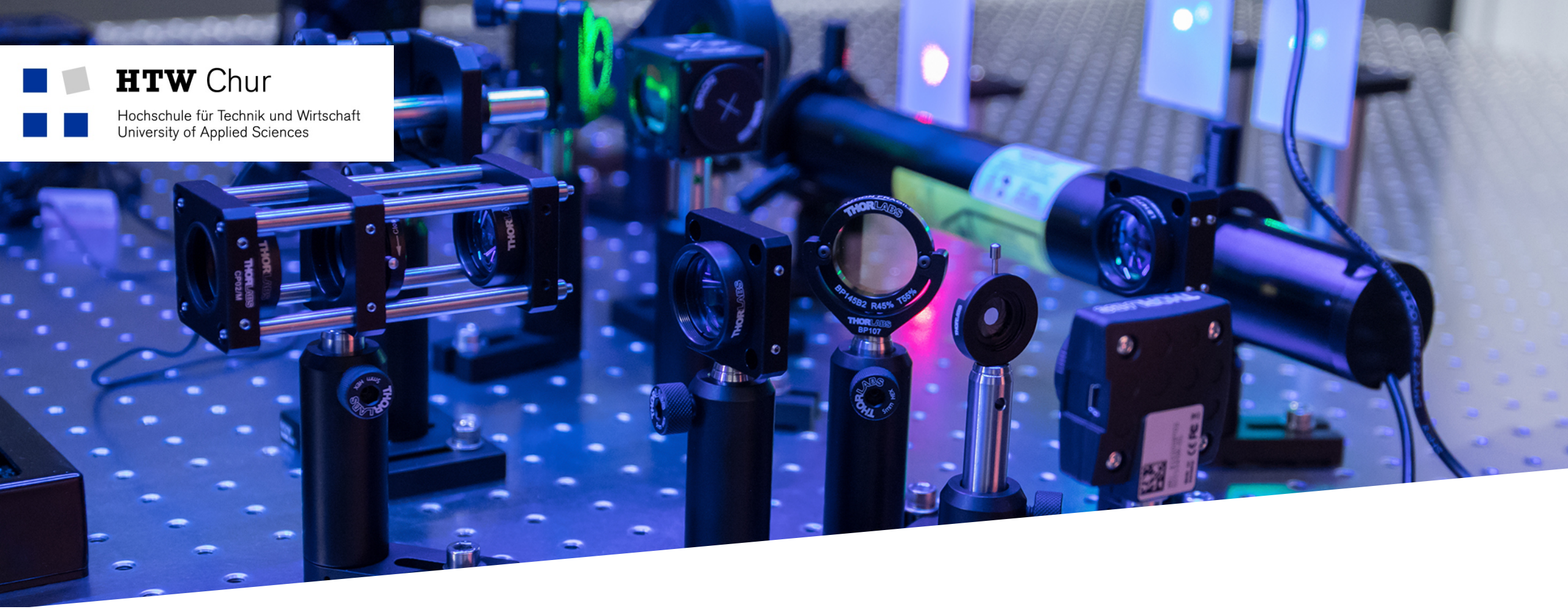

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3d Image Processing

An educational project with a 3d LiDAR scanner

21th of June 2018, Dr. Philipp Roebrock

3d-LiDAR-Sensor Sick MRS6124R

Sensor facts

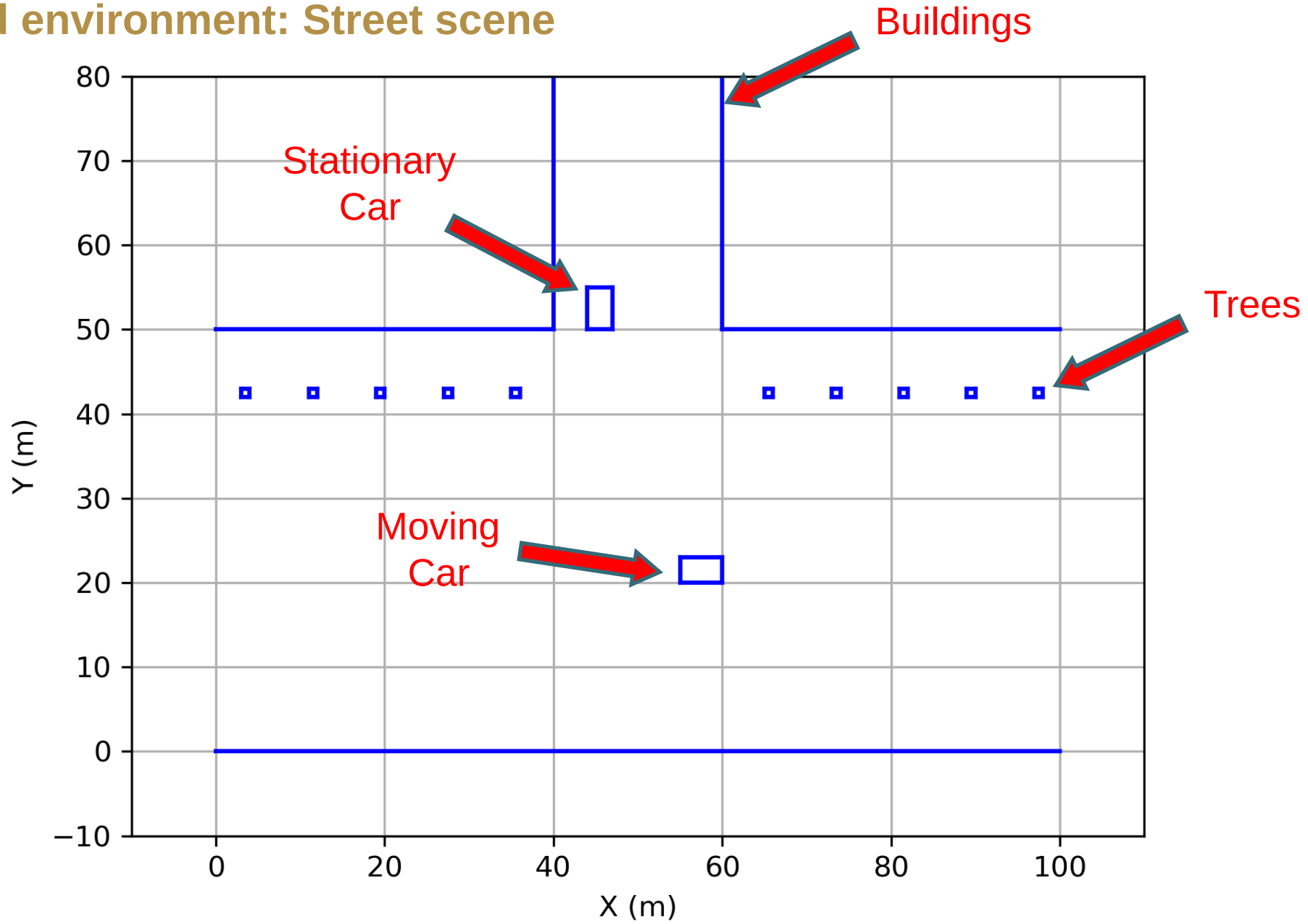
- LiDAR measurement principle
- Range 75m (@90% remission)
- Horizontal angle 120°, resolution 924 points
- Vertical angle 15°, resolution 24 layers
- Scan frequency 10Hz
- 22176 points per scan, 221760 points per second
- Systematic error ± 125 mm
- Statistical error ± 30mm
- Laser class 1, IP65, Weight 2,2kg
- Application: Autonomous Driving

