Local reflection symmetry in railway point cloud data

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- Present railway detection method
- Local reflection symmetry detection
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- Results

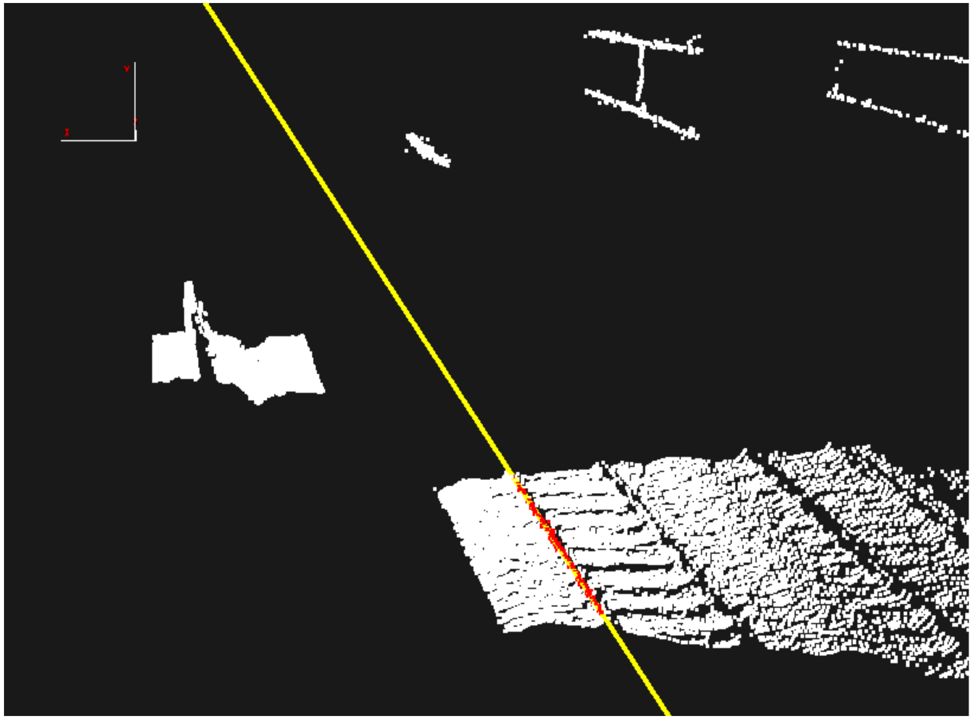
Motivation

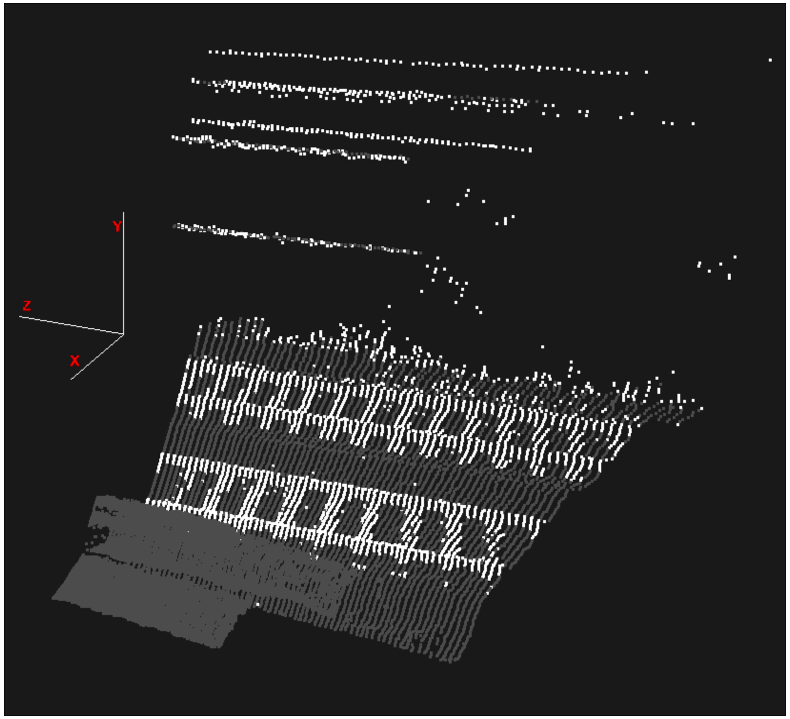
- Obstacle on railways
- Railway detection in the LiDAR point clouds

