

Visual odometry for trailer off-tracking estimation

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Vehicle Dynamics and Control Seminar

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Introduction

Trailer steering | Off-highway problem

Off-tracking estimation

Concept | Visual odometry | Processing

CAD simulations

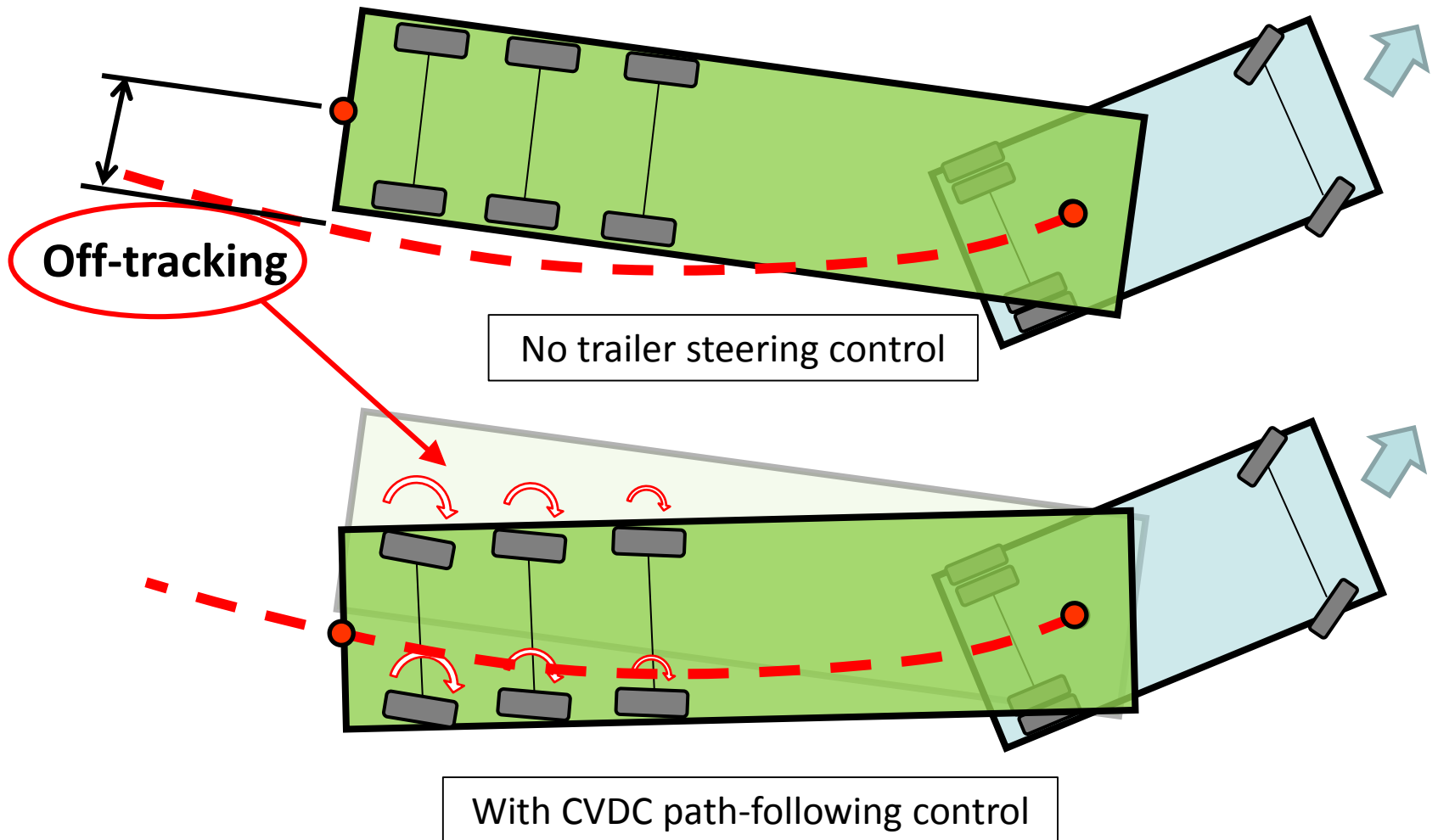
Overview | Results

Vehicle tests

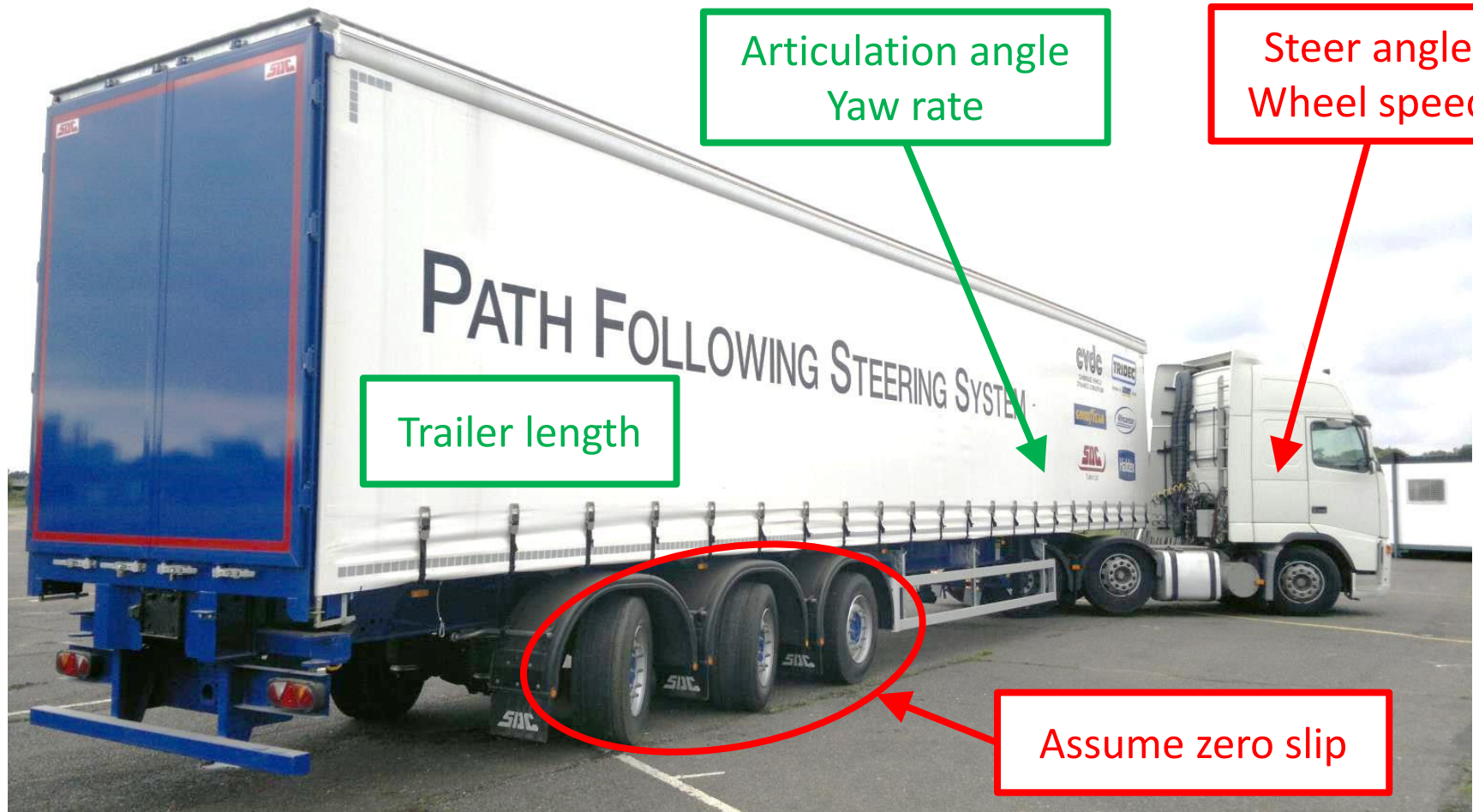
Instrumentation | Bourn airfield | Preliminary results