Test scan: Man on stage

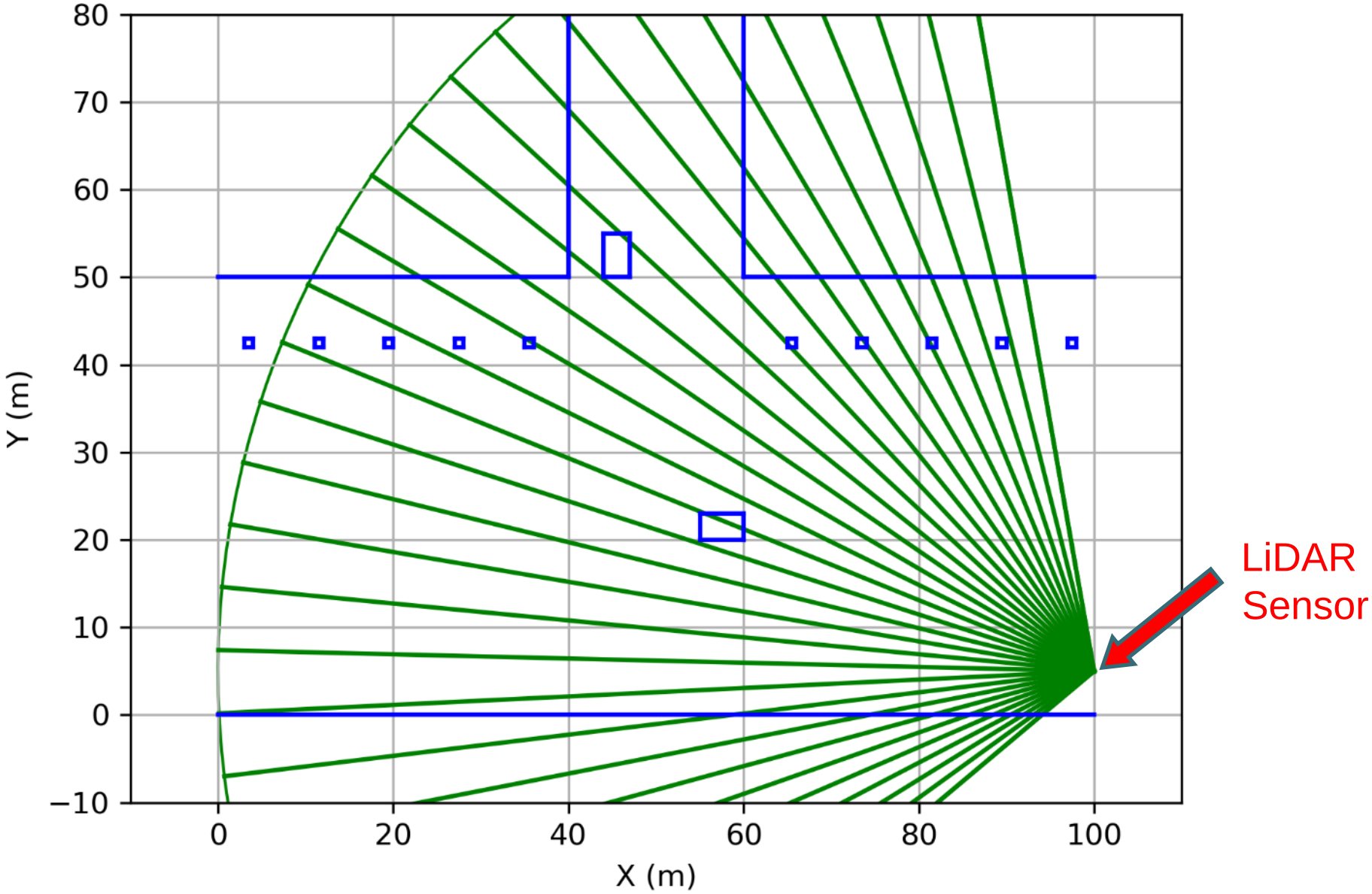
Project: Estimate car speed

- Keep the sensor stationary
- Scan a scene containing a moving car
- Estimate the speed of the car
- Test ideas previously with a 2d simulator

