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Modeling and Simulation Framework for Airborne Camera Systems

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Overview

Introduction

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- Motivation

Simulator Capabilities Overview

Camera Geometry and Sensor Platform

Experimental Result

- Structure from motion using FMV
- Generation of a simulated WAMI dataset for vehicle detection

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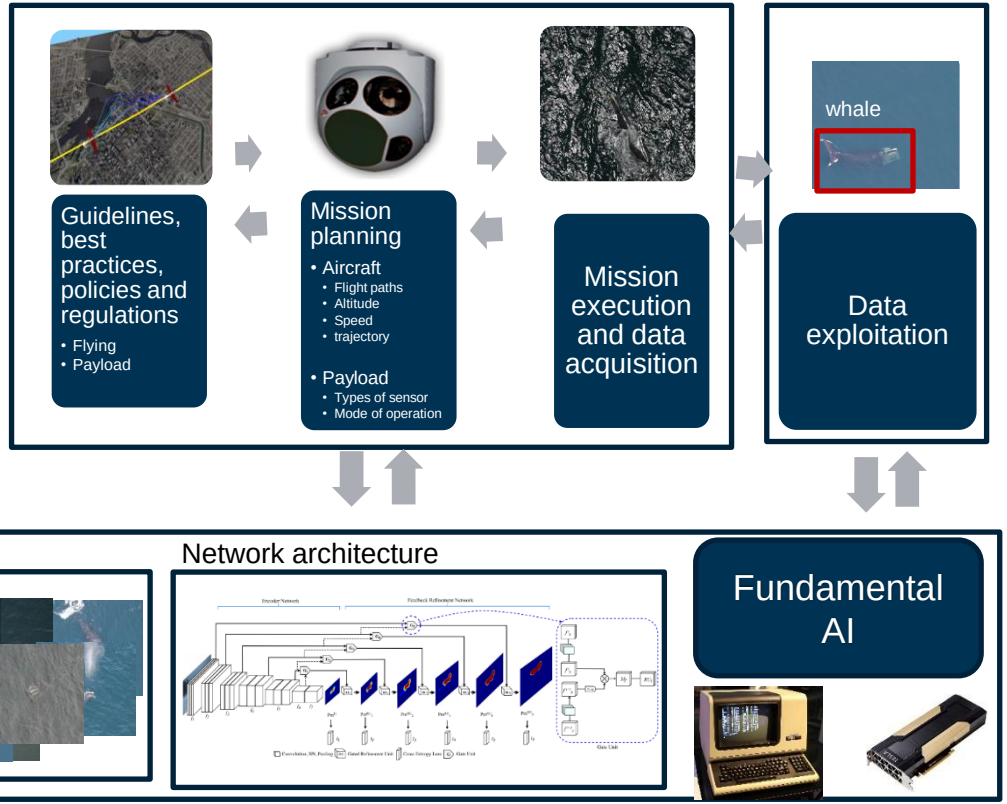
Modeling and Simulation Framework for ACS

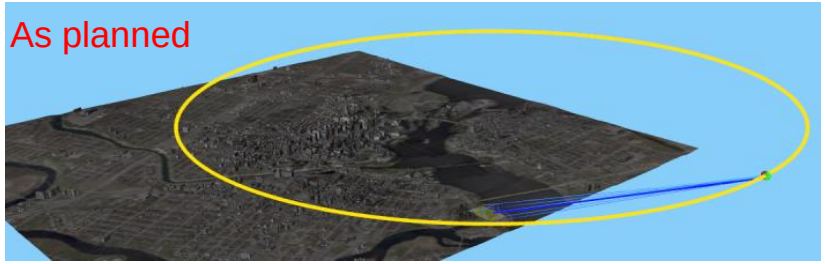
Motivation

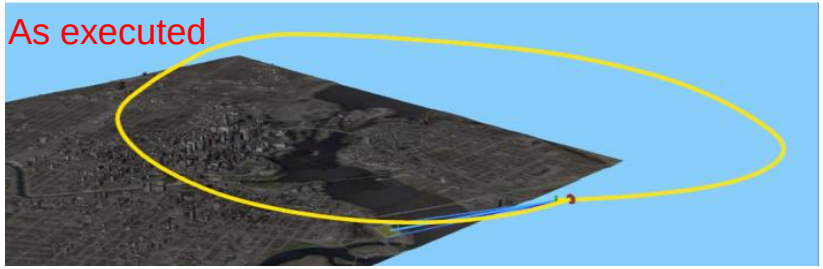
- M&S is a powerful and low-cost solution to characterize and optimize the performance of ACS for specific applications.



