DATA FROM SKY

a new point of view
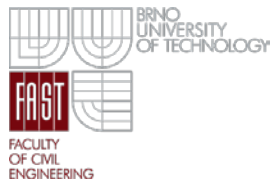
Traffic is a problem everywhere

With more than 1 billion vehicles and more than 7 billion people all over the world, traffic jams are key issues.

The total number of road traffic deaths [1] remains unacceptably high at 1.24 million every year.

The traffic jam costs can be split into:

• Road accident costs (direct and indirect)
• Environment costs (air, acoustic)
• Business costs (travel time, queues)
• Parking search costs

All drivers are involved.

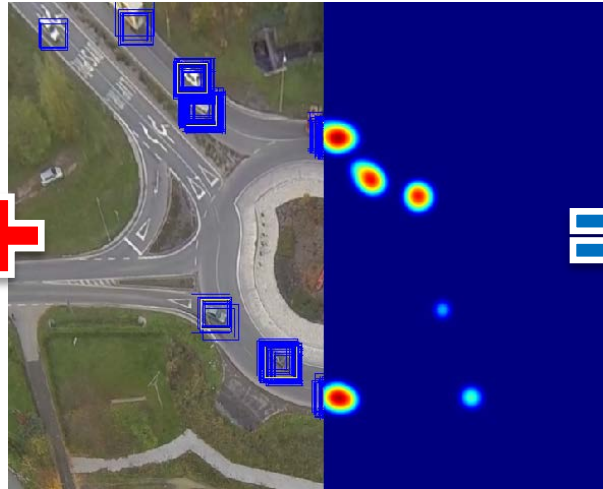(1) Global status report on road safety 2013

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Our solution

Problem: Advanced Traffic Data

Solution: DataFromSky service

Aerial video **+** DataFromSky service **=** Unlimited traffic data

DataFromSky is an advanced tool designed for monitoring and analyzing traffic flow in road networks by processing video data.

Our data

Classic traffic data
- Traffic counts
- Vehicles classification
- Gate counts
- O/D matrix

Dynamical data
- Speeds
- Lateral acceleration
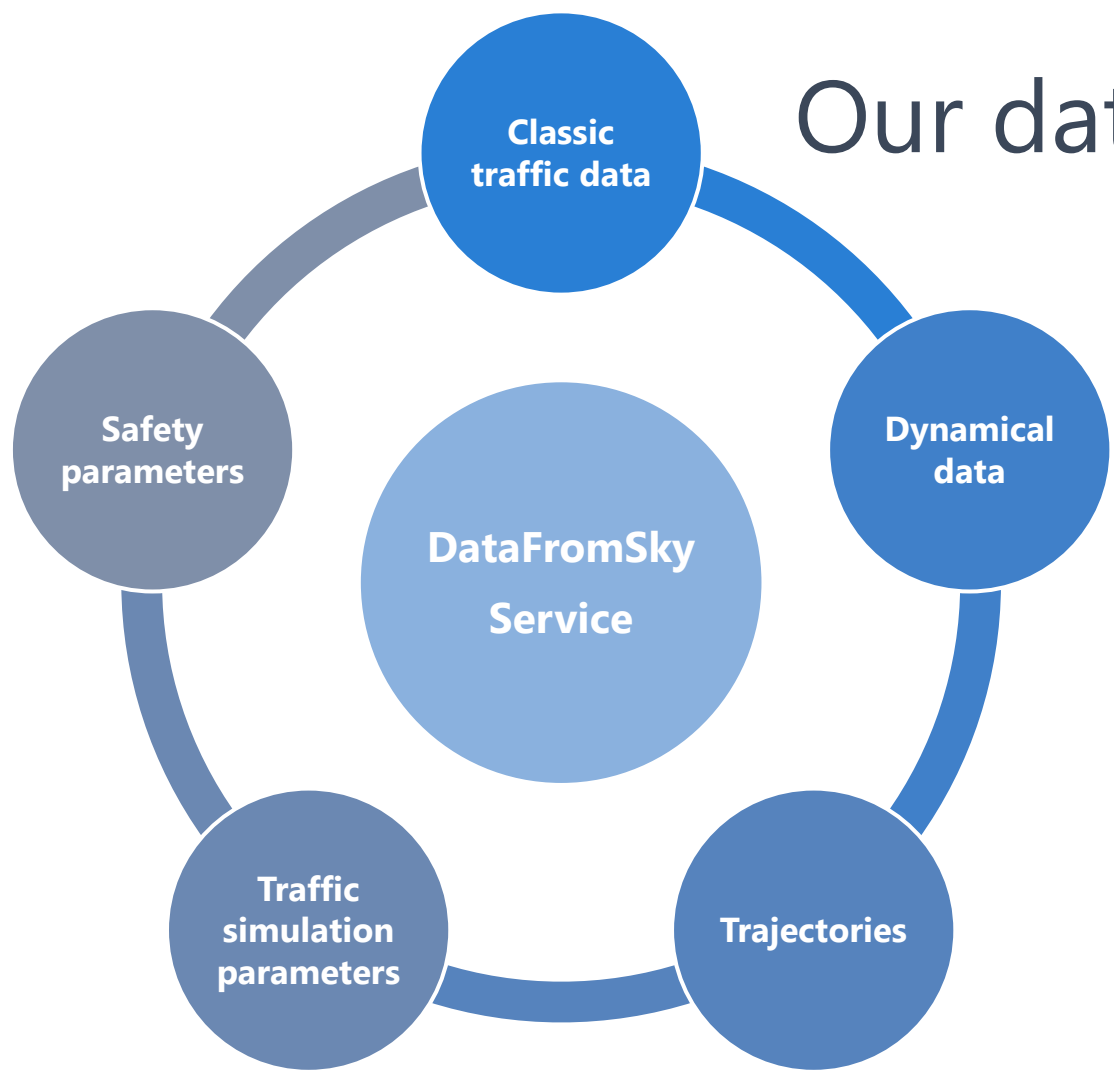- Tangential acceleration