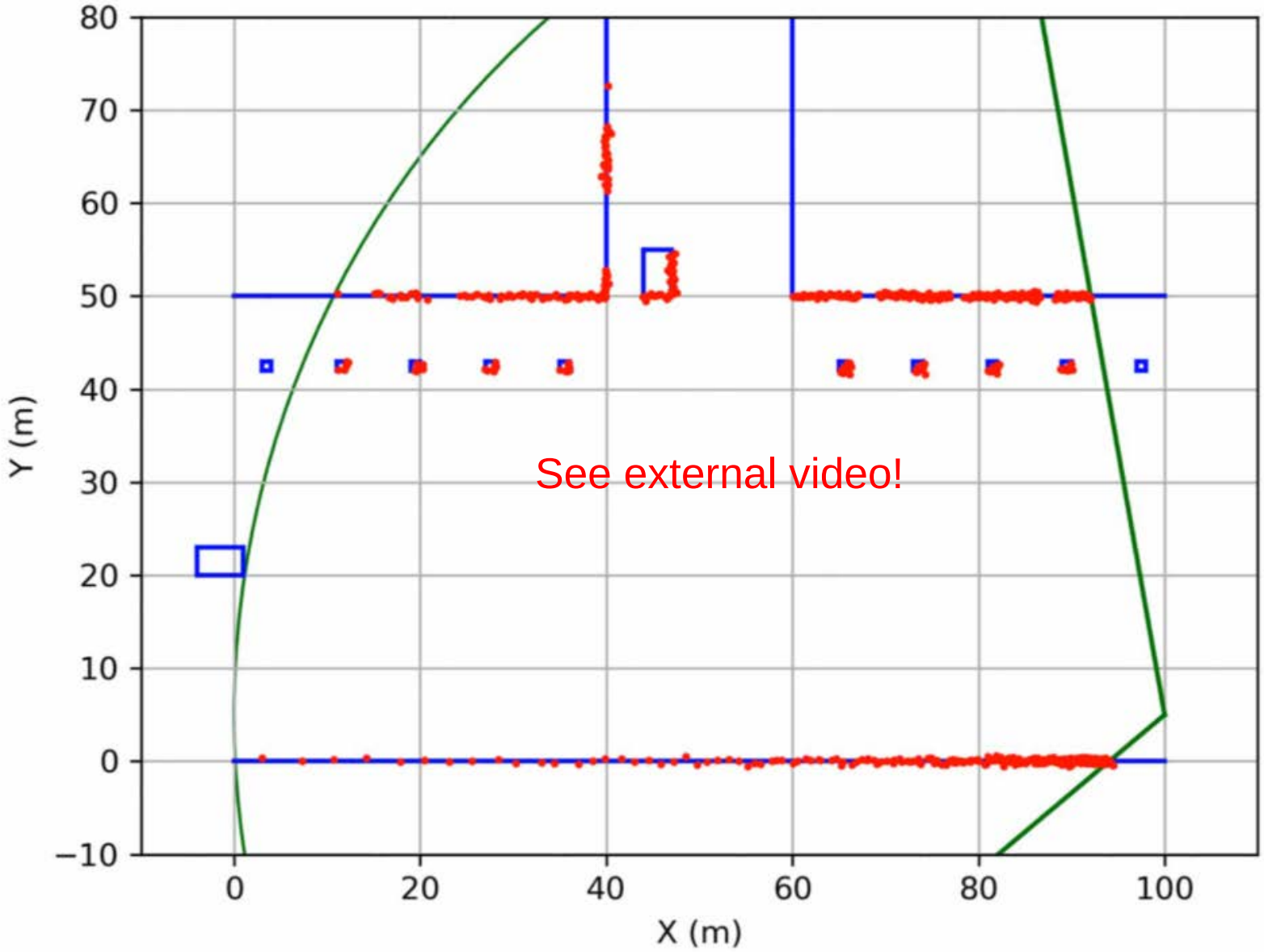
Simulated 2d environment: Street scene



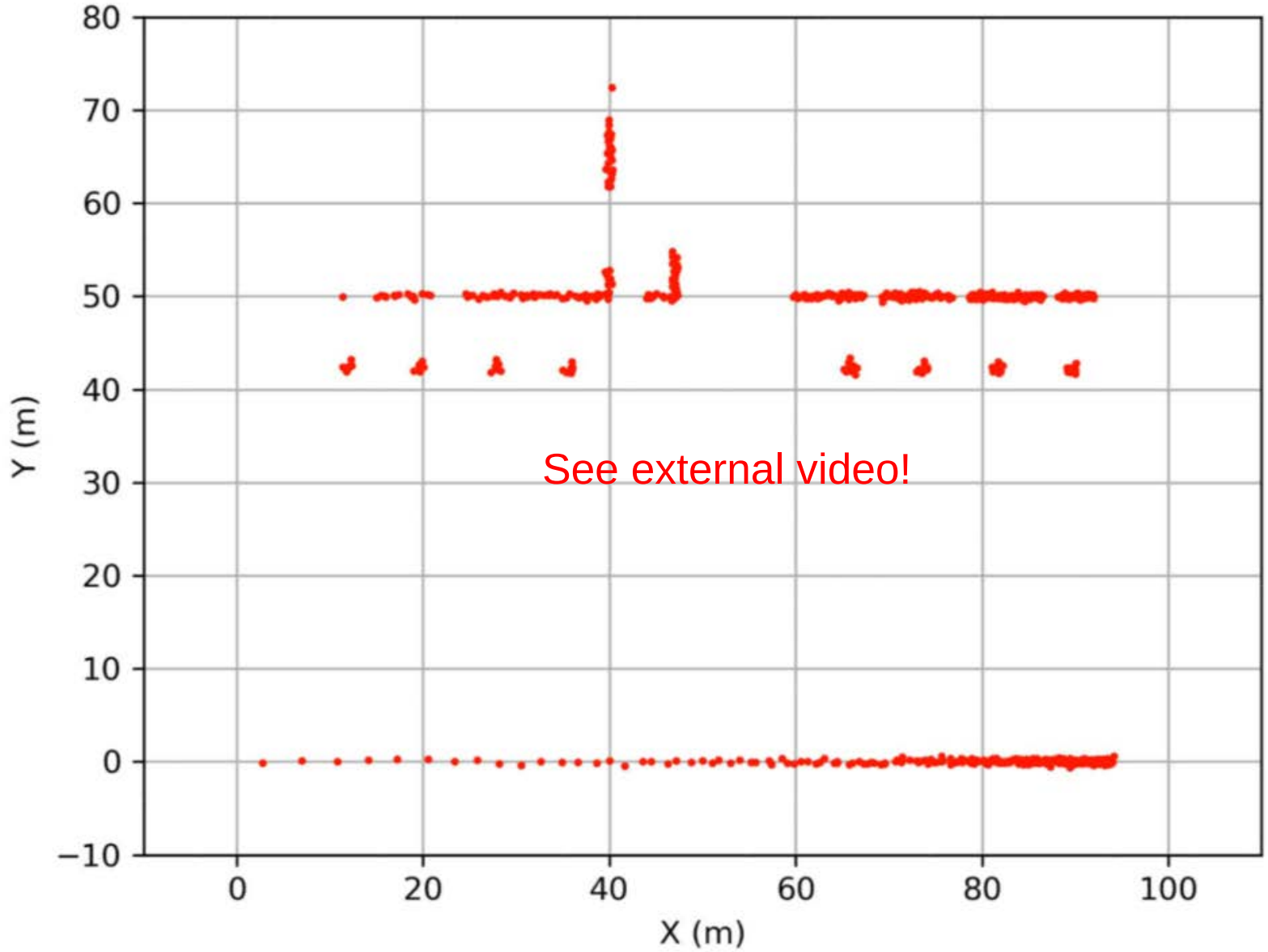
Simulated 2d environment: Street scene, LiDAR scanner