Conclusions

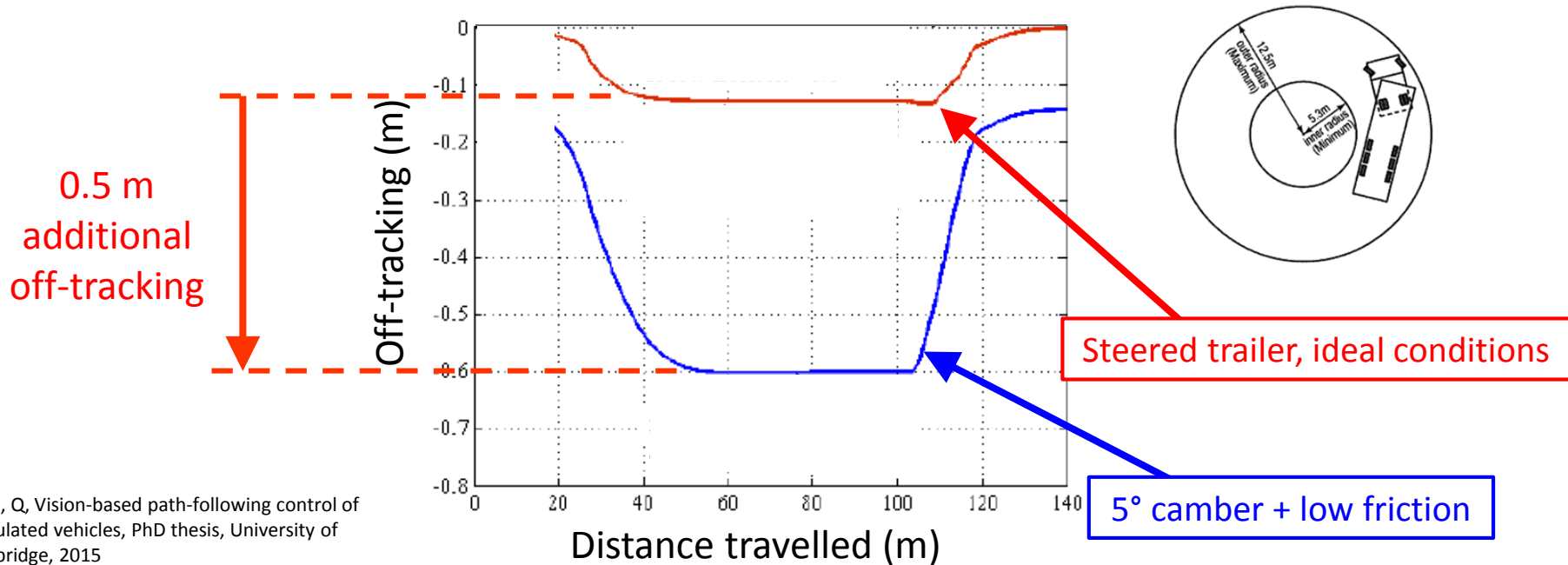
Introduction: Path-following trailer steering



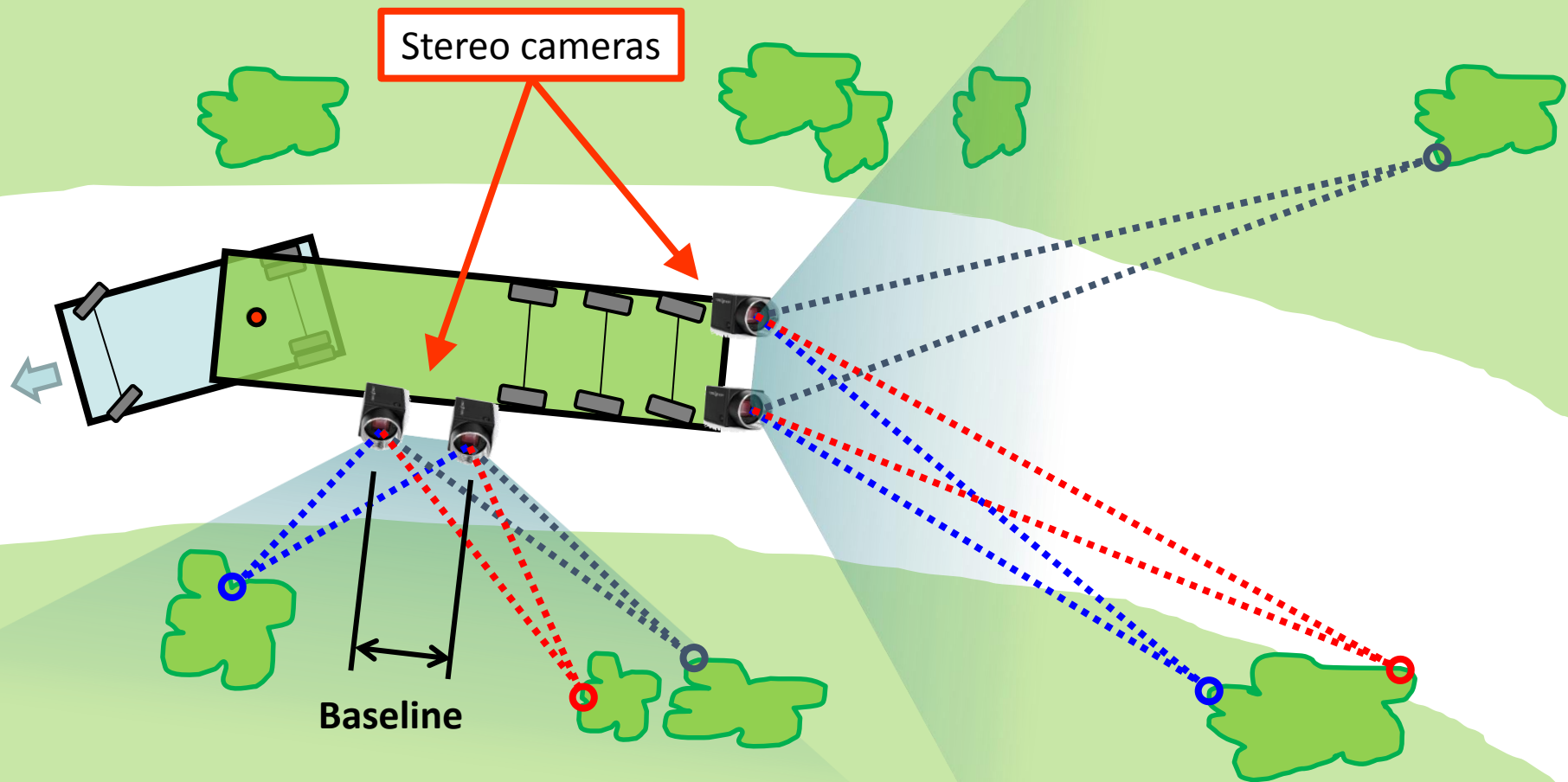
Introduction: Path-following trailer steering