Present railway detection method

- Exclusion of points based on reflectivity given by LiDAR
- Searching points between 10 and 20 cm above the surrounding points (height of the rail around 17 cm)
- Clustering based on closeness
- PCA for searching the rail line
- Merging two parallel lines (1.45 m apart)

Present railway detection method

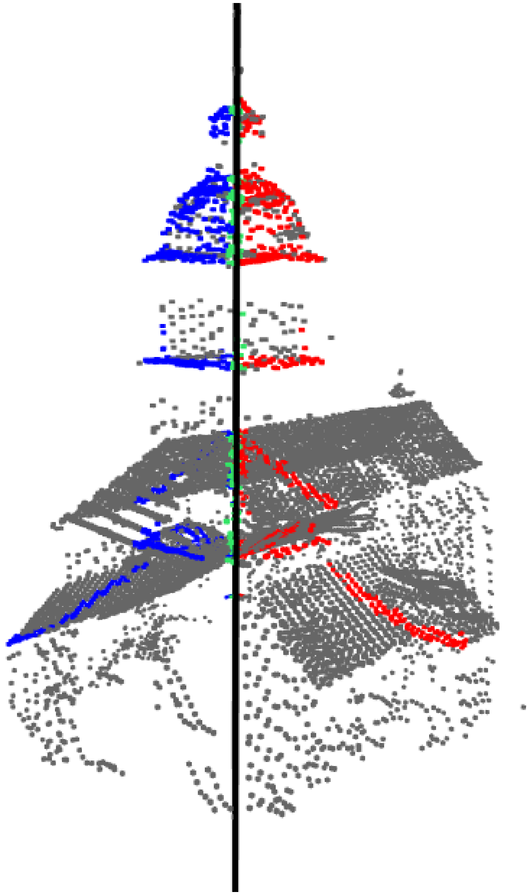


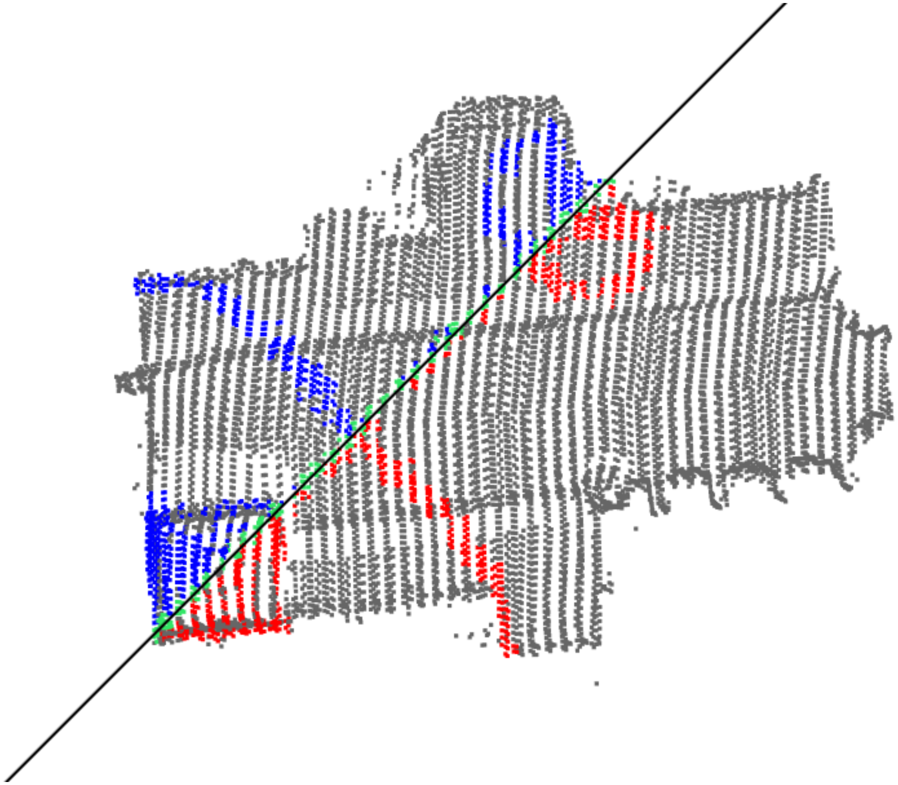


Present method issues

- Unreliable reflectivity parameter (rust)
- Relying solely on the height can lead to a false positive
- Symmetry as an additional feature can be beneficial

Local reflection symmetry detection (example)