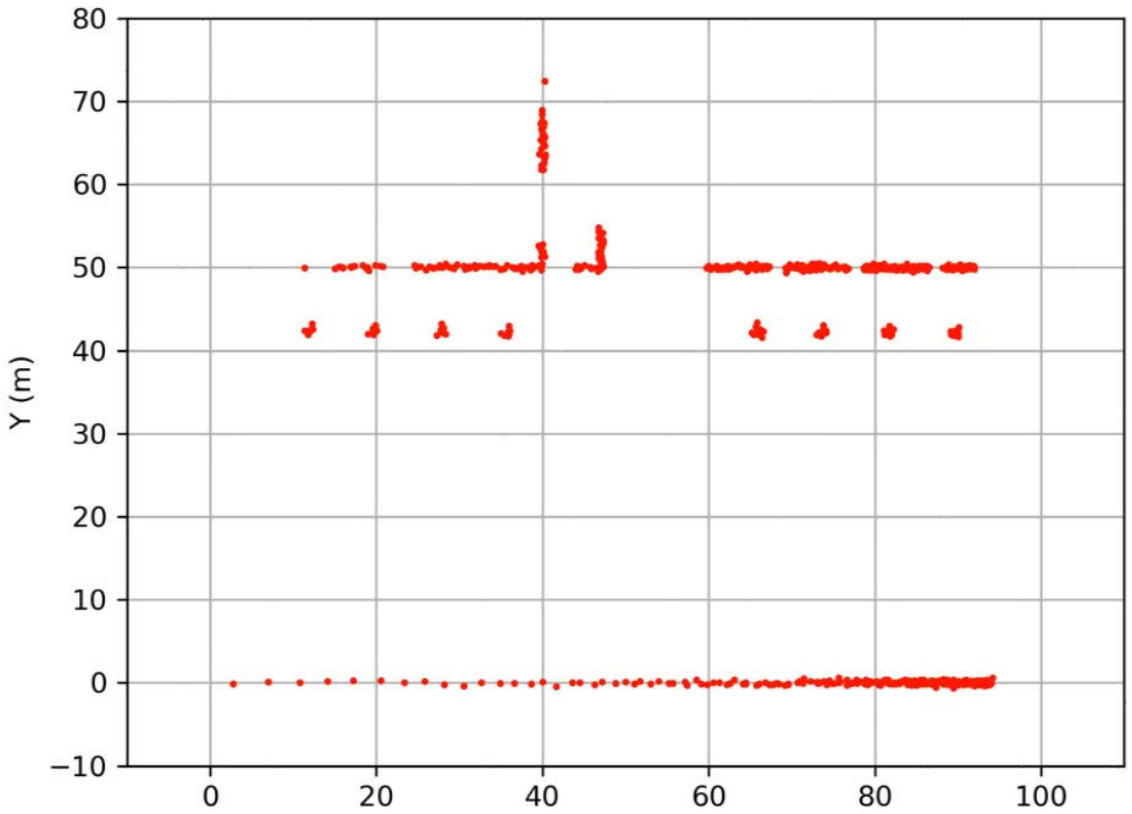
Simulated 2d LiDAR scan



Simulated 2d LiDAR scan (raw)



First step: Isolating the car in the scene



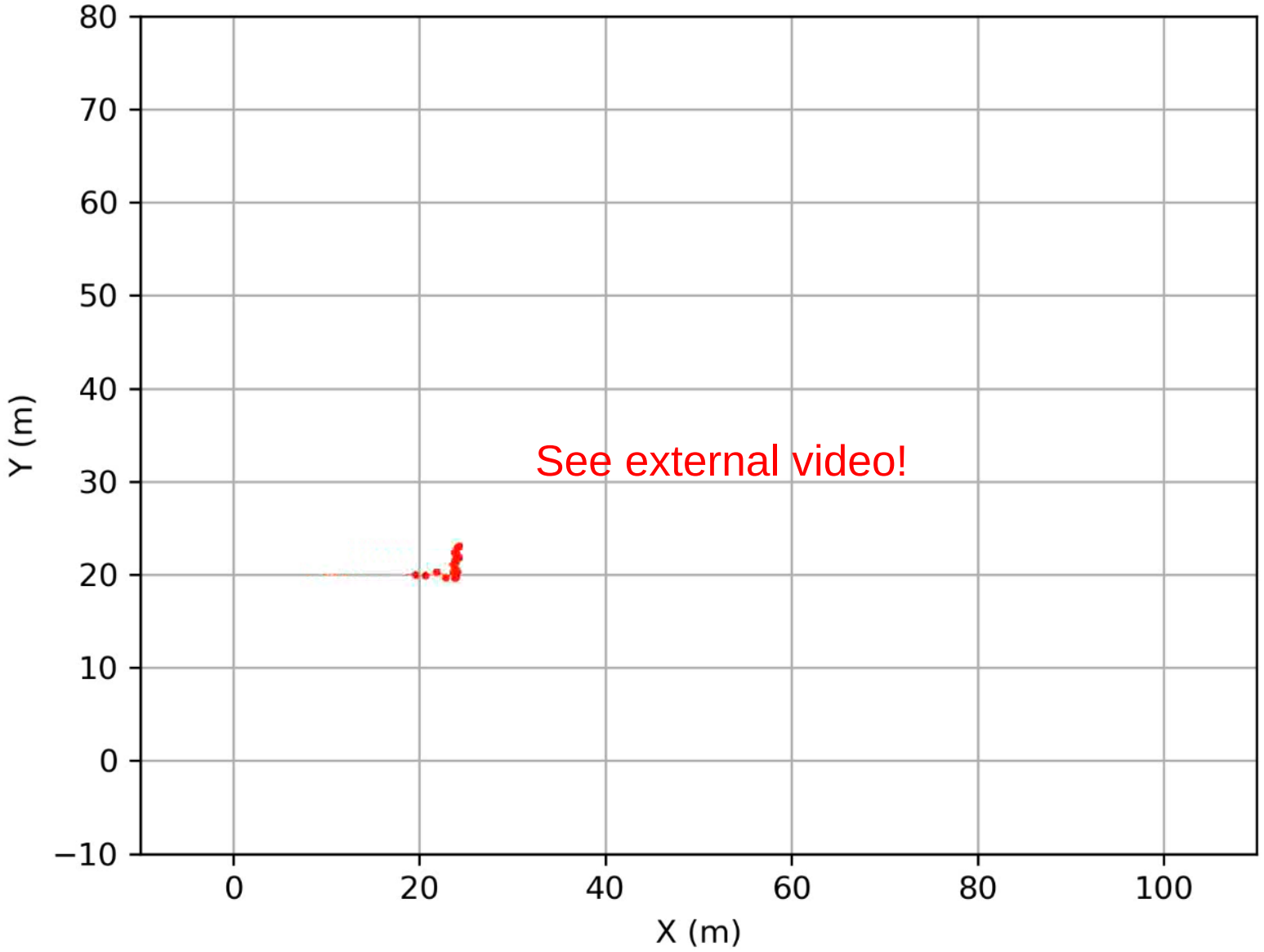
- Take scan of scene without the car (figure left)
- Use this scan as the set of static points
- For each new scan: Iterate over all points of the new scan and check if the point is somewhere close to any of the static points: If this is the case: remove the point from the scan

Remark:
If not done properly, this is a very expensive operation!