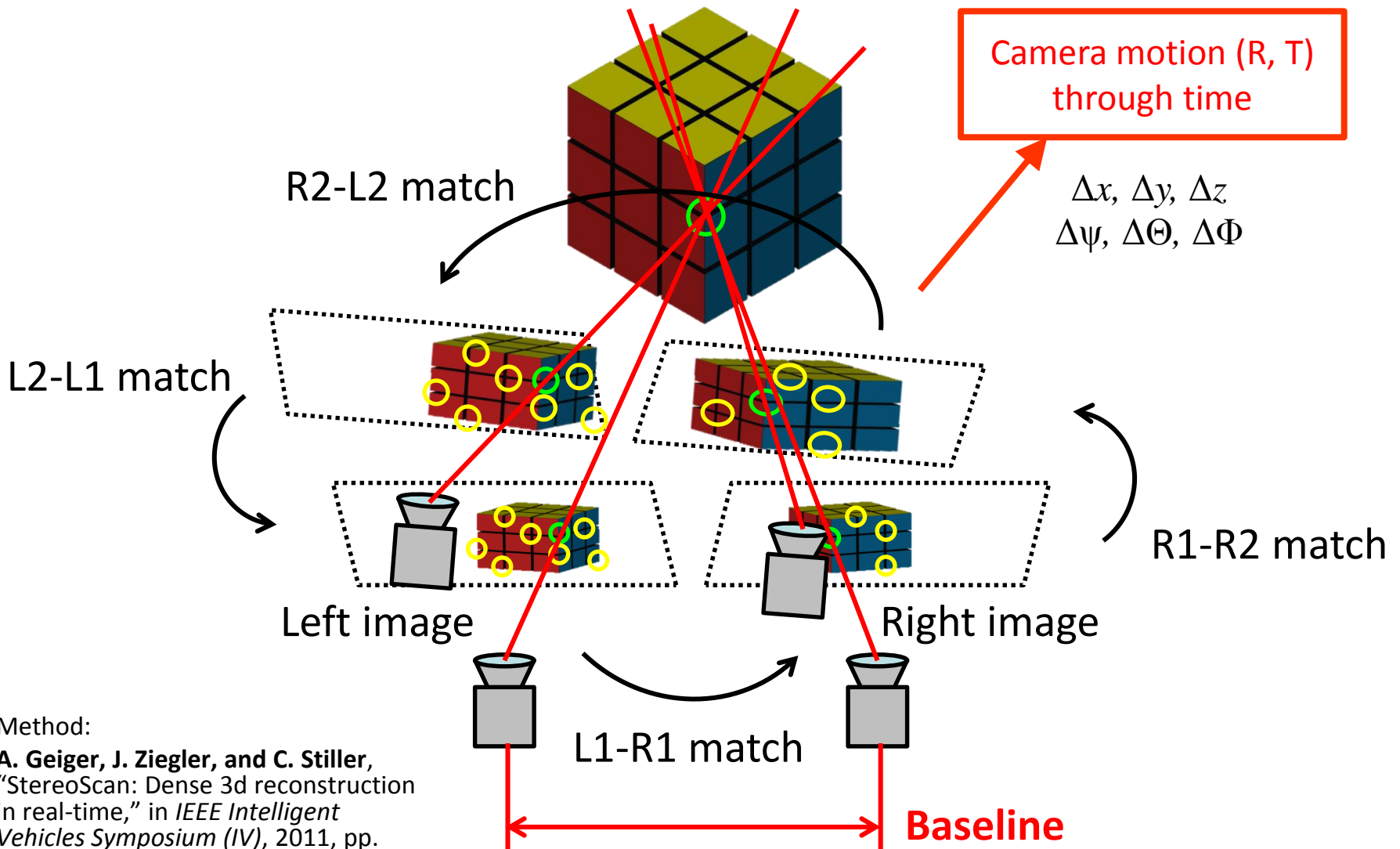
Introduction: Off-highway problem



Off-tracking estimation: Concept



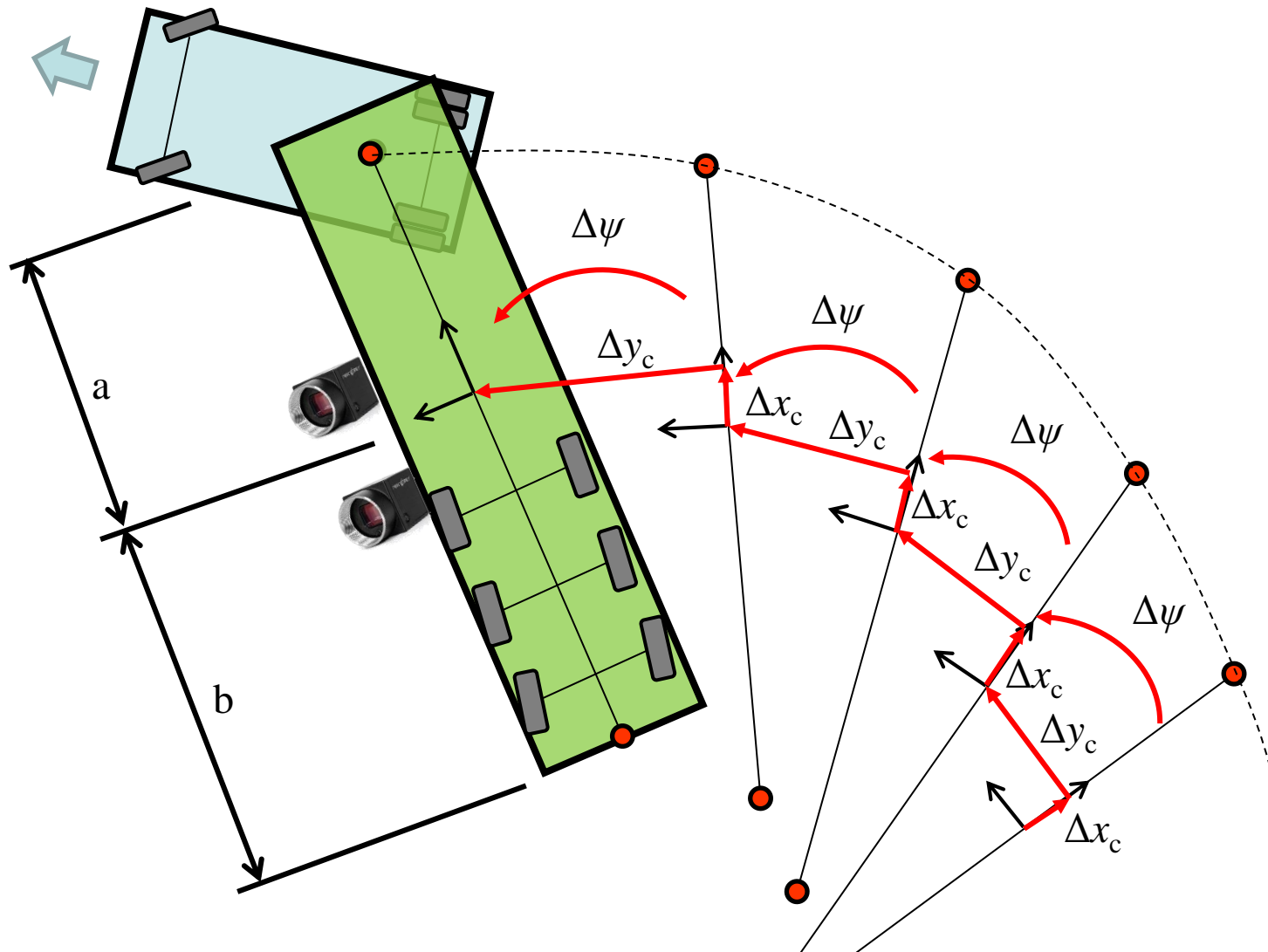
Off-tracking estimation: Visual odometry



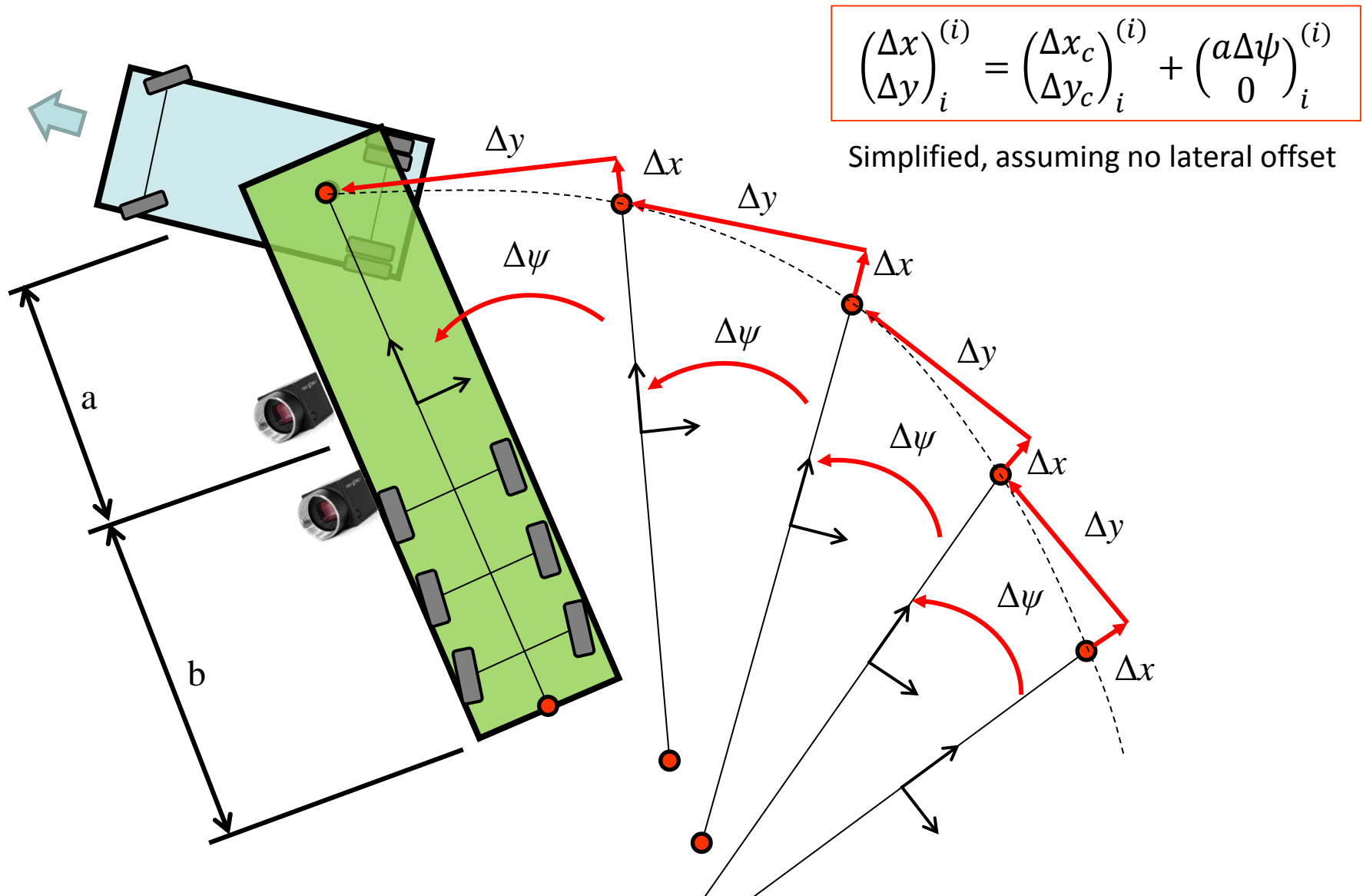
Method:

A. Geiger, J. Ziegler, and C. Stiller,
"StereoScan: Dense 3d reconstruction
in real-time," in *IEEE Intelligent
Vehicles Symposium (IV)*, 2011, pp.
963–968.