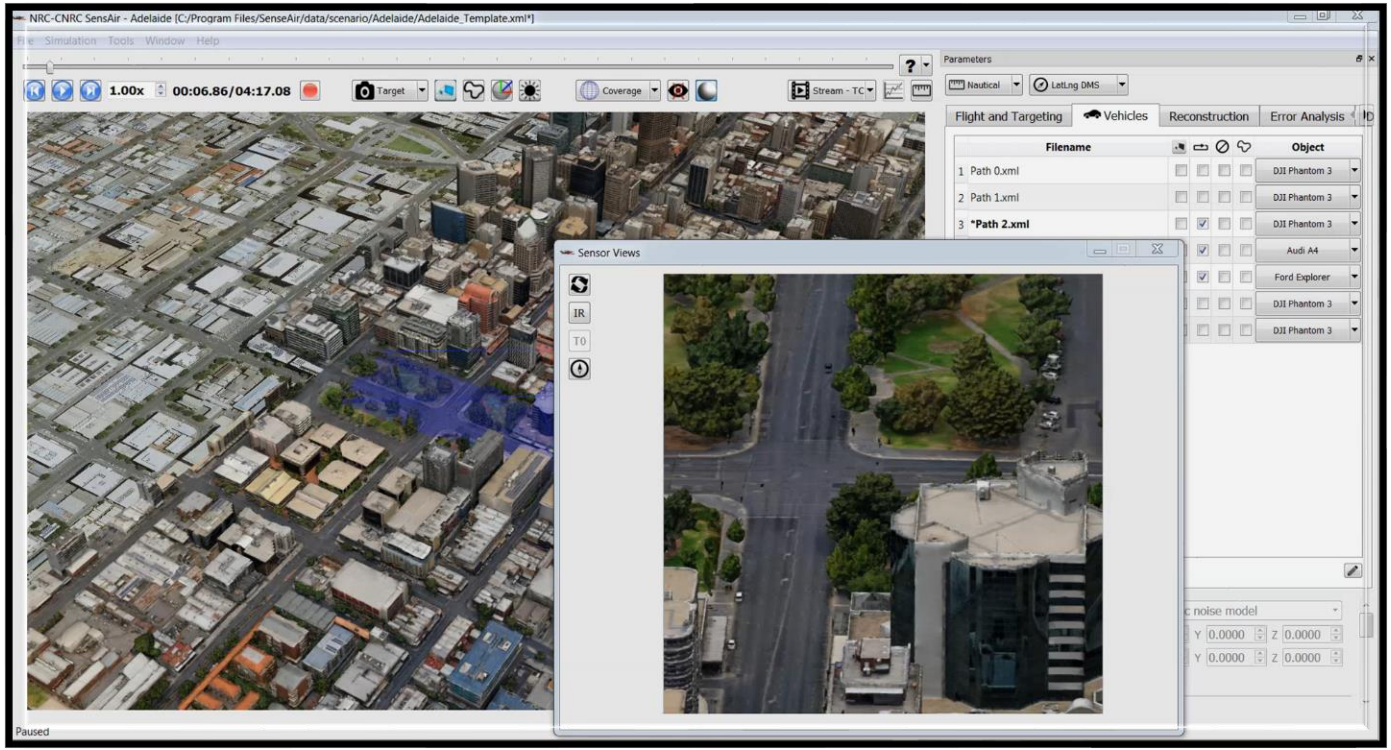
Simulator Capabilities Overview

Simulated entities	Image processing	Imaging Sensors
- Vehicles, drones (3D models) - Trajectory (SUMO, generation tool) - Terrain (DEM, 3D models)	- Style transfer (real to synthetic) - Range image generation - Feature matching	- Configurable optics - Configurable camera pose - Variable zoom and focal lengths
Interfaces	**Camera geometry**	**Sensor platform**
- Video streaming - Images and trajectory recording - Remote control interface and API	- Epipolar geometry assessment - Homography assessment - Monte Carlo simulation	- Land and airborne platforms - Configurable trajectory - Simulated GPS and IMU