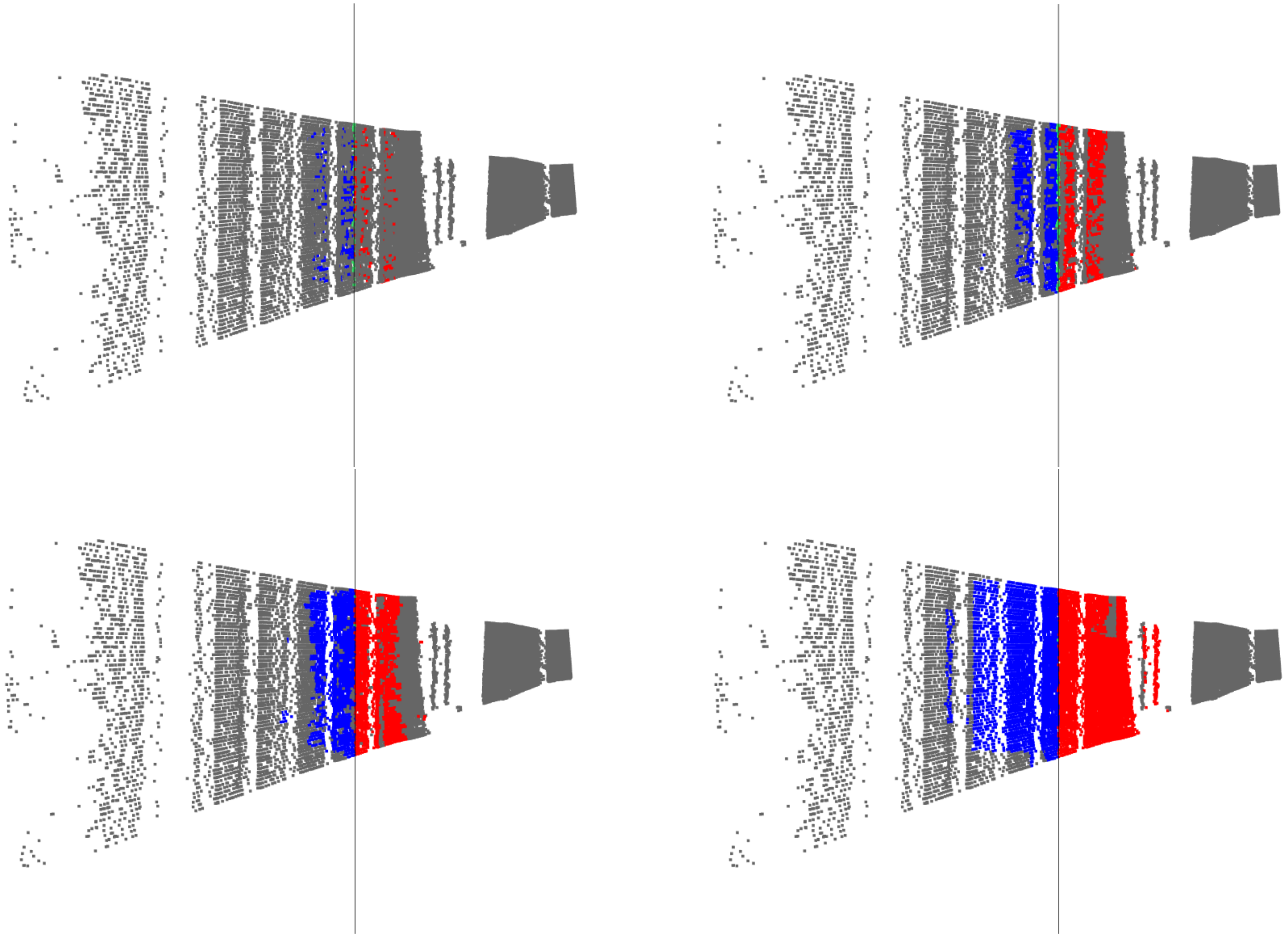
Local reflection symmetry detection

- Voxelization
- EO data → vertical symmetry planes expected
- Basic symmetries found in horizontal voxel slices and then merged

Results (test case 1)

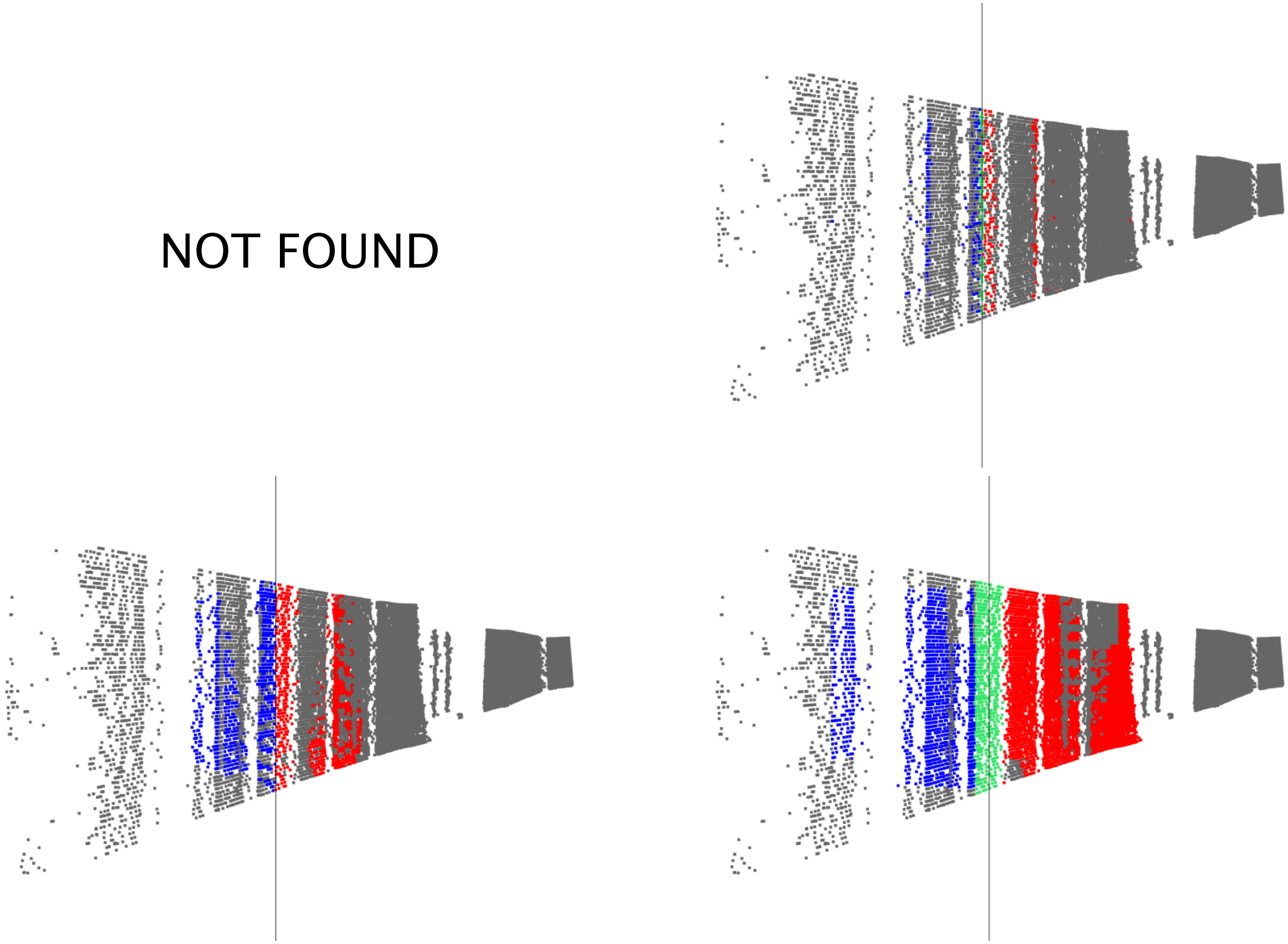
	Test case 1			
Number of points	24,389			
Voxel side [cm]	5	10	20	100
Voxels	15,101,352	1,892,400	239,400	2,160
Time of execution [s]	111.44	97.81	15.50	0.04
Number of symmetries	4,699	17,939	13,749	167
Index of best symmetry	137	1	11	49

