HOW TO SEE THROUGH THE OBJECTS ON THE OCCLUDED SCENE?

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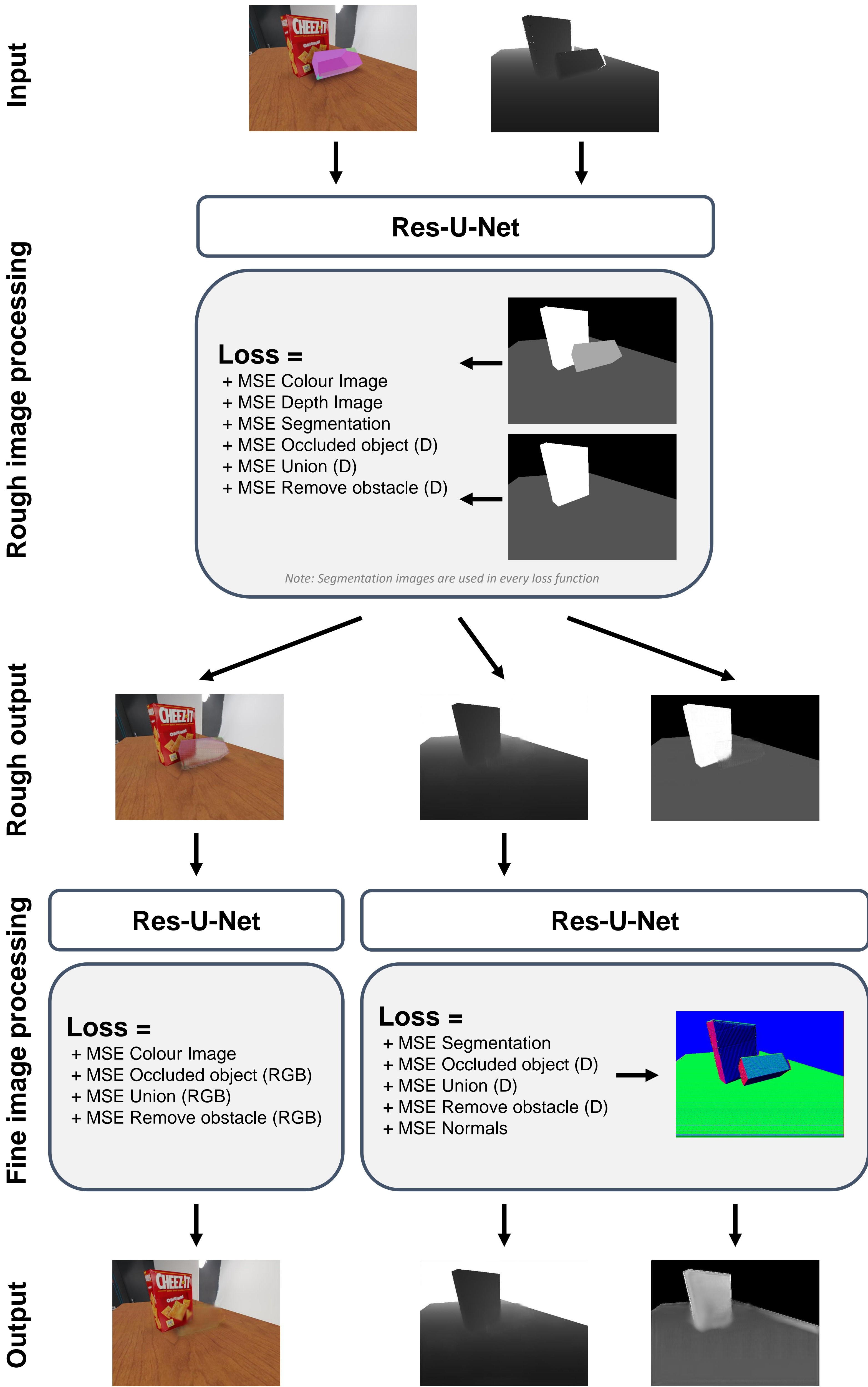Poznan University of Technology, Institute of Robotics and Machine Intelligence
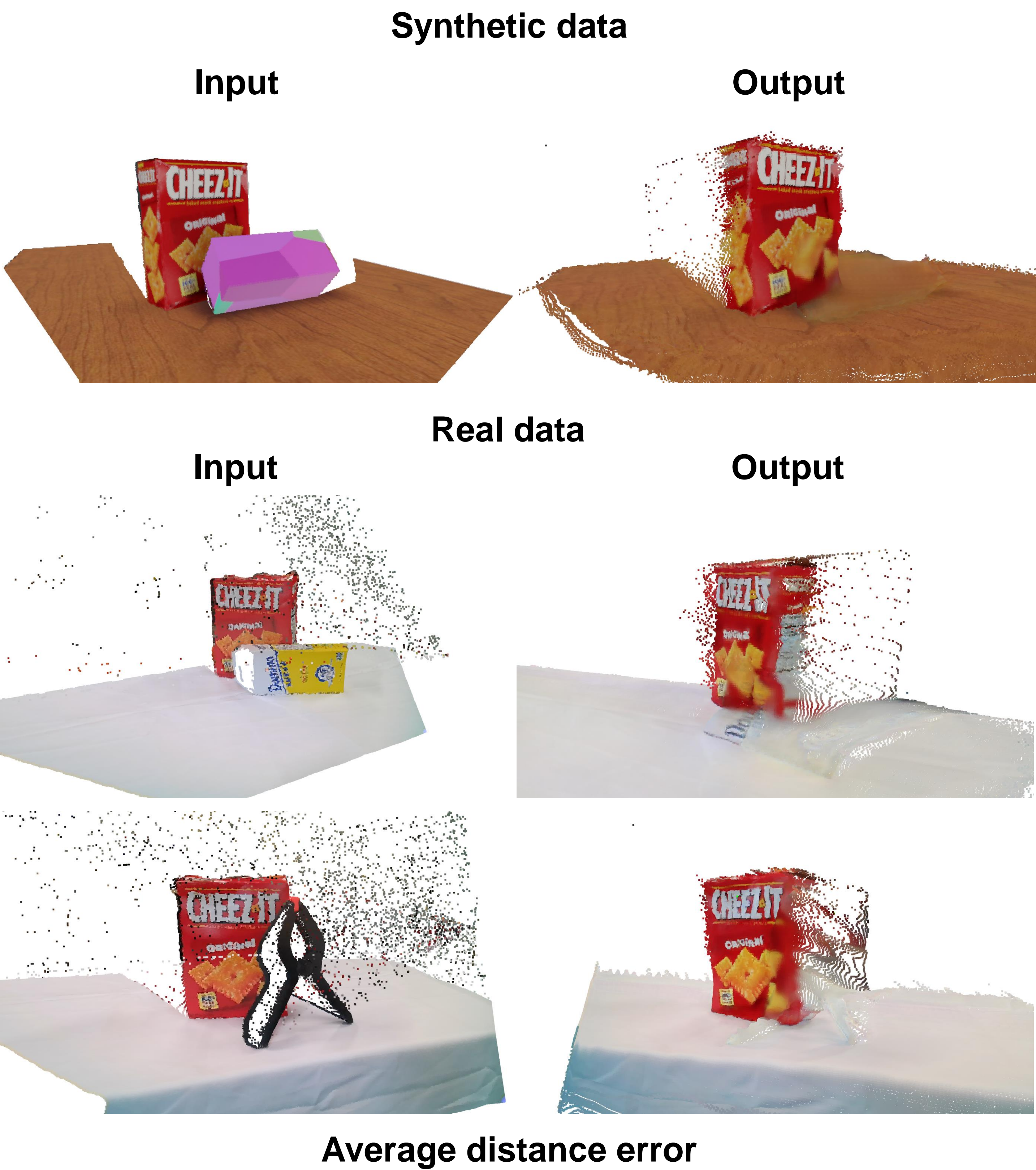
Objectives