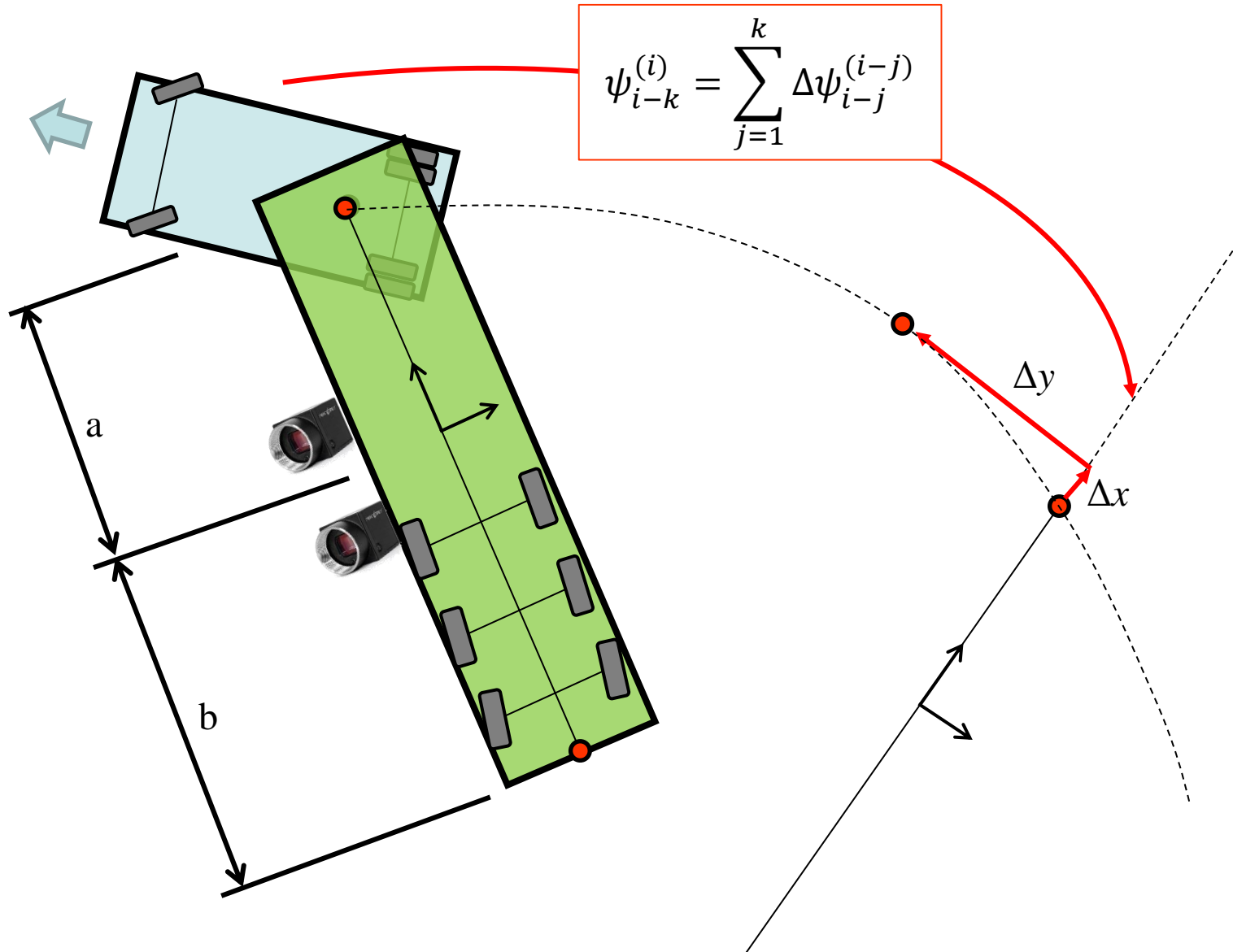
Off-tracking estimation: Processing



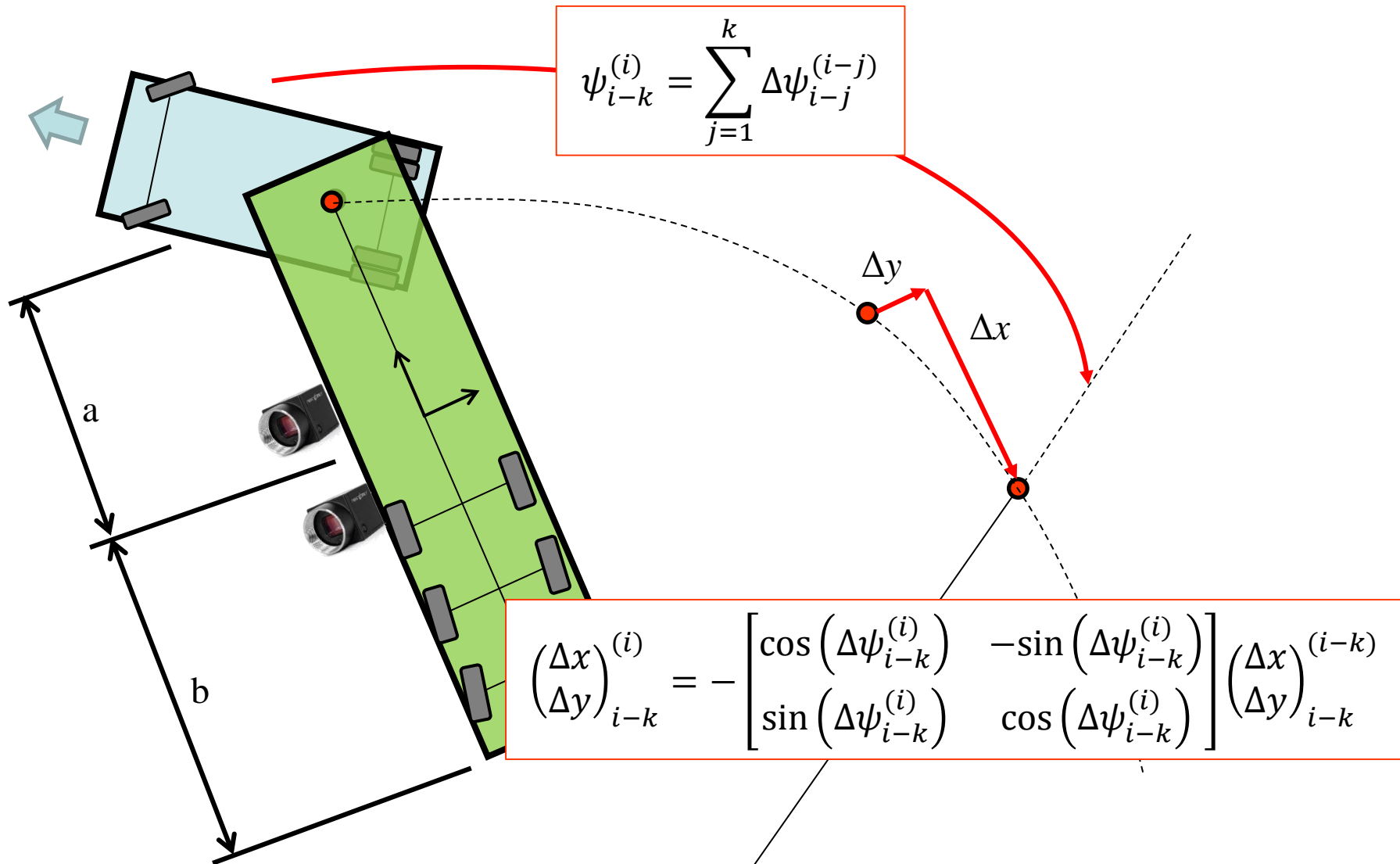
Off-tracking estimation: Processing



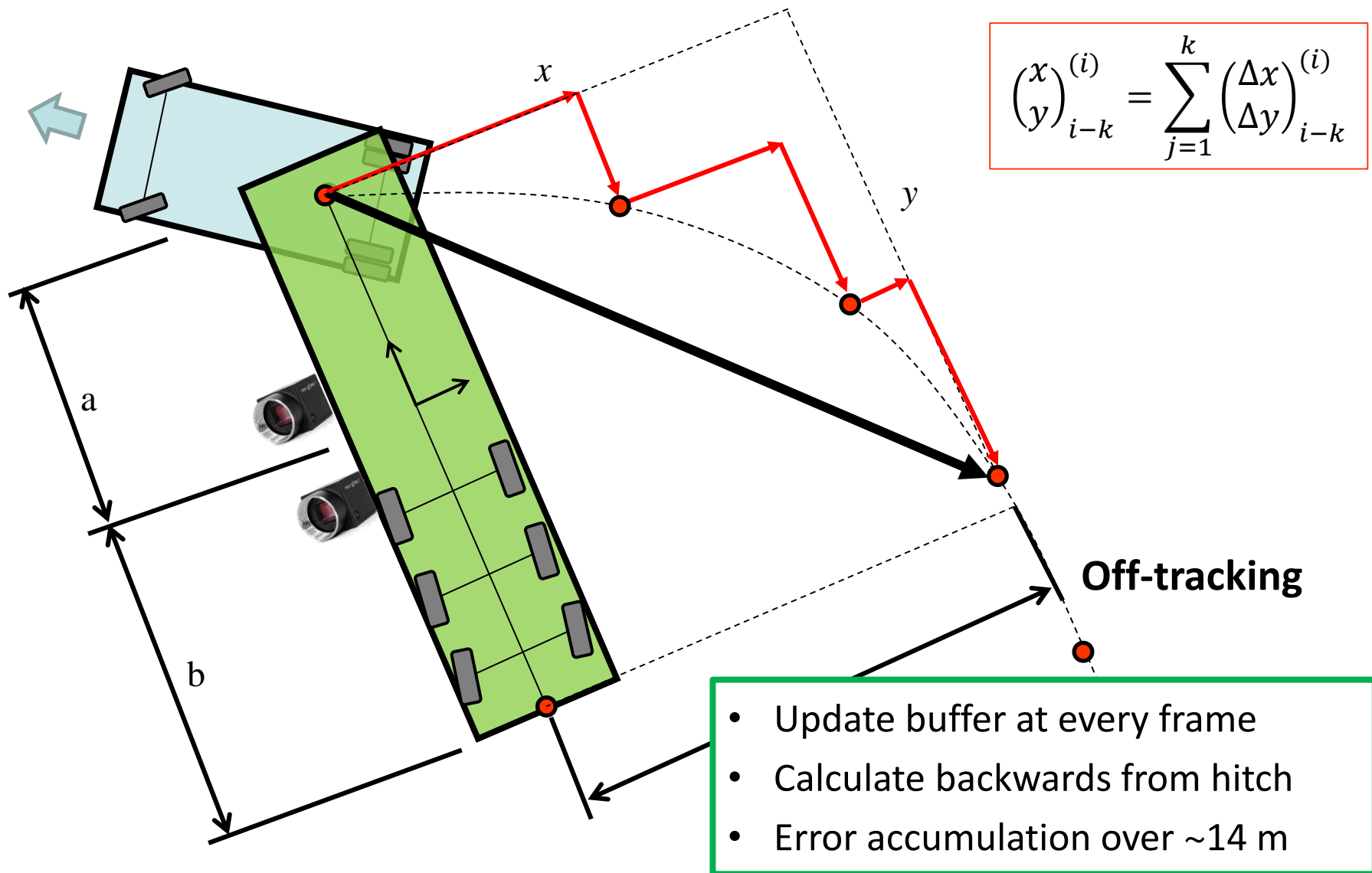
Off-tracking estimation: Processing



Off-tracking estimation: Processing



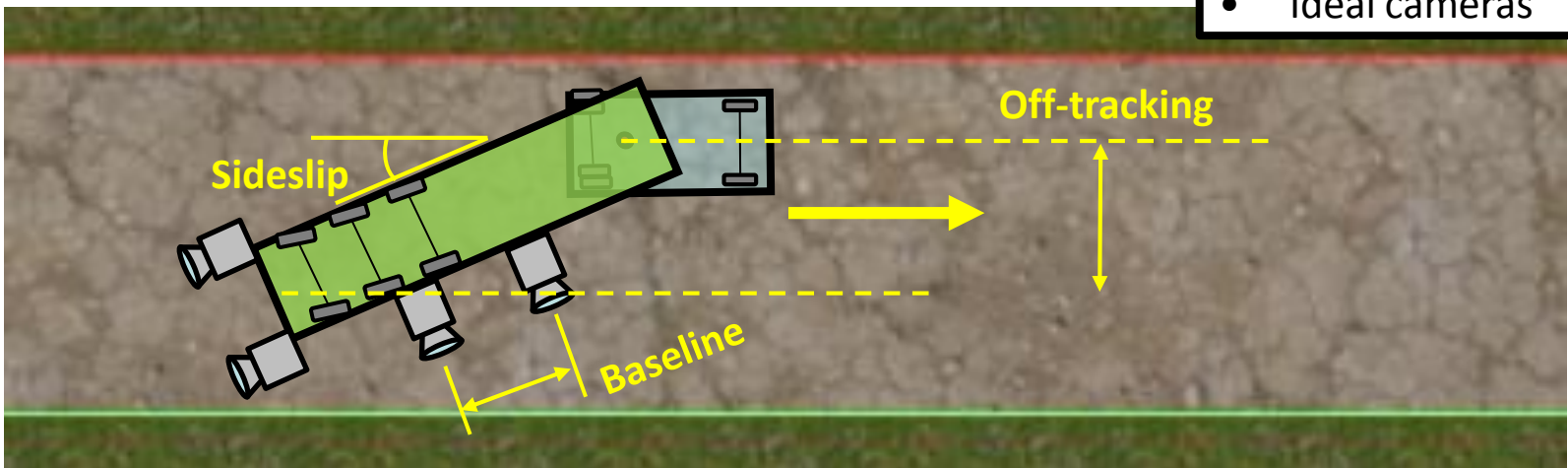
