/create the most suitable network architecture for the problem.
- Find/create a dataset and a metric for the problem (partially done already).
- Train the network and evaluate the experimental results obtained on the dataset.

3 Requirements

The intern should have knowledge of python, computer vision and deep learning. Experience with C++, pytorch, tensorflow, GPU programming and 3D data processing is a plus.

The internship will have a minimum duration of 10 weeks.