Trajectories
- Vector format
- Clustering

Traffic simulation parameters
- Travel time
- Travel distance
- Speed profile
- Critical headway
- Follow-up headway

Safety parameters
- Time to collision
- Detection of anomalies

Race Track Monitoring

compare your driving
with others

35.3 km/h
-2.9 m/s/s

24.1 km/h
2.1 m/s/s

13.4 m
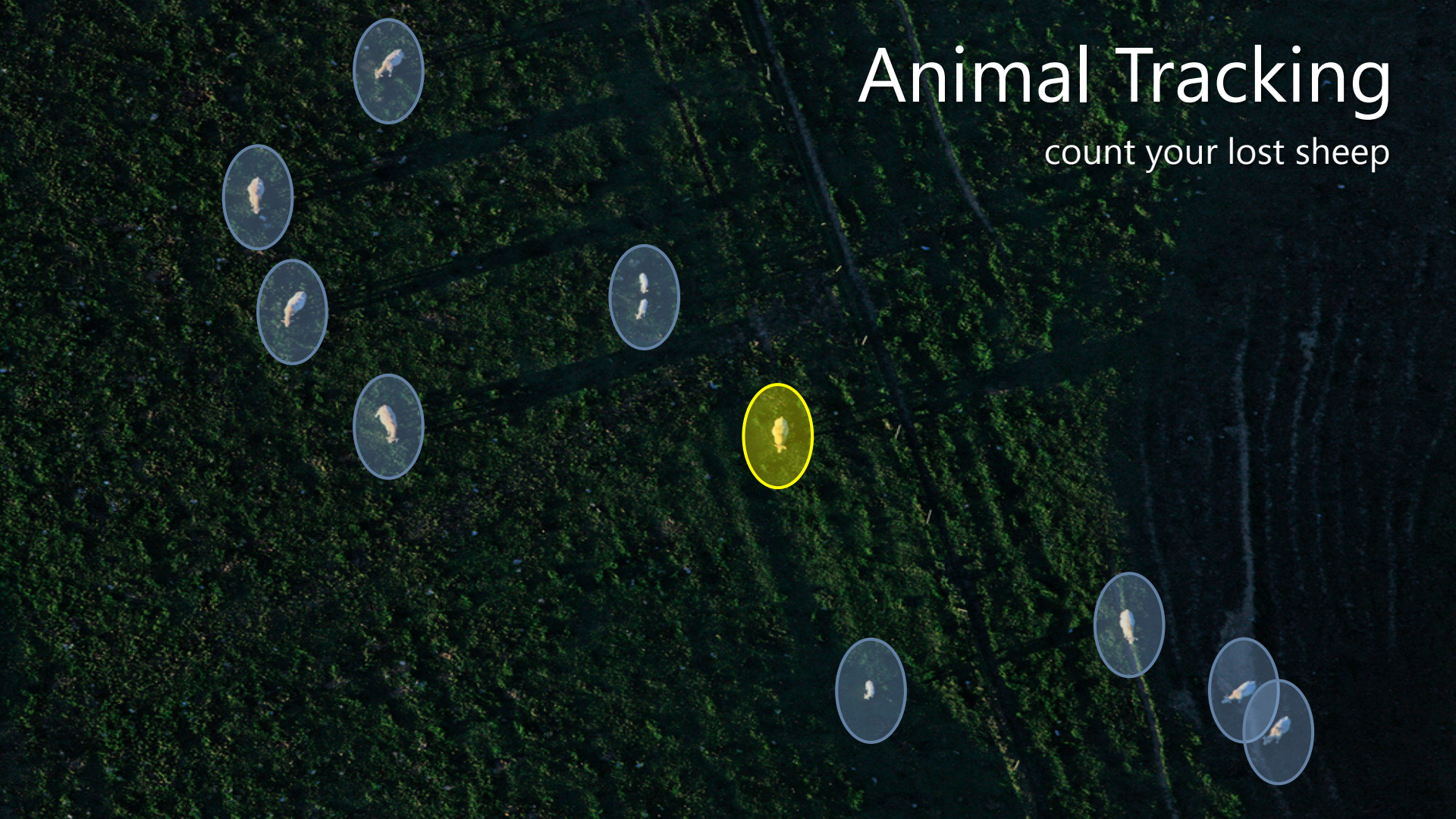
4.4 m

25.1 km/h
1.0 m/s/s

SLOW

Object Counting

no matter what, DFS will keep you updated with the numbers

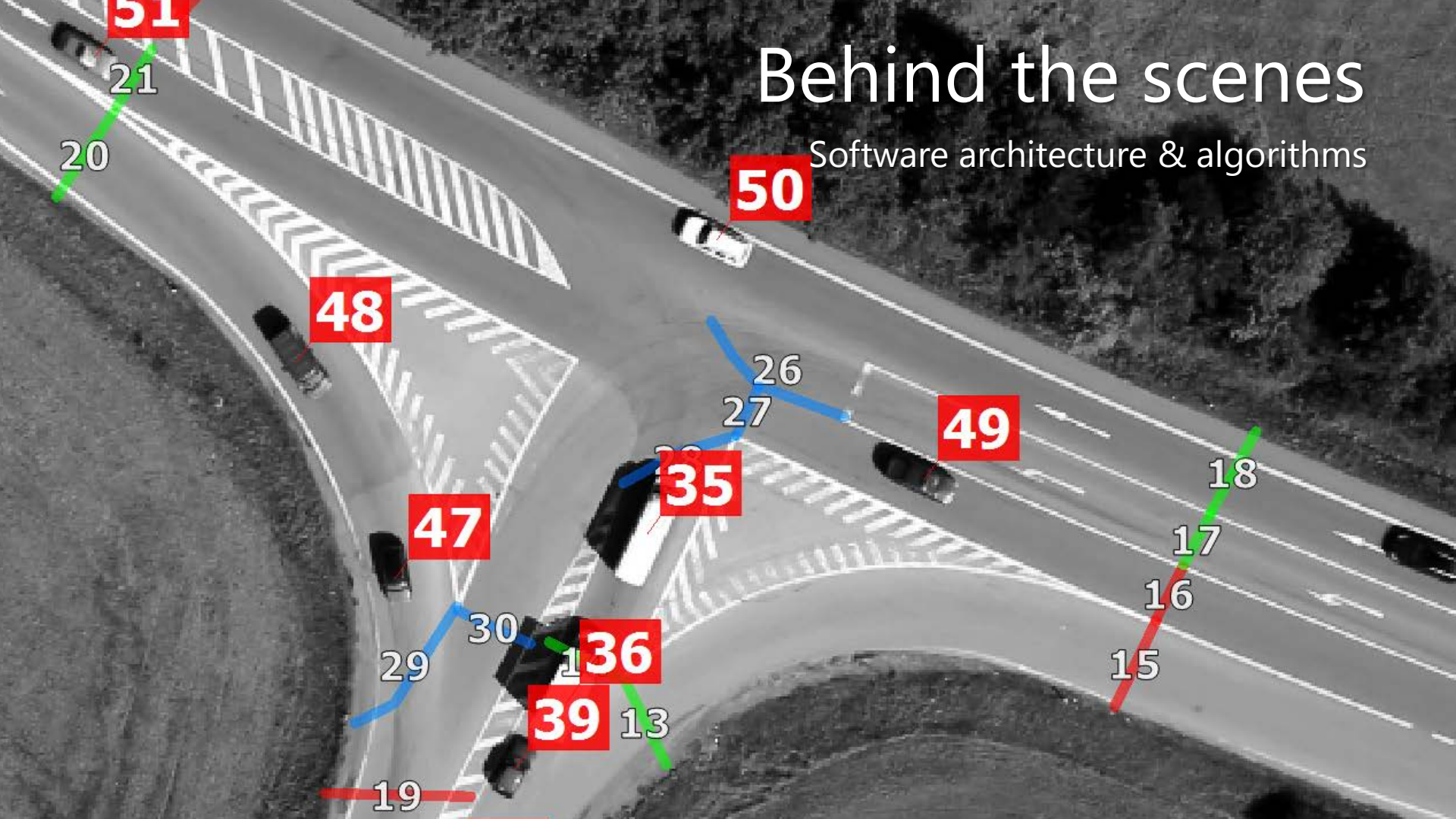Vehicles: 435, Traffic flow: 125 vehicles per hour, Occupancy: 93.5 %