Off-tracking estimation: Processing



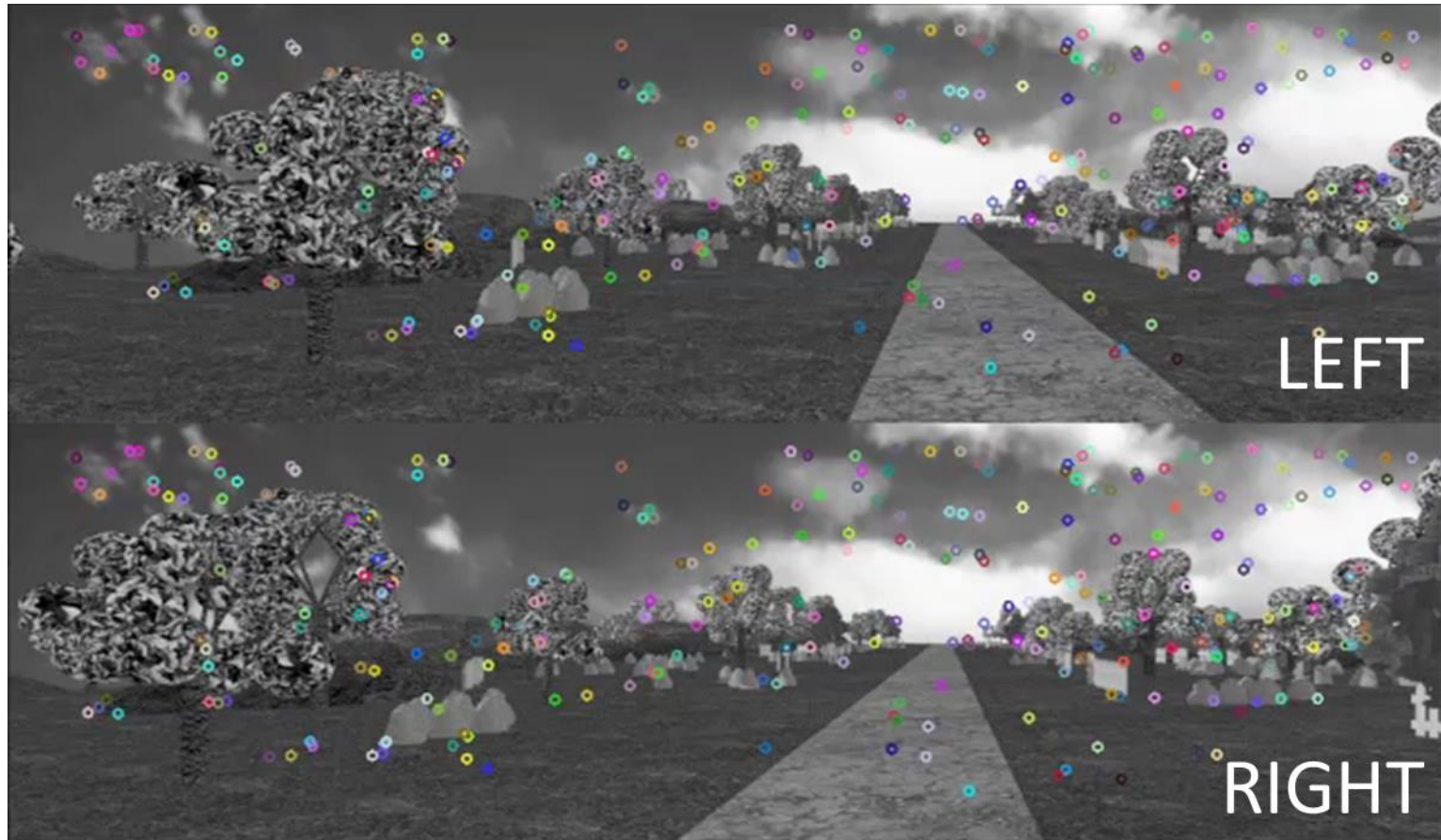
CAD simulations



- Constant sideslip
- 100 m, 5 m/s, 10 fps
- 14m trailer length
- Ideal cameras



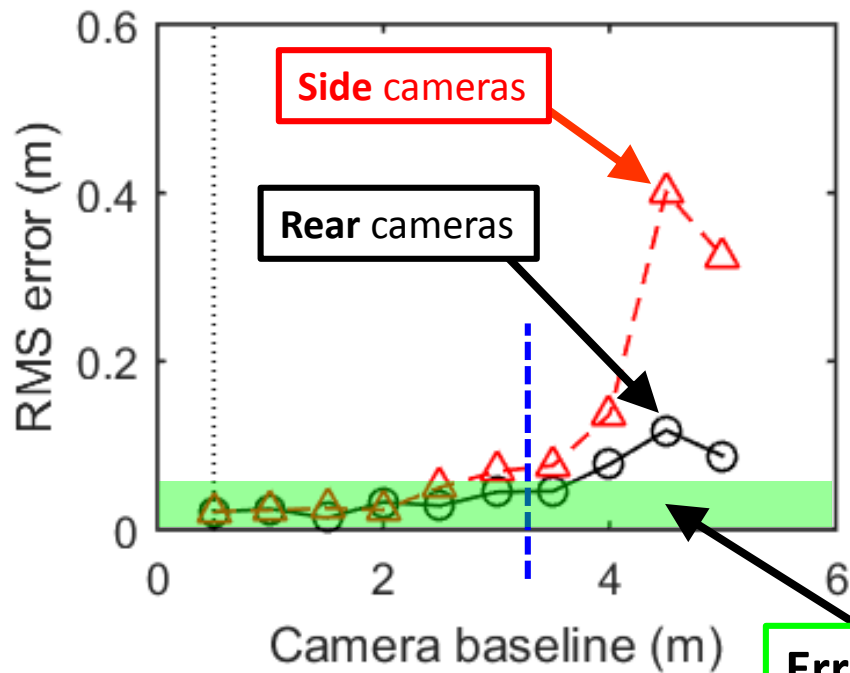
CAD simulations: Results



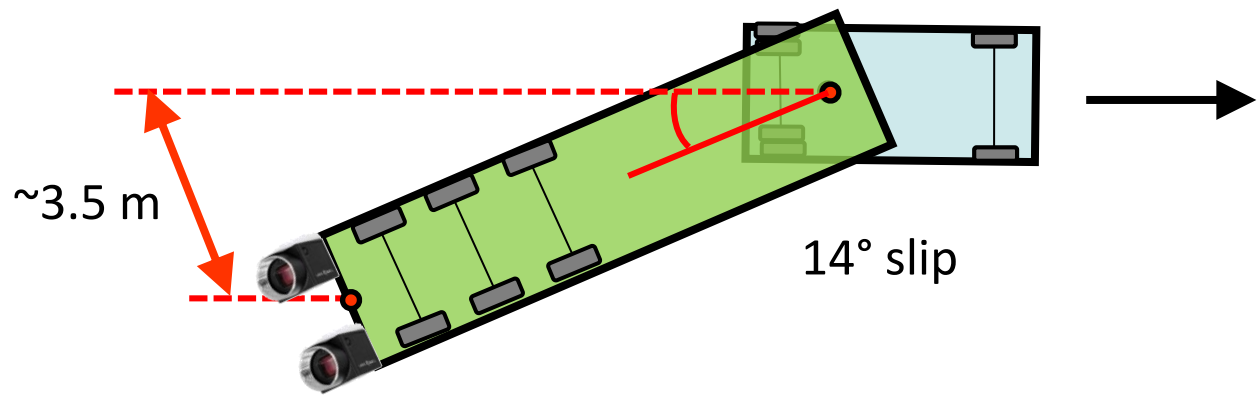
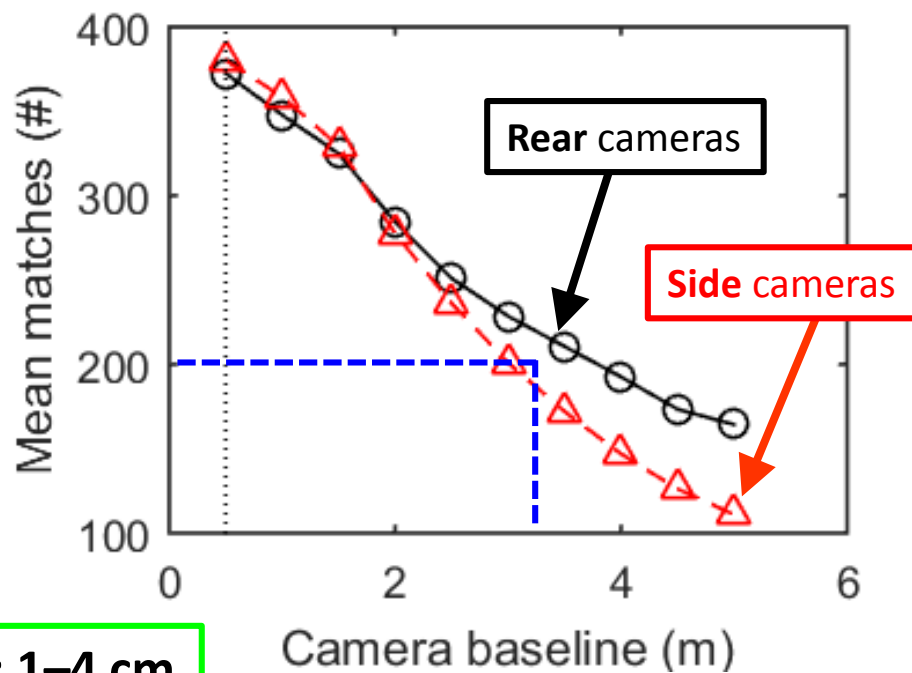