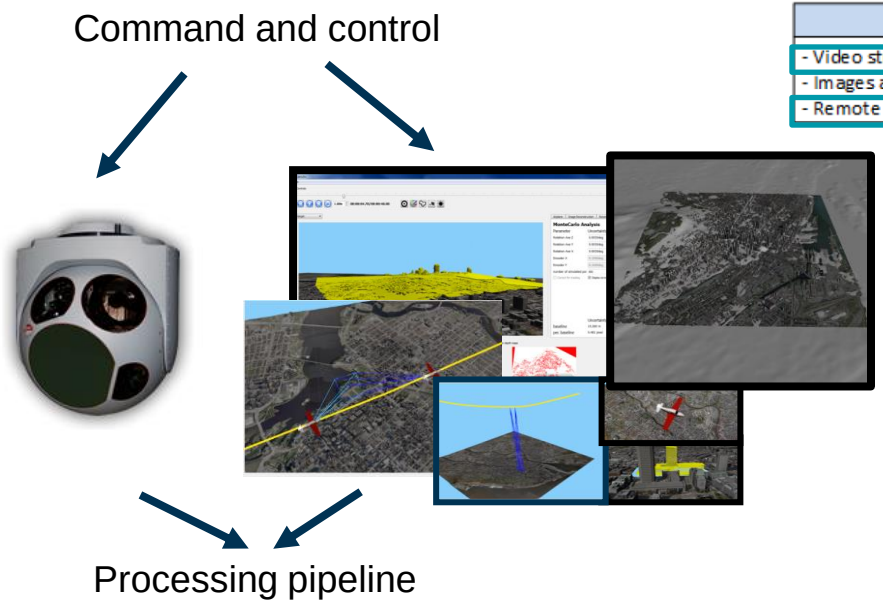
Simulator Capabilities: Simulated Entities



multi-resolution rendering techniques [Borgeat et al. 2005]

Simulator Capabilities: Interfaces

Digital Twining Application



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Video Streaming:

- STANAG 4609 H.264
- HD-SDI
- Proprietary binary format

Remote control interfaces:

- web-based
- TCP/IP

Simulator Capabilities: Image Processing

Realistic Imagery

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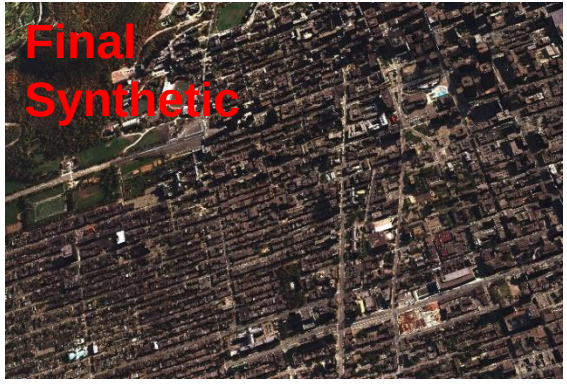