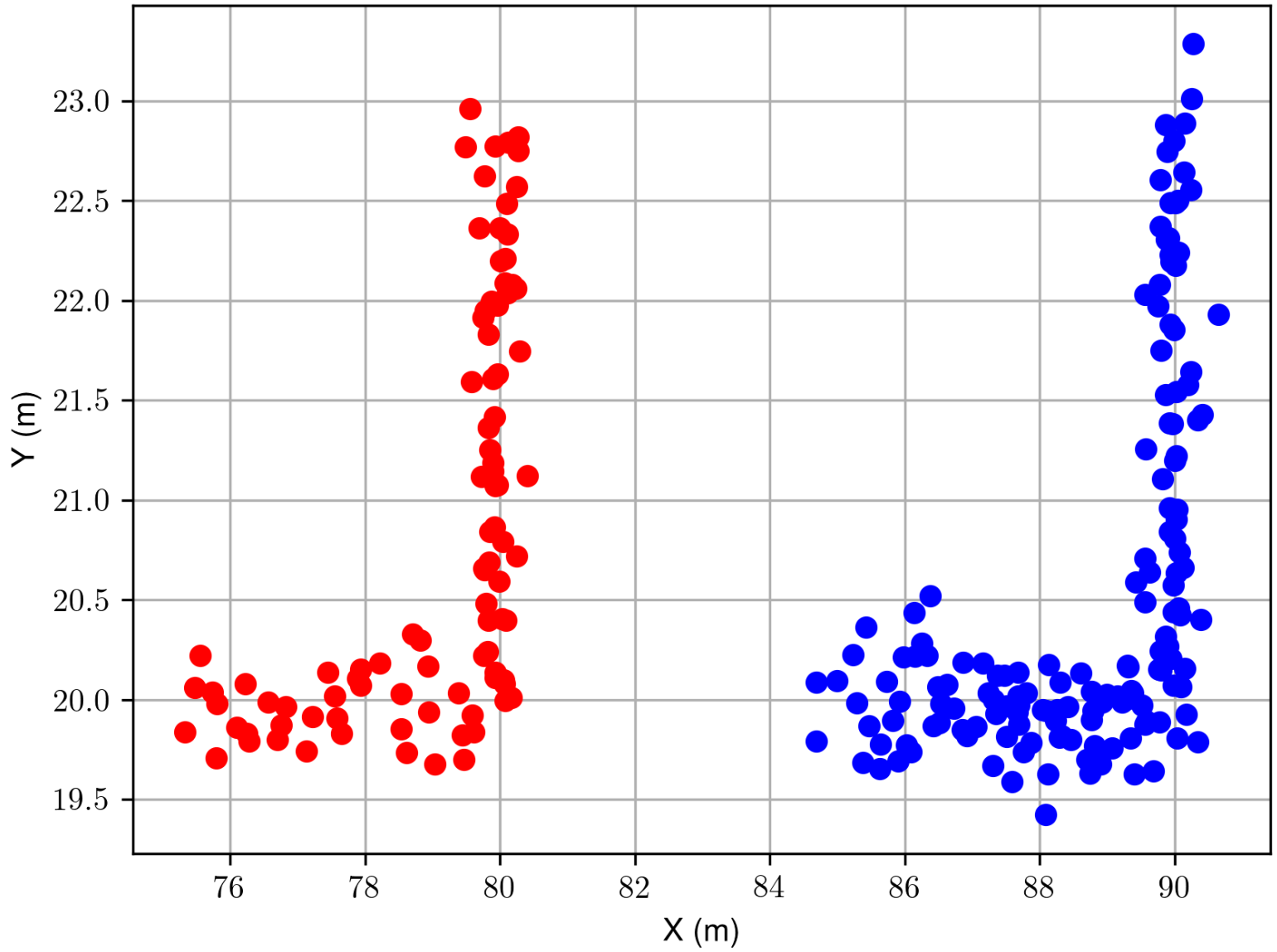
- 22k points from Sick MRS6124R
- For each new scan 22k * 22k = 492M distance calculations
- When scanning with 10Hz: 4.9G distance calculations per second

Solution: see e.g. space partitioning data structures

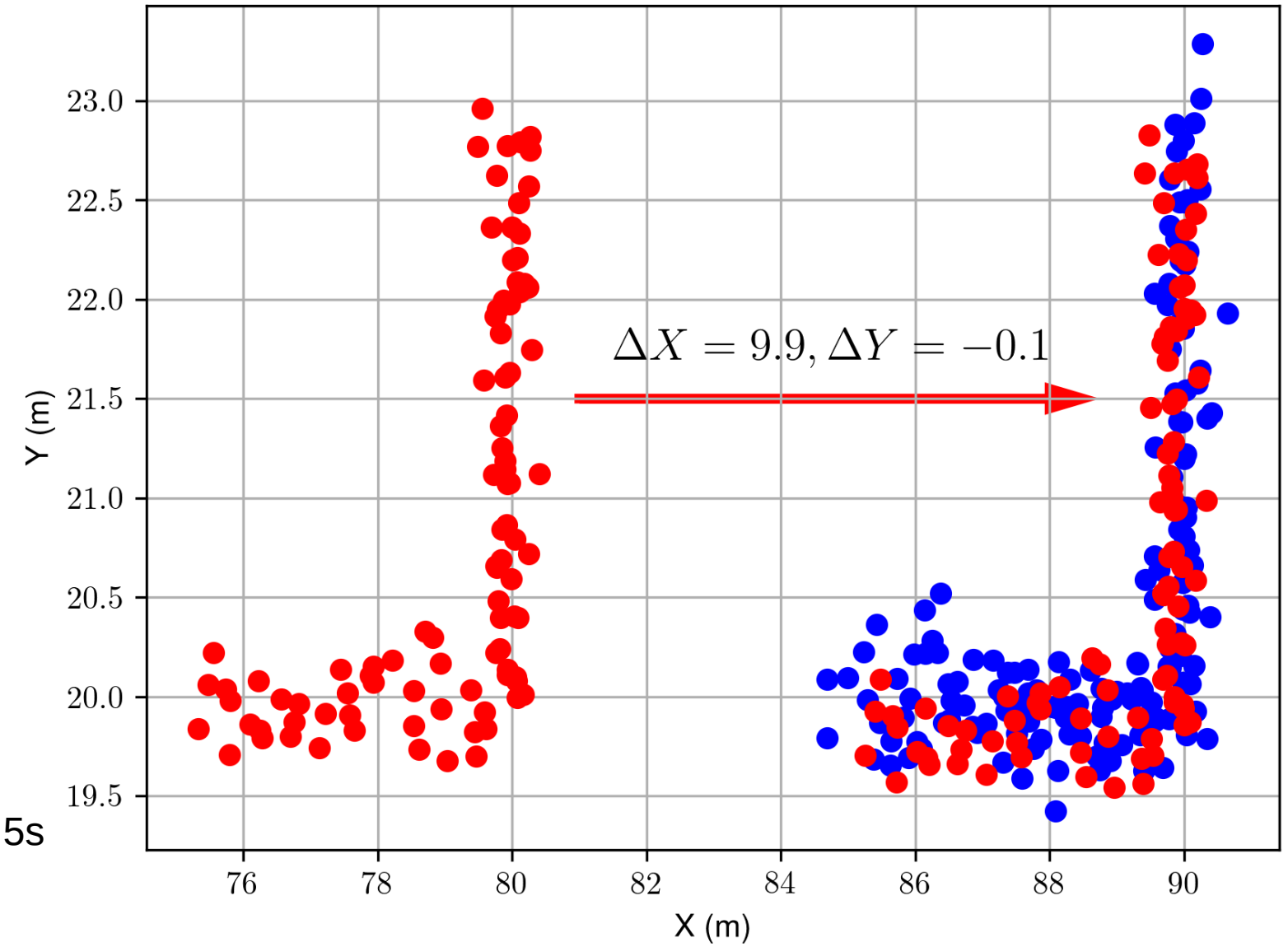
Simulated 2d LiDAR scan, static points removed