Animal Tracking

count your lost sheep

Behind the scenes
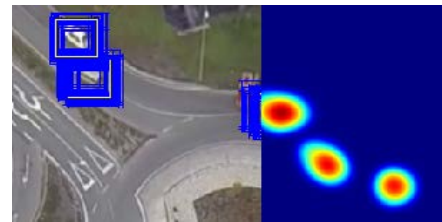
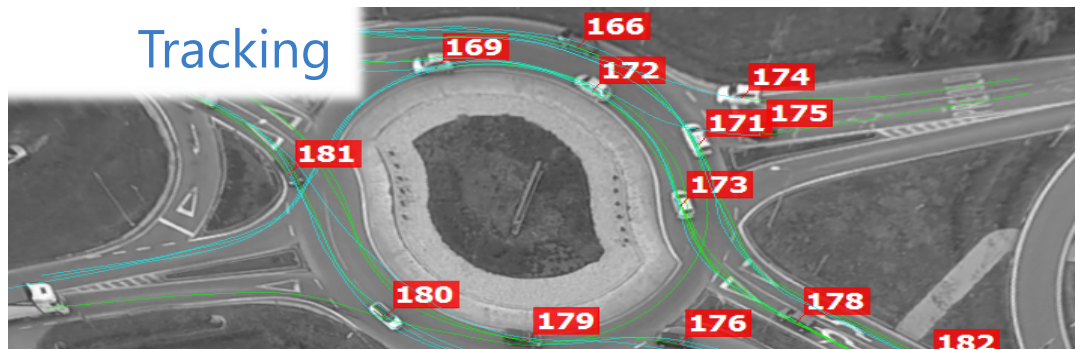Software architecture & algorithms

Basic tasks


Preprocessing

Detection

Positive

Negative

Tracking

Multi-Object Tracking

Aim: Generate complete continuous trajectories of all vehicles from given video sequence and vehicle presence clues generated in detection phase.

- Pitfalls:
  - "Tiny" targets – even down to cca 10x10 px
  - Blur due to motion and defocus
  - Low feature salinity
  - Multiple similar objects
  - Variable appearance of the same object
  - Occlusion and overlaps