Camera Geometry and Sensor Platform

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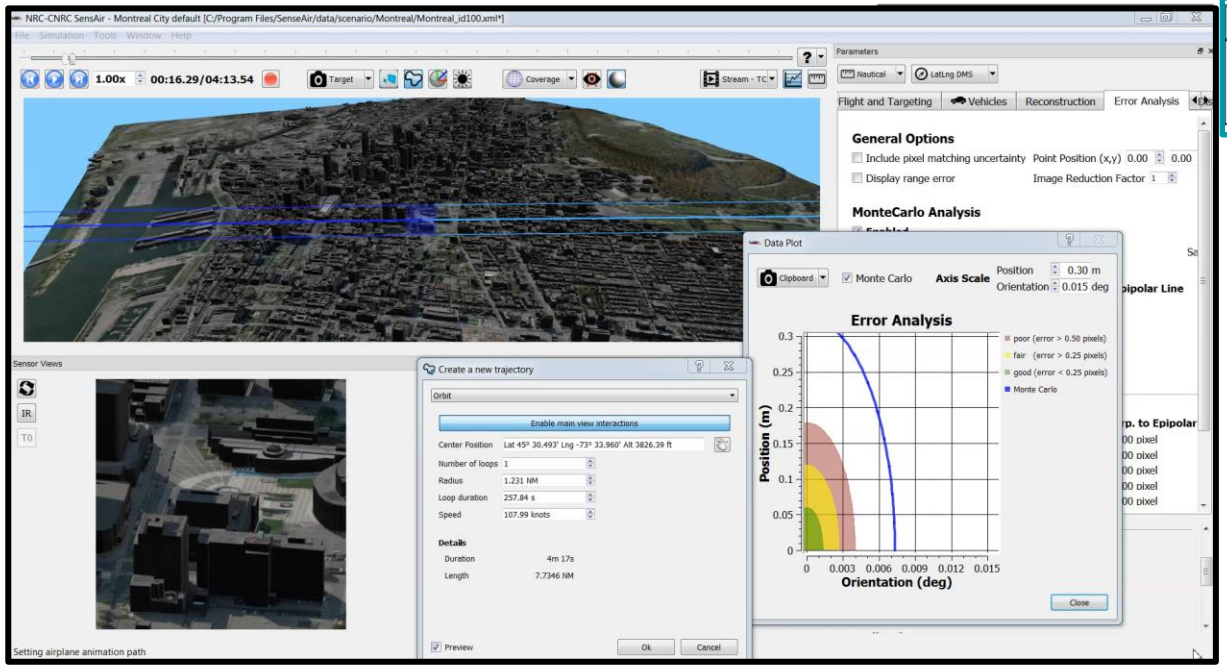
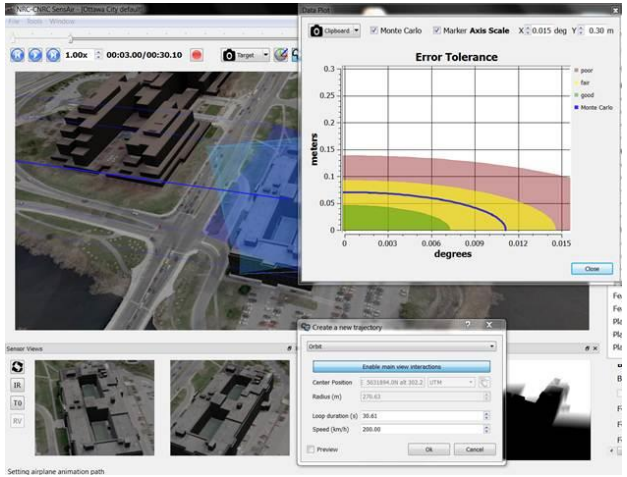