Visual odometry algorithm:

A. Geiger, J. Ziegler, and C. Stiller, "StereoScan: Dense 3d reconstruction in real-time," in *IEEE Intelligent Vehicles Symposium (IV)*, 2011, pp. 963–968.

CAD simulations: Results

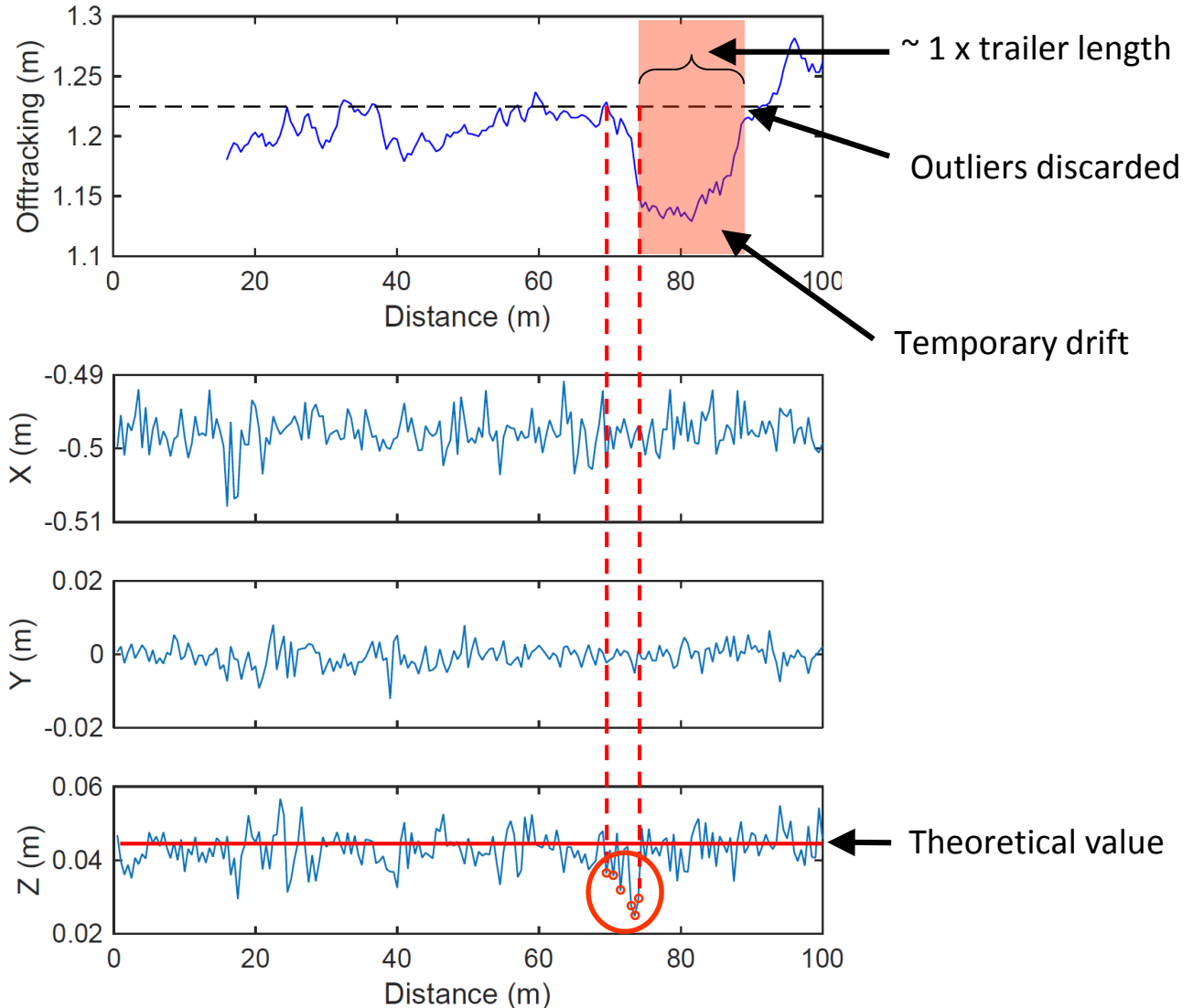
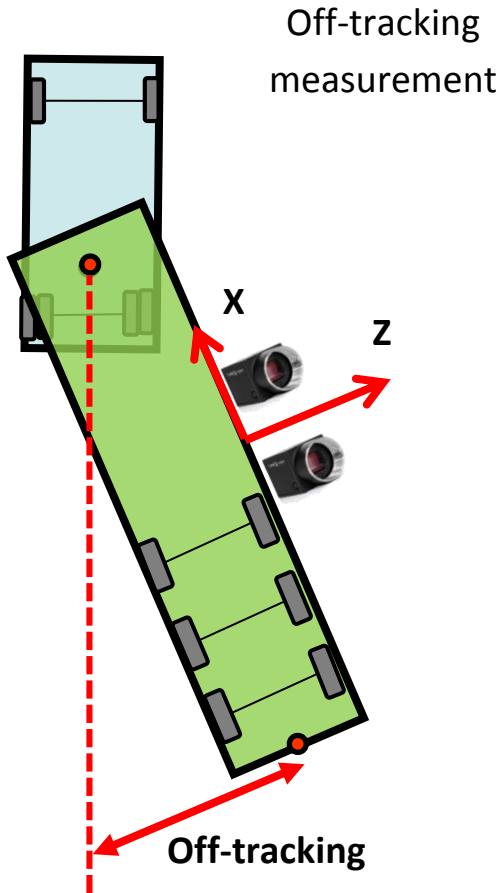