Blur and low feature salinity


Variable single target appearance
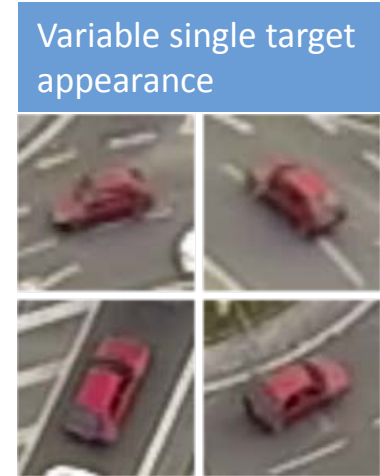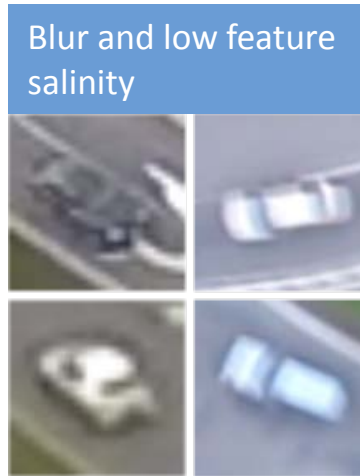
Occlusion

Multi-Object Tracking

Particle Filter

= Bayesian **Bootstrap** Filter
- able to capture multimodal probability distribution
- samples state space by particles, which represent solution candidates.

- Target Representation
  - Circular template
  - RGB + Edge colour space

- Particle
  - $\mathbf{x}$, $\mathbf{v}$, s = position, velocity and size
  - dynamic model: $\mathbf{x} = \int \mathbf{v}\, dt + \mathbf{x}_{init}$
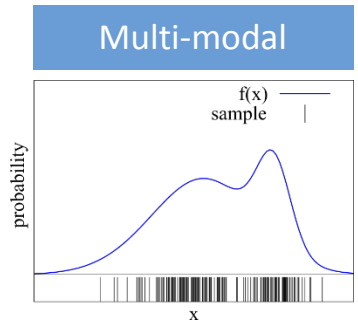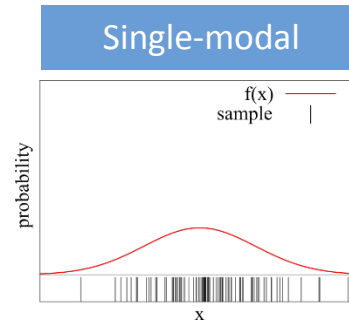
Multi-Object Tracking

Particles

- Evaluation:

$$W(p, t) = e^{App(p,t)^2 Att(p)}$$

  - Appearance similarity:

$$App(t) = \frac{1}{1 + \text{SAD}_C(T_t, T_p)}$$

  - Attraction factor:

$$Att(p) = heat\left(D_{weak}, p\right)$$

- Resampling: roulette wheel according to $W(p, t)$

- Transition: dynamics + noise
- Estimated state = best evaluated particle.

Problems:
- Fast moving targets
  - High "noise" of particle positions at the beginning of tracking
- Occlusions, overlaps, plasticity
  - Smart target representation update algorithm

Postprocess

Noisy trajectory

Postprocessing…

Smoothed trajectory

Aim: Reduce noise in generated tempo-spatial data.