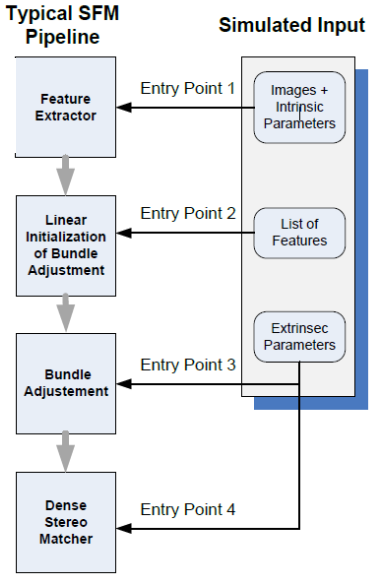
Structure from motion using FMV

4-step optimization of the SfM pipeline from aerial imagery

Step 1



Step 2



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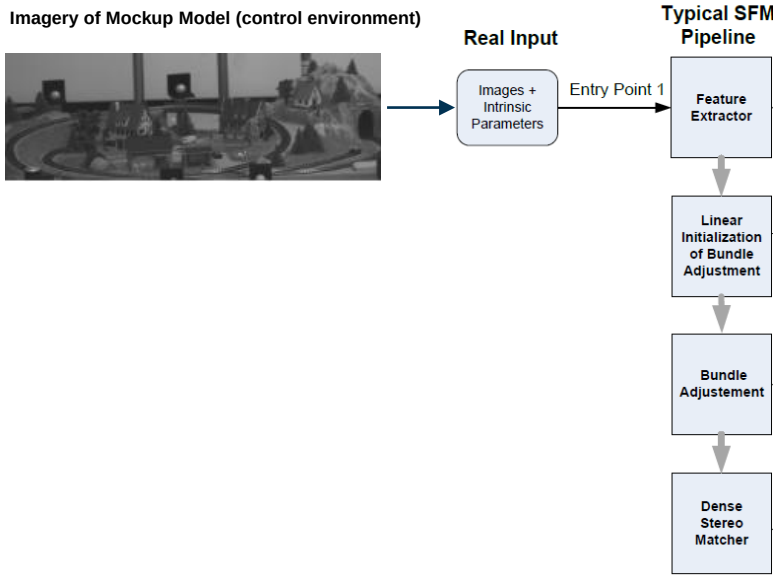
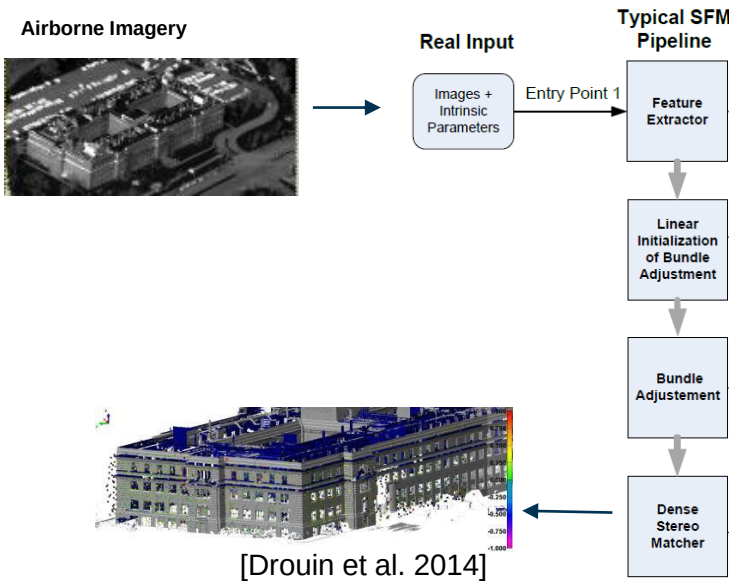
Step 3



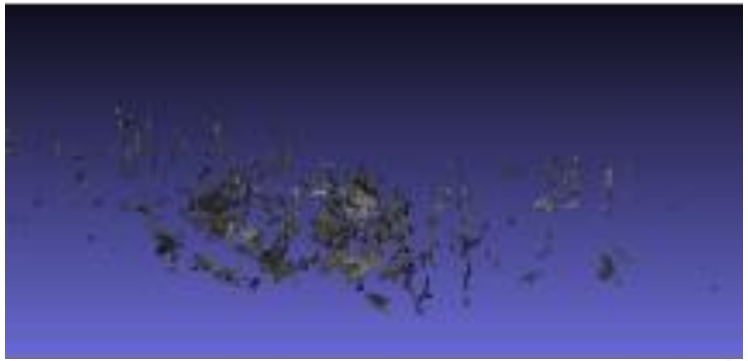
Step 4

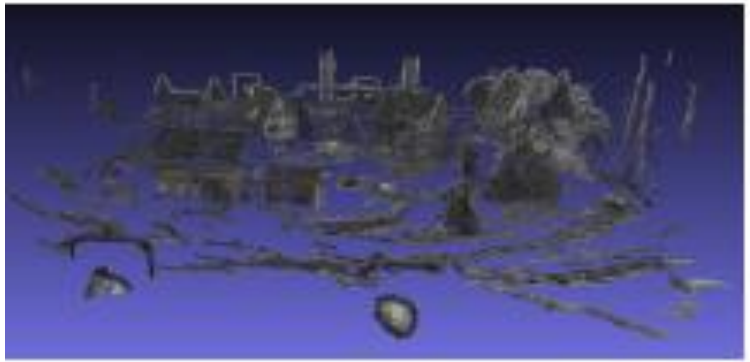


[Drouin et al. 2014]