Results (test case 1)



Railway track 1: a) 5 cm b) 10 cm c) 20 cm d) 1 m

Results (test case 1)

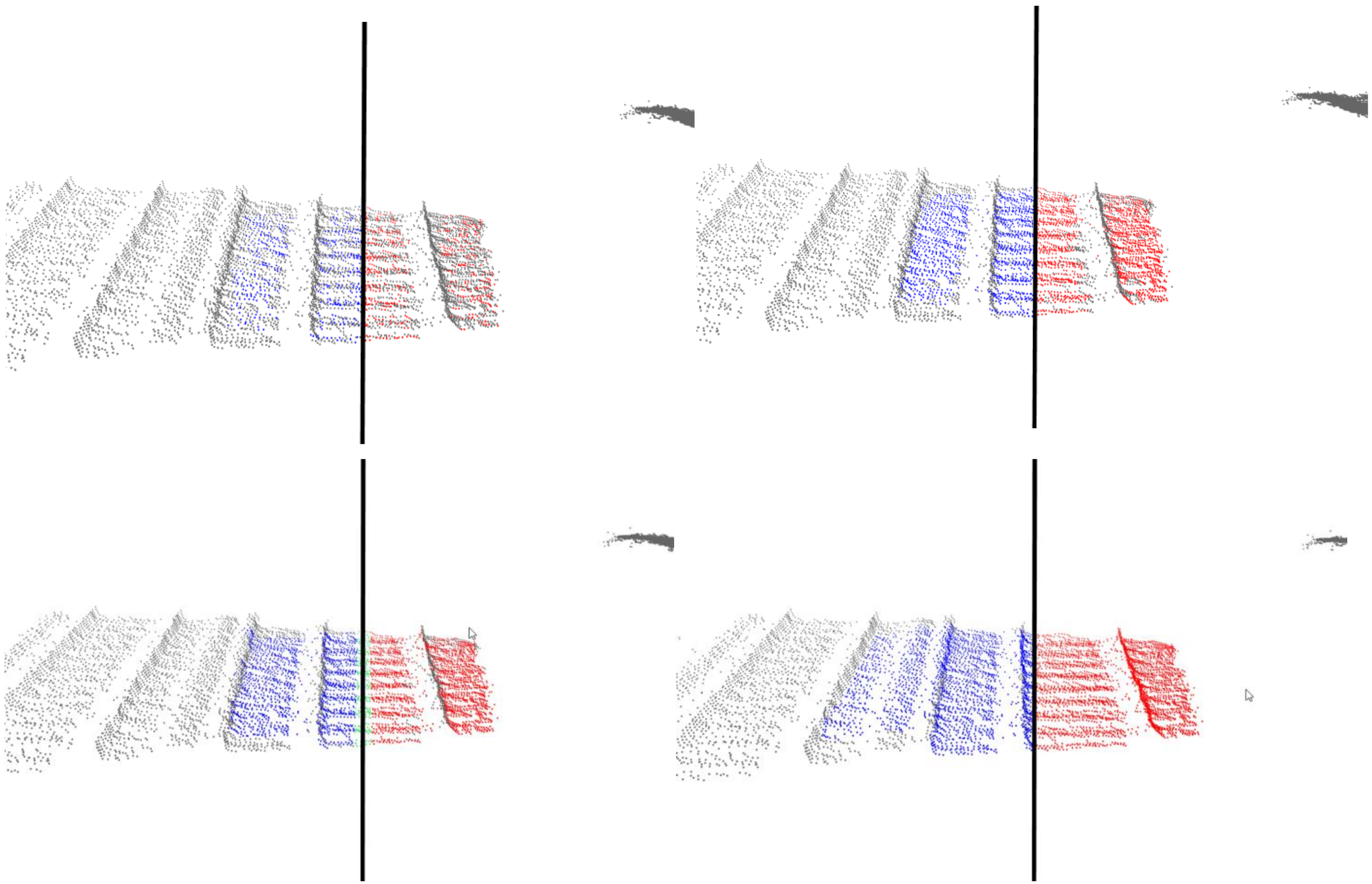


Railway track 2: a) 5 cm b) 10 cm c) 20 cm d) 1 m

Results

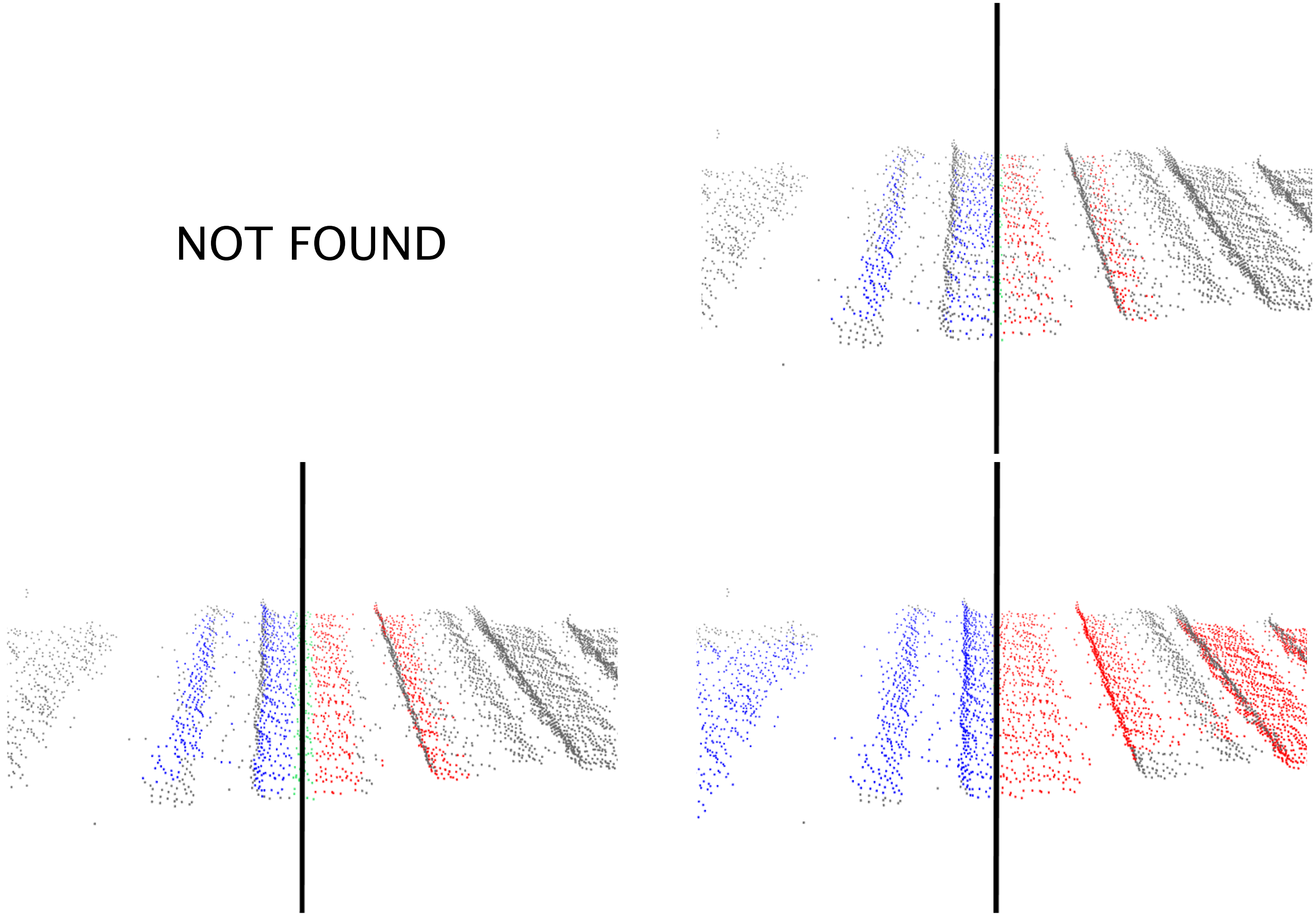
	Test case 2			
Number of points	26,563			
Voxel side [cm]	5	10	20	100
Voxels	22,545,600	2,830,400	353,800	1,600
Time of execution [s]	210.68	117.22	20.54	0.02
Number of symmetries	6,118	21,550	12,571	190
Index of best symmetry	100	1	24	42