Errors: 1-4 cm

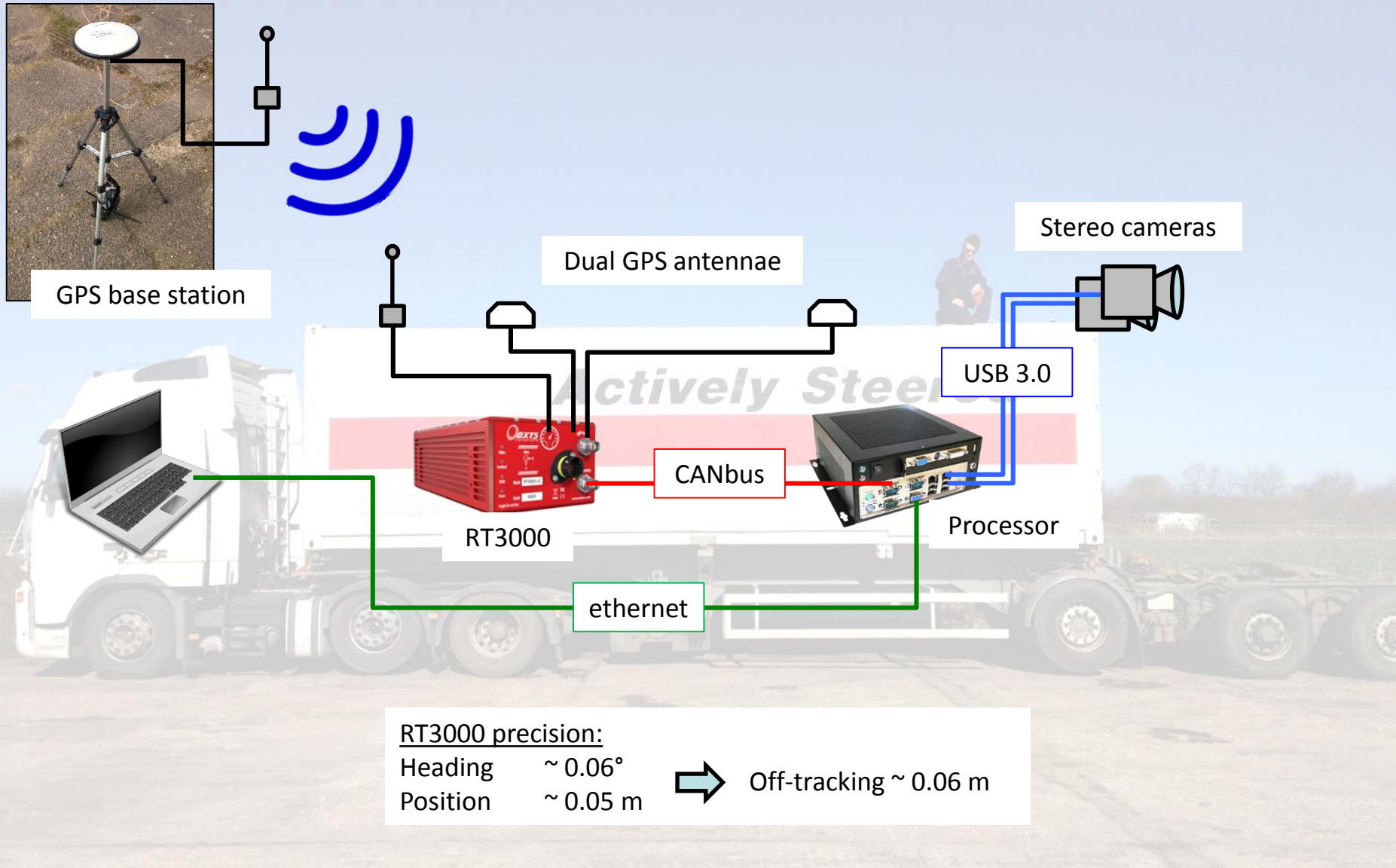


CAD simulations: Results

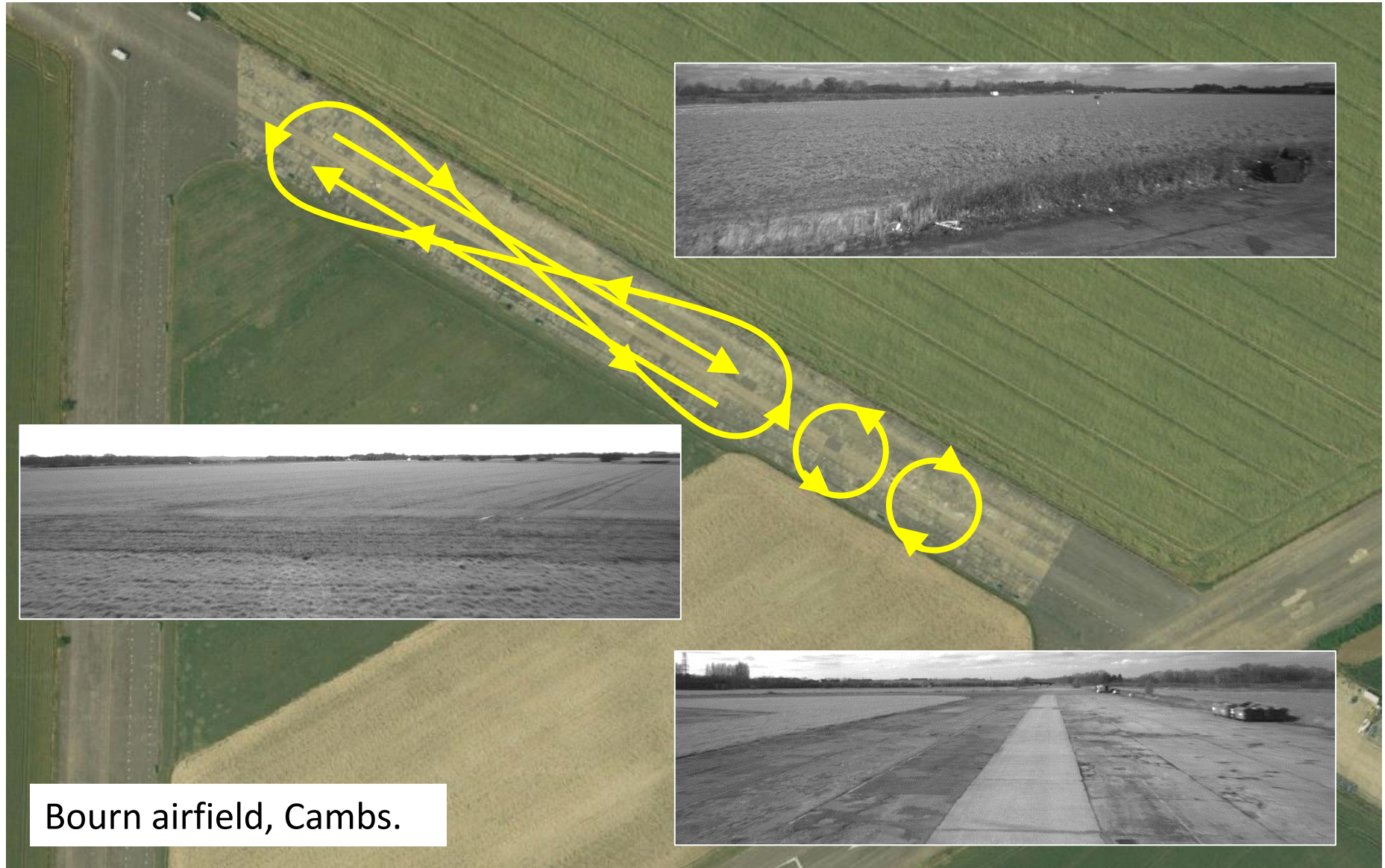
- Side cameras
- 5° slip
- 1.5 m baseline