Second step: Estimate translation between two consecutive scans

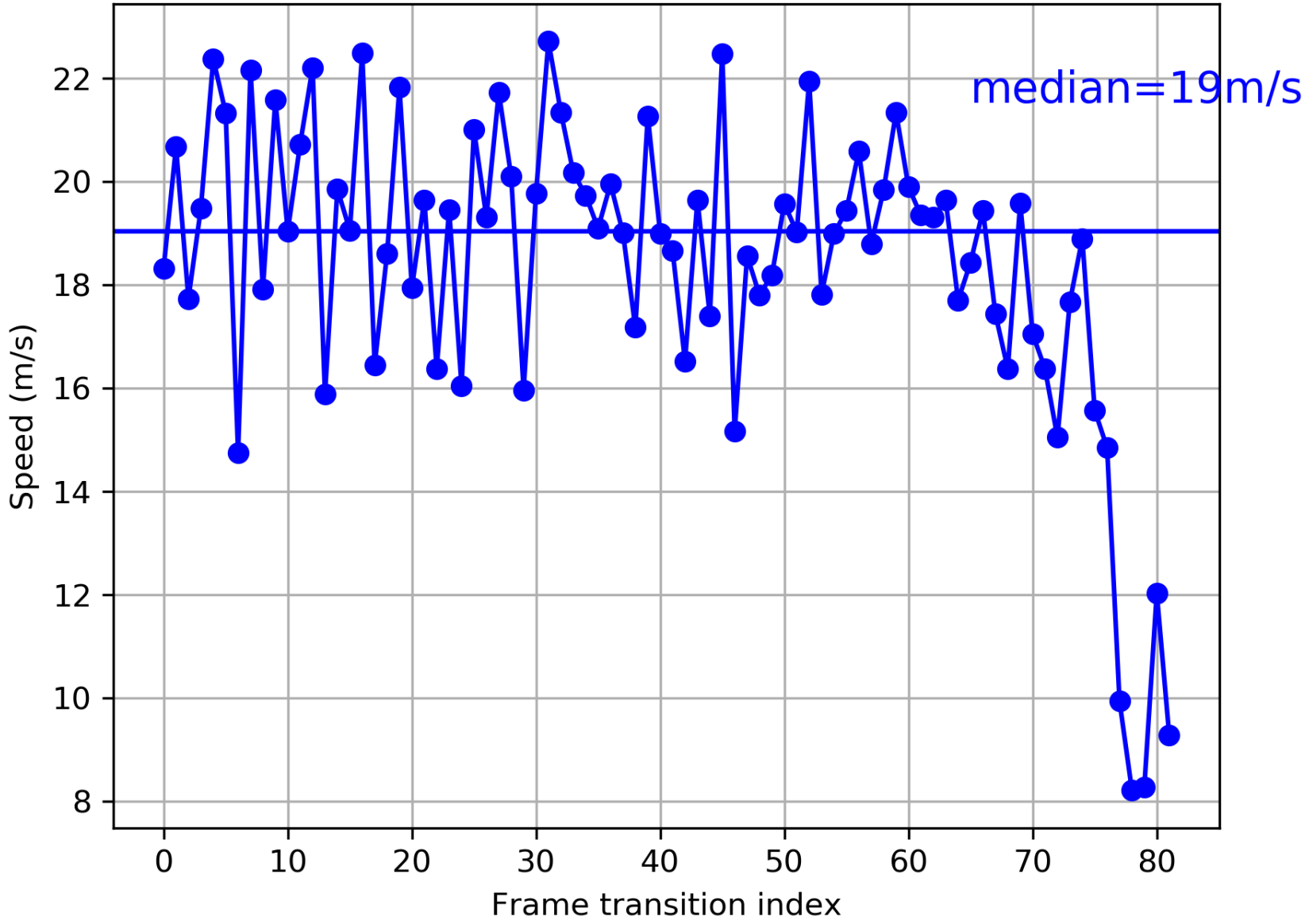


Registration: Iterative closest points (ICP) to estimate transformation

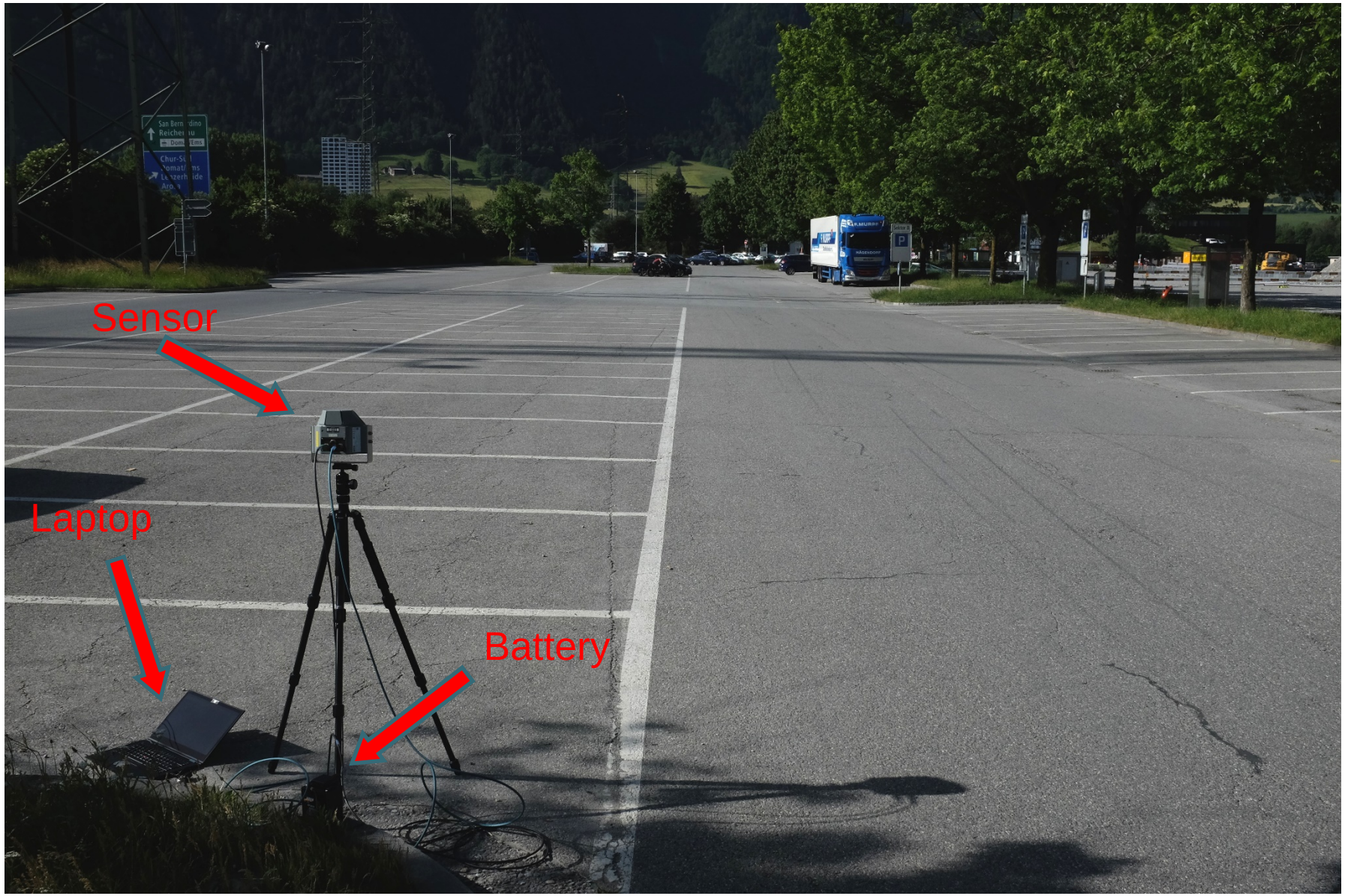


Car speed 20m/s
Time between scans 0.5s

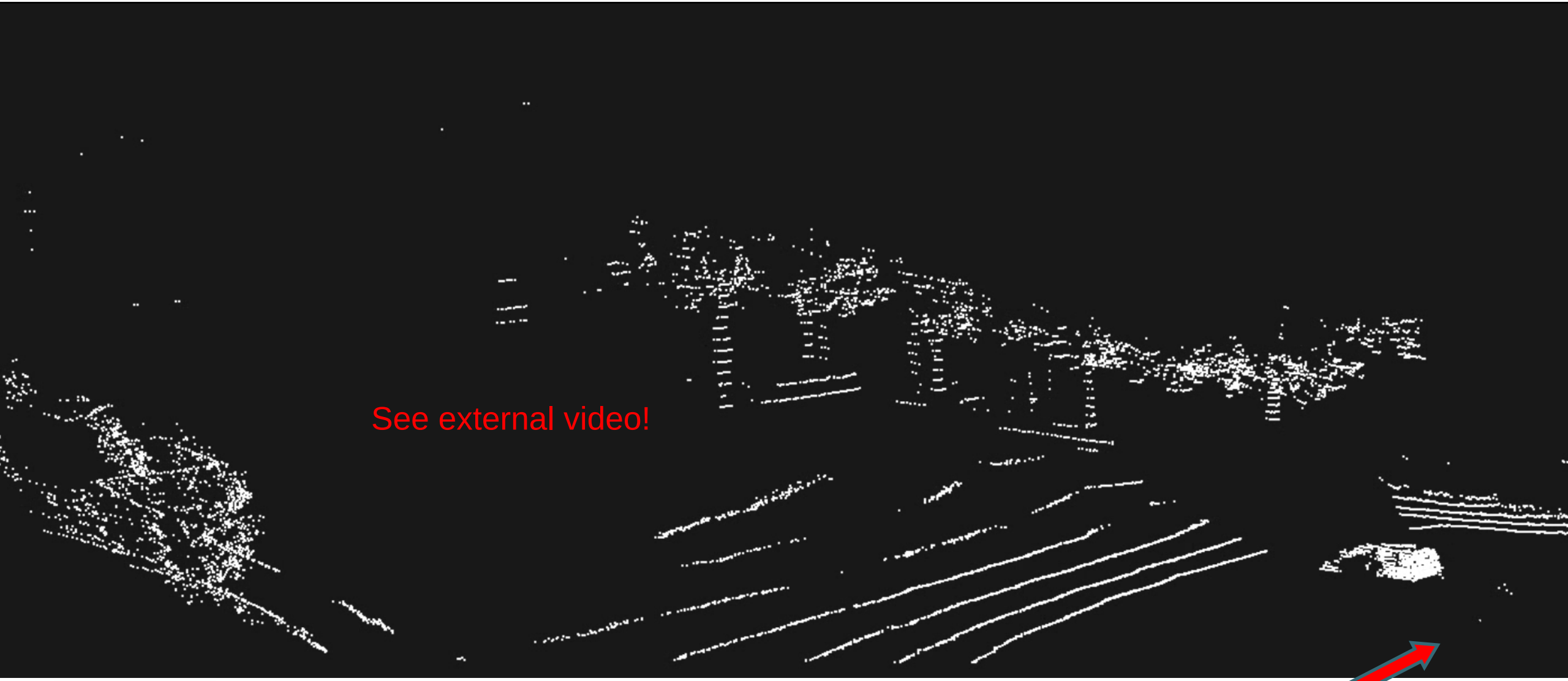
2d Result for simulated speed of 20m/s



