A Synthetic Data Generation Pipeline for Point-Cloud-Based Rebar Segmentation

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AIS Construction Lab
Autonomous Intelligent Sustainable

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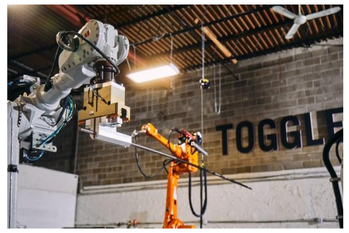
Motivation

Rebar recognition drives automation in reinforcement work

Quality Control



Robotic Manipulation

Segmenting rebars from **3D point clouds** vs. 2D images:

- Better leverages 3D priors (more robust to occlusions and perspective variations)
- Scales to large scenes (more efficient detection)

Deployment bottleneck: Scarce high-quality 3D dataset

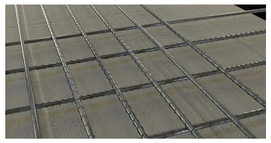
Can we learn rebar segmentation from point cloud using synthetic data?

Method

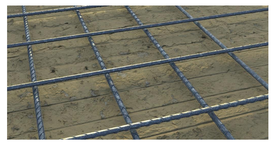
Step1. Parametric Scenario Generation

Rebar Models

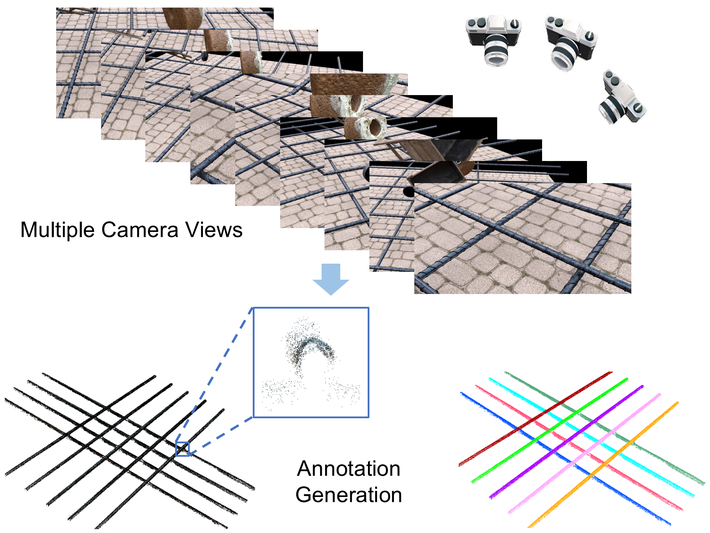
Rebar Placement



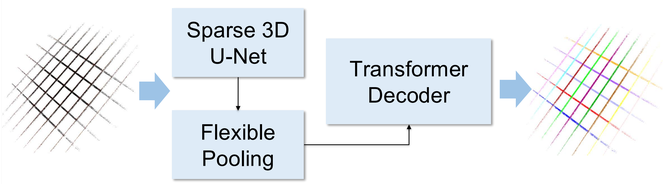
Lighting



Step 2. Point Cloud Reconstruction



Step 3. Model Training

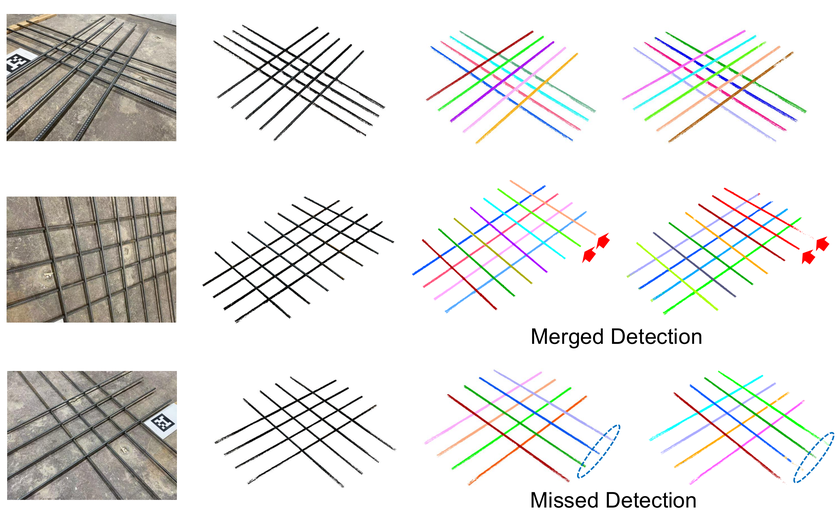


Oneformer3D

Highlights

- Parametric rebar asset modelling
- High-fidelity data generation
- Zero manual labeling expenses

Experiment & Results

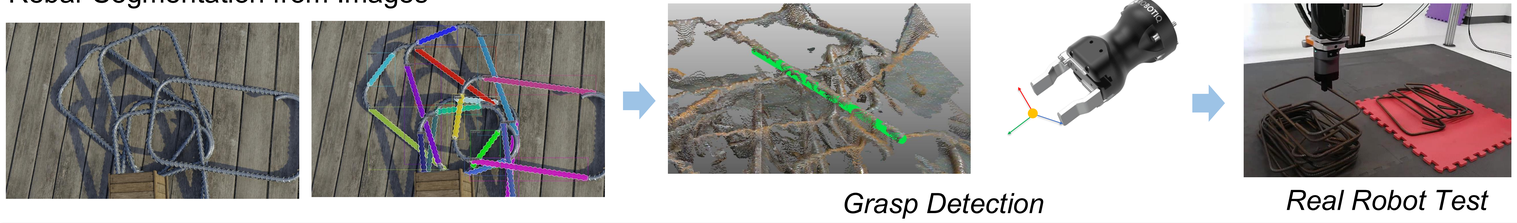


Domain	Segmentation mAP
Synthetic	99.4
Real	95.4

Extension

Our pipeline can be easily generalized to other rebar recognition tasks [1]

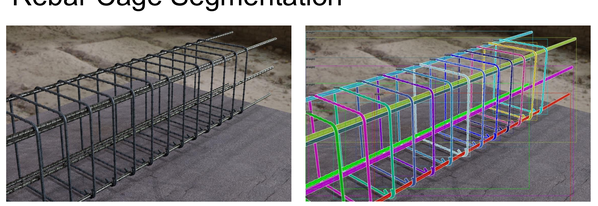
Rebar Segmentation from Images



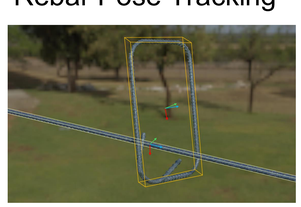
Grasp Detection

Real Robot Test

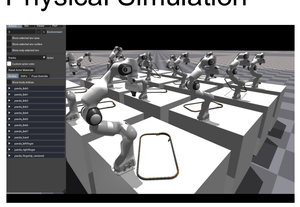
Rebar Cage Segmentation



Rebar Pose Tracking



Physical Simulation



[1] Sun, Tao, et al. "Rebar grasp detection using a synthetic model generator and domain randomization." *Automation in Construction* 176 (2025): 106252.

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