Vehicle tests: Instrumentation

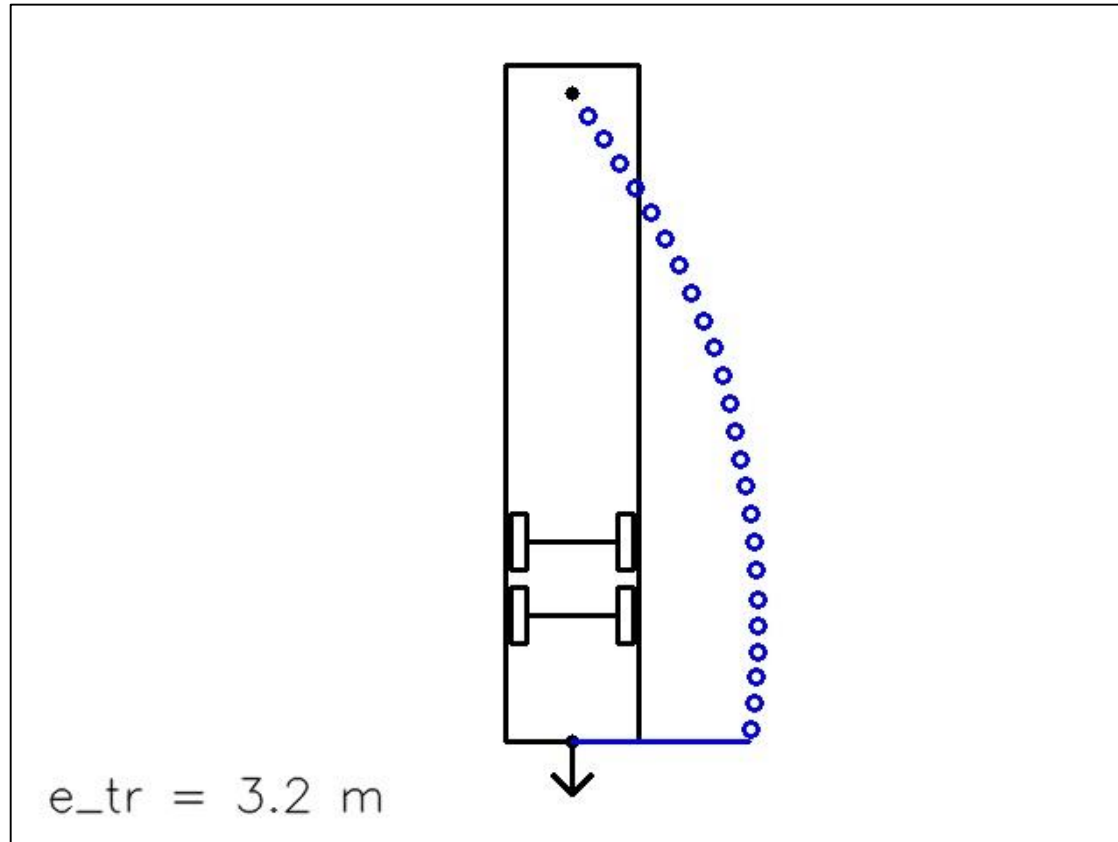
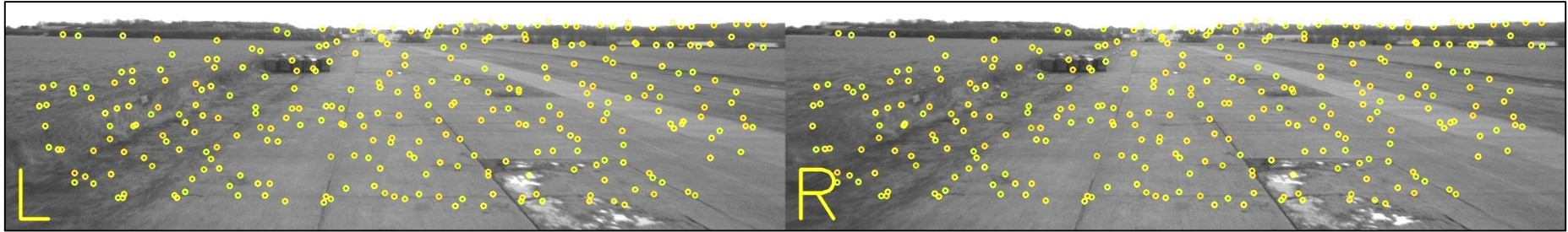


Vehicle tests : Bourn Airfield



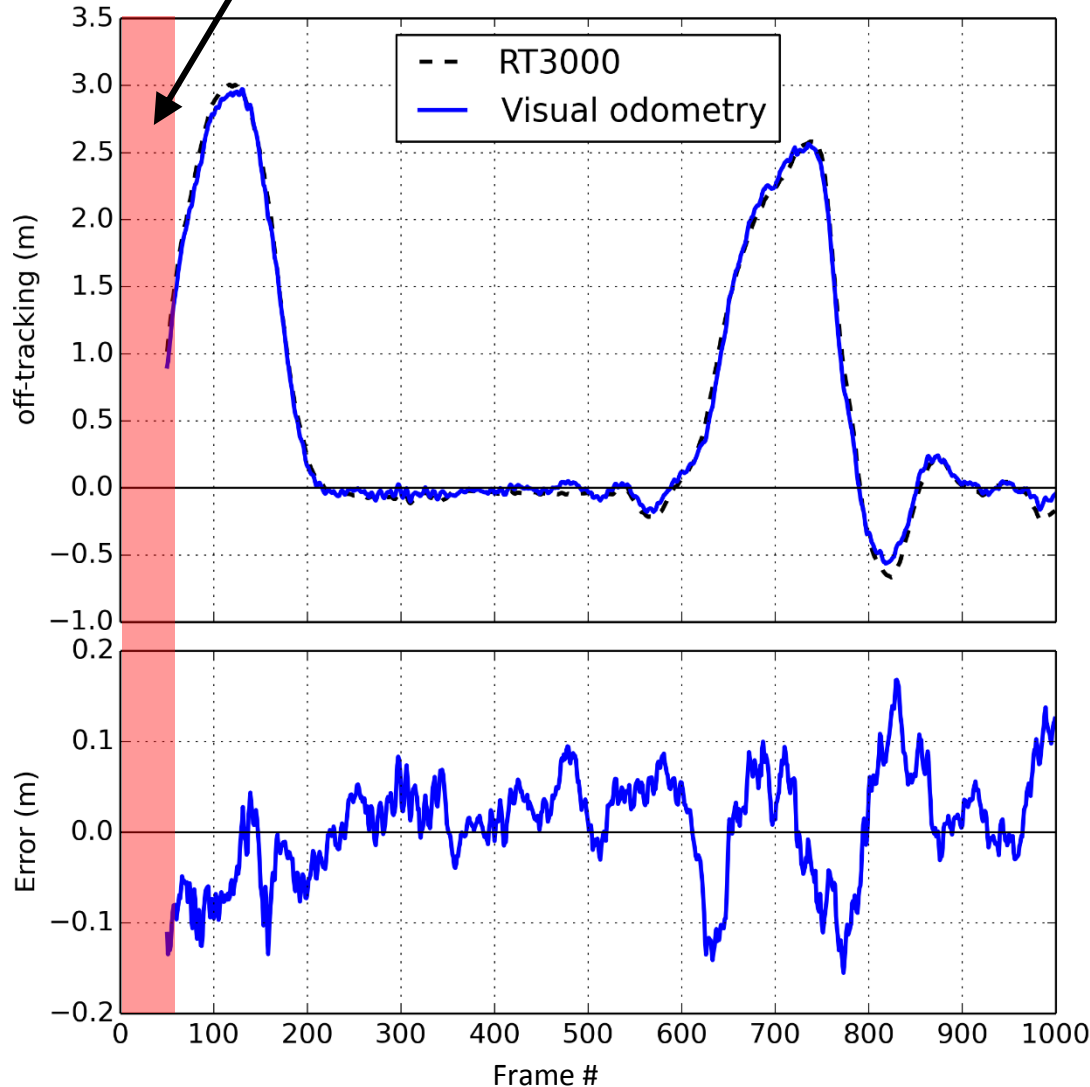
Bourn airfield, Cambs.

Vehicle tests : Preliminary results



Vehicle tests : Preliminary results

Initialisation (1 x trailer length)



Test shown:

$$e_{\text{RMS}} = 6 \text{ cm}$$

$$e_{\text{AVE}} = 1 \text{ cm}$$

$$e_{\text{MAX}} = 17 \text{ cm}$$

All tests:

$$e_{\text{RMS}} (\text{rear}) \sim 15 \text{ cm}$$

$$e_{\text{RMS}} (\text{side}) \sim 25 \text{ cm}$$

Conclusions and future work

1. Simulations (idealised, perfect cameras)
 - Accuracy ~ **1–4 cm**
 - Rear-mounted cameras best
 - Drift is bounded
2. Vehicle tests (early stages)
 - Accuracy ~ **15 cm**
 - **< 10 cm** likely obtainable after refinement
 - Rear-mounted cameras best
3. Future work
 - Ongoing open-loop tests
 - Closed loop tests off-highway

Acknowledgements



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Contact: ccd33@cam.ac.uk