Results (test case 2)



Railway track 1: a) 5 cm b) 10 cm c) 20 cm d) 1 m

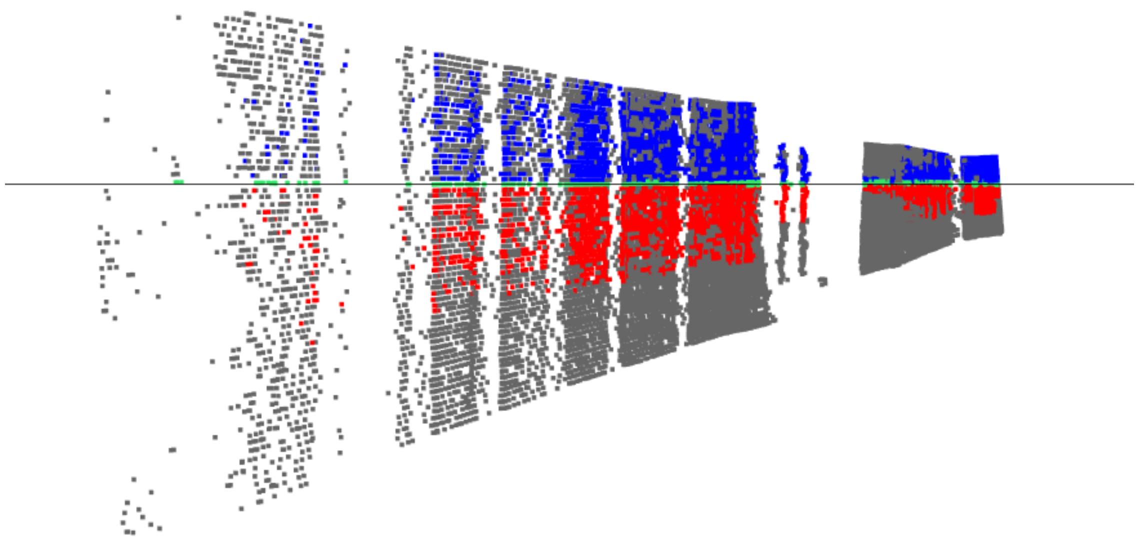
Results (test case 2)



Railway track 2: a) 5 cm b) 10 cm c) 20 cm d) 1 m

Conclusion

- Issues:
  - manual finding of railways
  - non-unique railway recognition
  - perspective view of LiDAR



Future work

- Incorporation of the algorithm into the existing railway detection method
- Automatic detection of railways
- Speed improvements