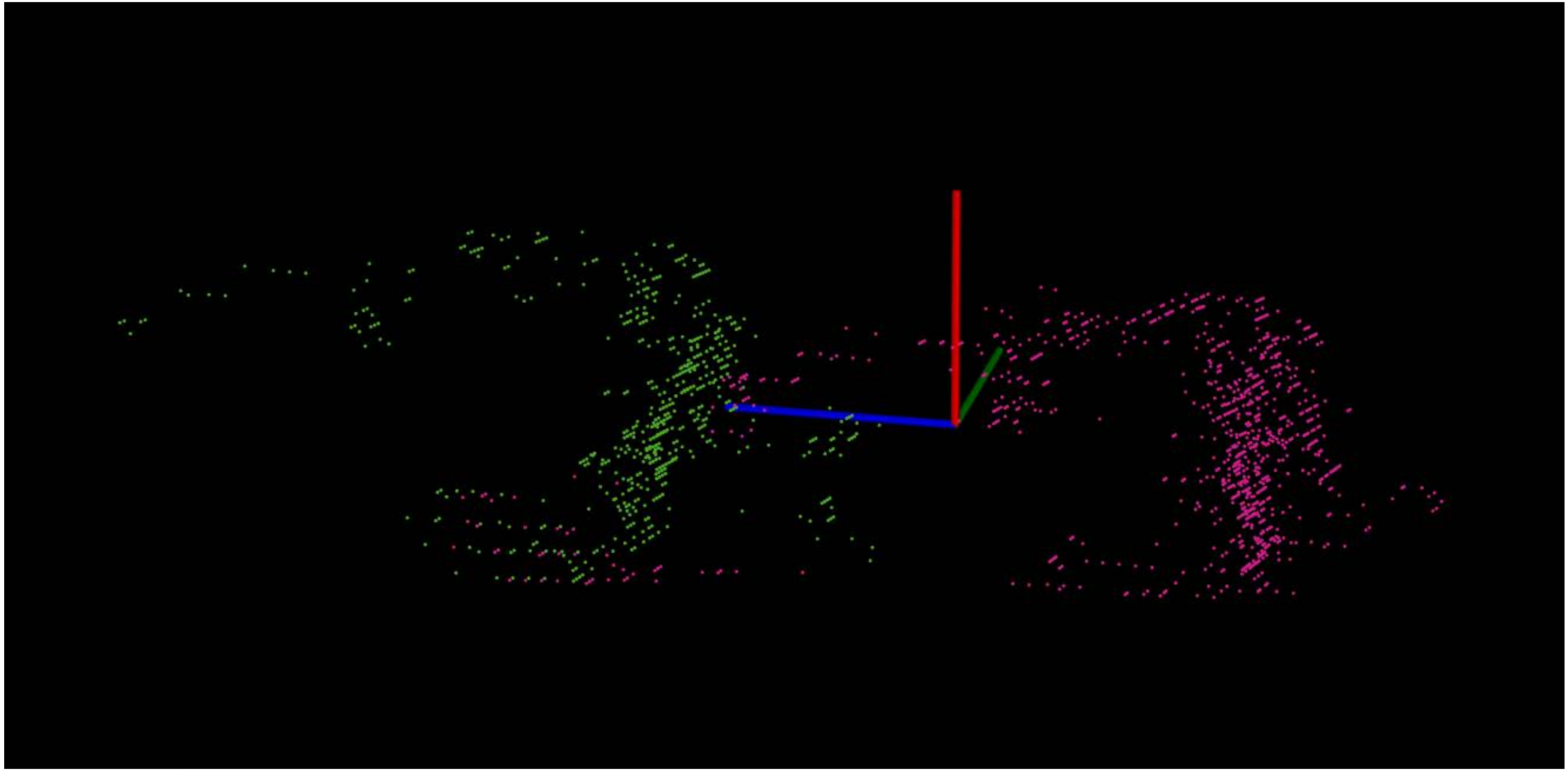
Switch to 3d: Scene in an empty parking lot



3d LIDAR scan

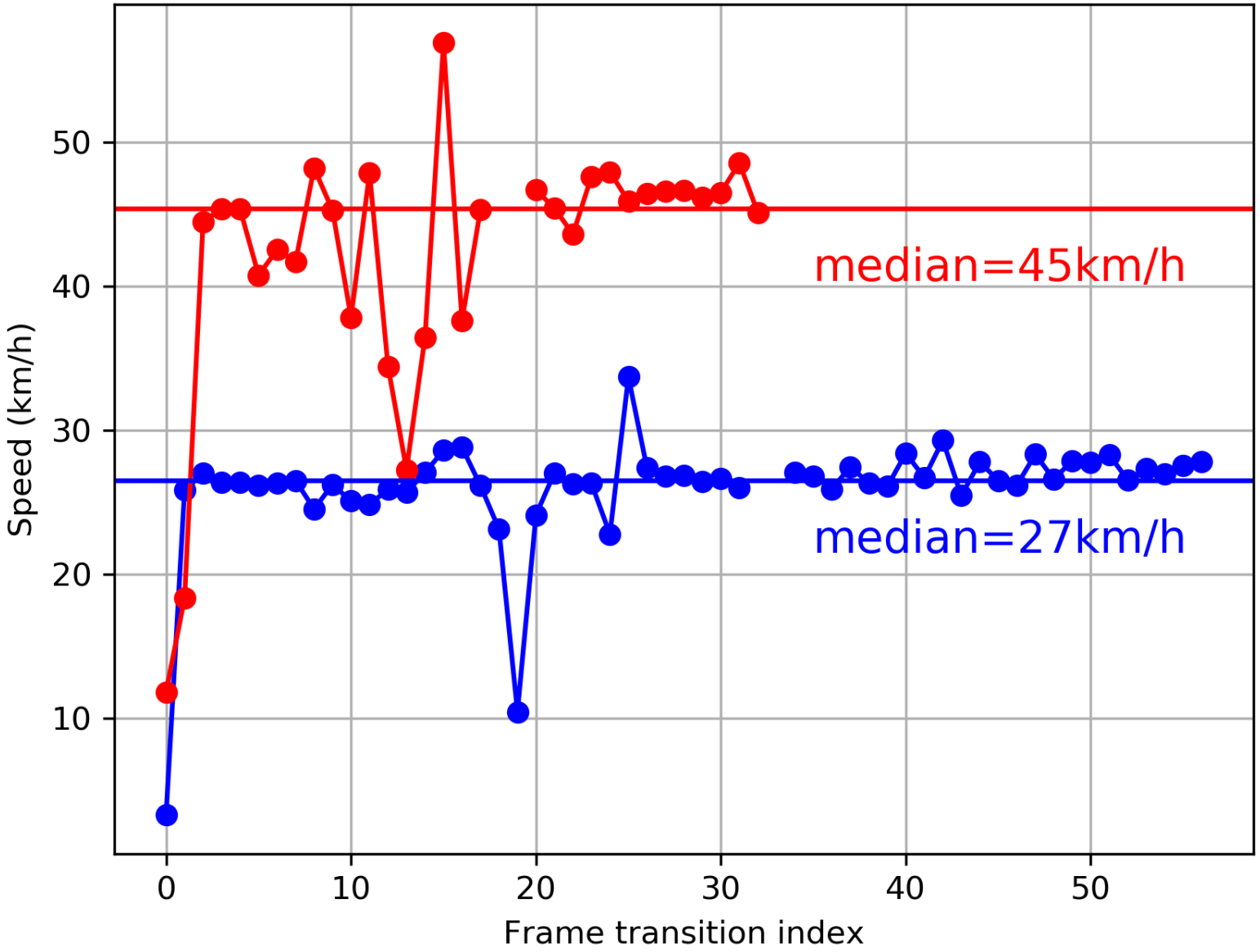


3d Registration of two consecutive scans



Sensor Position

3d Results for two experiments with speeds of 30km/h + 50km/h



Conclusions

- Was the 2d simulator a good help for developing a 3d solution? YES!
- Did the speed estimate work? YES!

- Is the proposed solution generic and stable? NO!
- Is the sensor a good choice for that kind of application? NO!

So, why did you do it?
- Great demo application for 3d computer vision
- Shows applications and challenges in 3d computer vision

3d Computer Vision is a major trend!

The end.