Noise:
- on local scale – almost "white noise" (due to nature of particle filter)
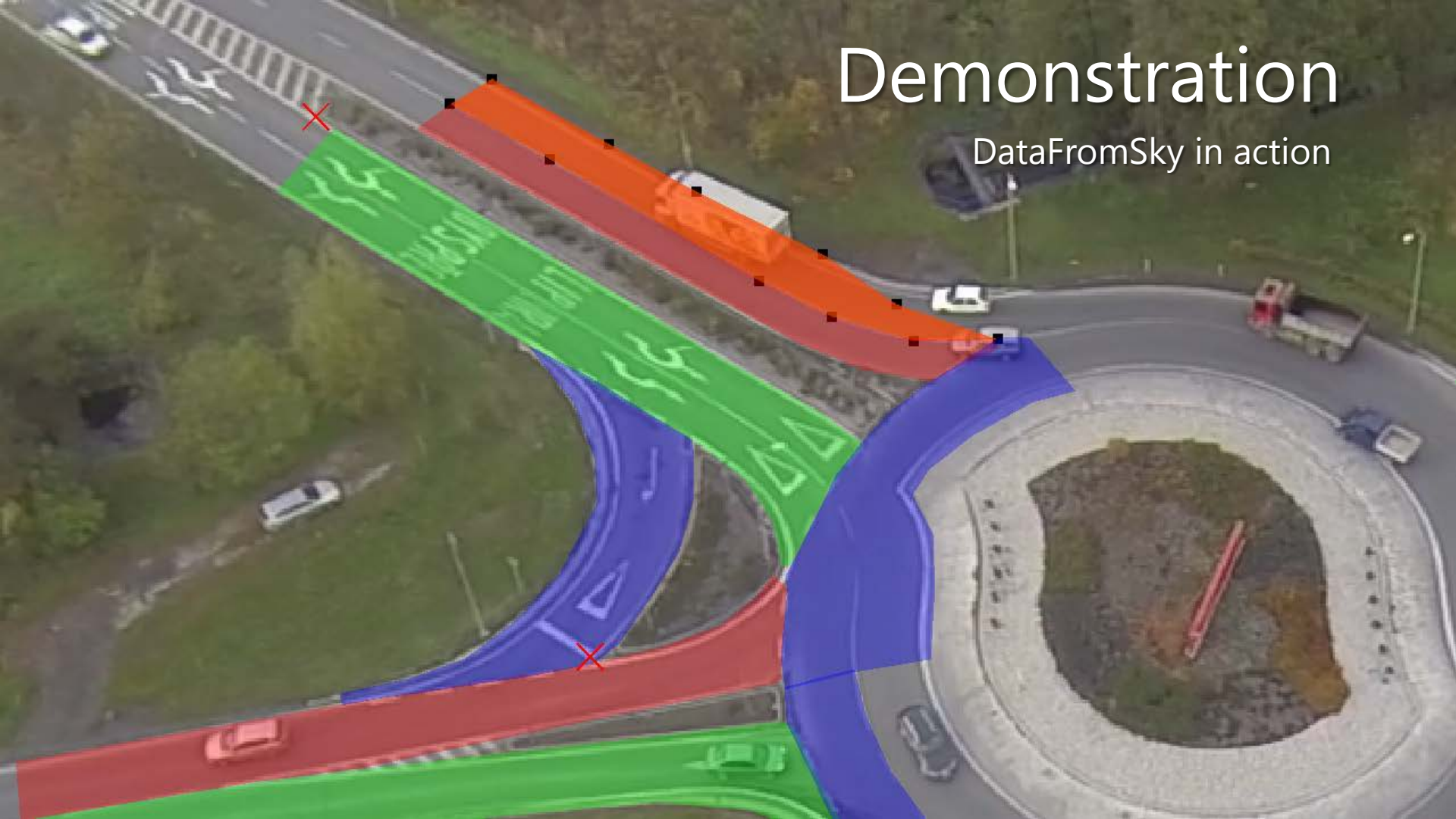- on overall scale – sudden short term deviations (occlusions, overlaps)
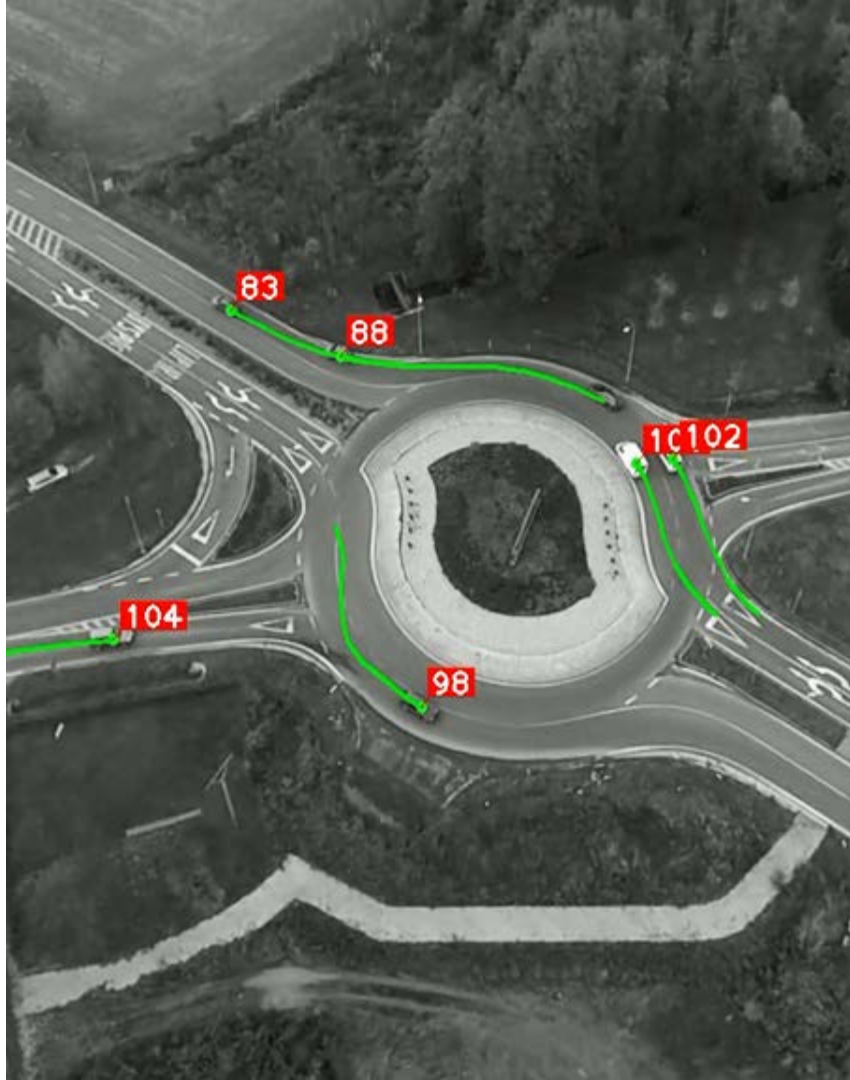
Solution:
- Local scale: approximating B-spline curve (spatial)
- Overall scale: interpolating cubic spline curve (spatial) and monotone