Gathering 3D information about the scene from a robot RGB-D camera is limited due to occlusions. Also, during grasping and in-hand object manipulation, the robot loses useful information about the object's shape and pose because of occlusions caused by the robot's fingers. In contrast, humans can estimate the pose of occluded objects from a single view.

Methods

In this research, we designed a cascade of 2D CNNs that gradually reconstruct the 3D shape of occluded object in the scene. The goal of the neural network is to reconstruct the occluded part of the known object on the scene. We use the Blender software to generate a photorealistic synthetic training dataset. With the proposed cascade of neural networks the robot can see through the objects that occlude the desired object. The obtained output is used to reconstruct the 3D shape of the desired object despite occlusions.

Input

Rough image processing

Res-U-Net

Loss =
+ MSE Colour Image
+ MSE Depth Image
+ MSE Segmentation
+ MSE Occluded object (D)
+ MSE Union (D)
+ MSE Remove obstacle (D)

Note: Segmentation images are used in every loss function

Rough output

Fine image processing

Res-U-Net

Loss =
+ MSE Colour Image
+ MSE Occluded object (RGB)
+ MSE Union (RGB)
+ MSE Remove obstacle (RGB)

Res-U-Net

Loss =
+ MSE Segmentation
+ MSE Occluded object (D)
+ MSE Union (D)
+ MSE Remove obstacle (D)
+ MSE Normals

Output

Results

Synthetic data

| Input | Output |

Real data

| Input | Output |

Average distance error

	Dataset	Train		Valid		Test	
	Metric	Mean [mm]	SD	Mean [mm]	SD	Mean [mm]	SD
Reconstruction occluded object (red)	Rough processing	72.33	226.73	72.84	230.70	76.94	238.09
	Fine processing	6.39	12.80	6.43	12.74	6.52	12.91
Reconstruction removed obstacle (red)	Rough processing	575.94	540.29	562.81	535.66	569.78	538.13
	Fine processing	15.08	20.26	14.81	19.60	15.11	20.16

Acknowledgements

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