piecewise cubic interpolation (time-distance) to maintain continuity of vehicle velocity.
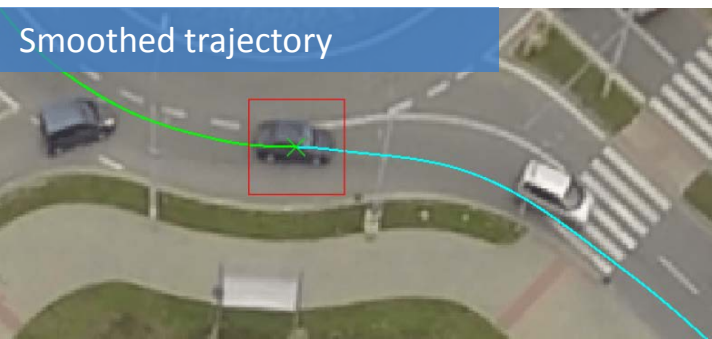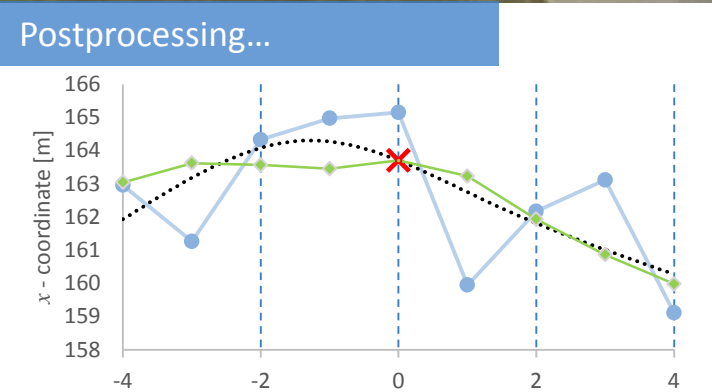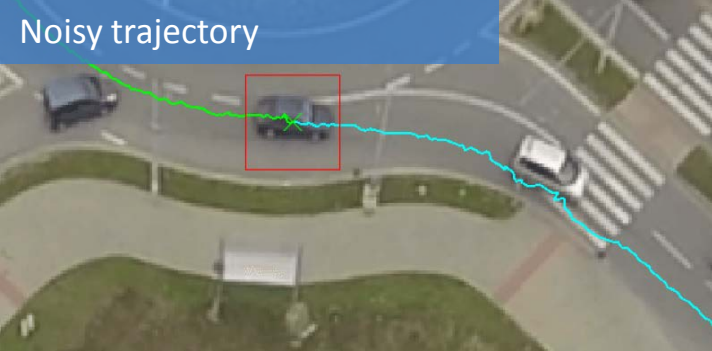
DataFromSky in action

Follow our project!

See our videos on:

- vimeo.com/datafromsky
- www.datafromsky.com
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