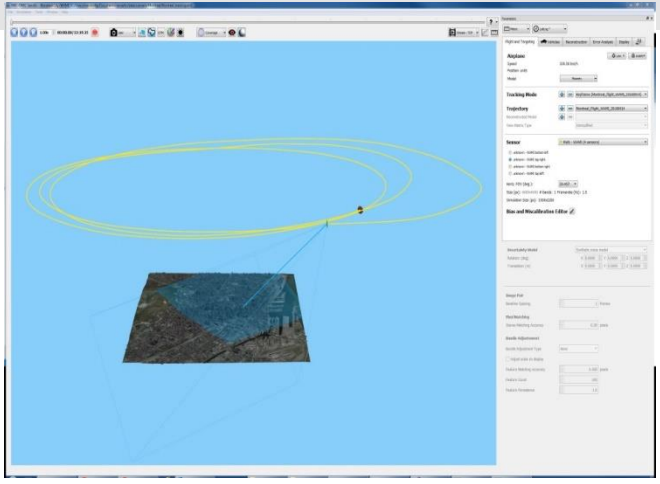
Structure from motion using FMV

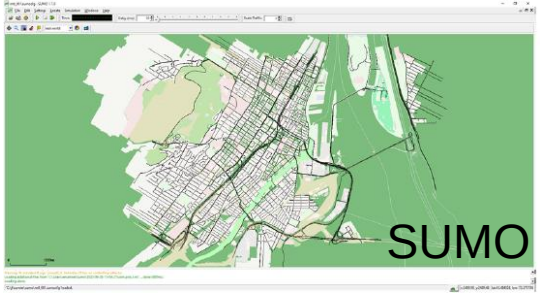
	Scale Model (1:220)	Real size equivalent
Camera altitude	2.67 m	587 m
Target ground distance	11.89 m	2615 m
Target distance	12.12 m	2680 m
Camera field of view	2.4 deg.	2.4 deg.
Target area	0.45 m x 0.30 m	99 m x 66 m
Target height variation	0.12 m	26 m





Generation of a simulated WAMI dataset for vehicle detection





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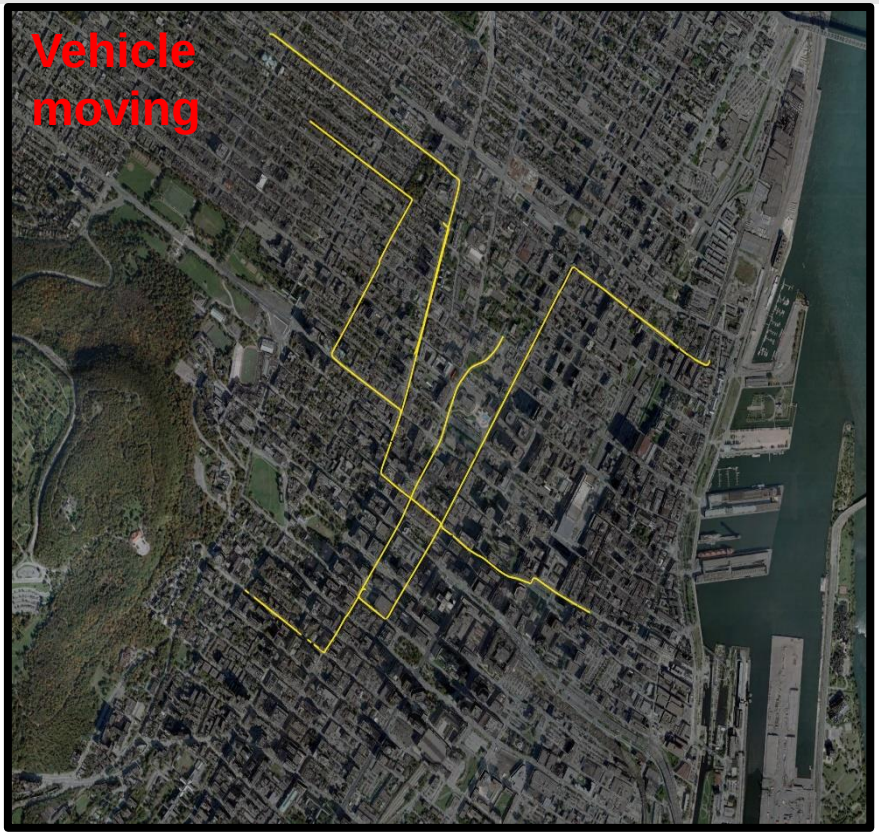

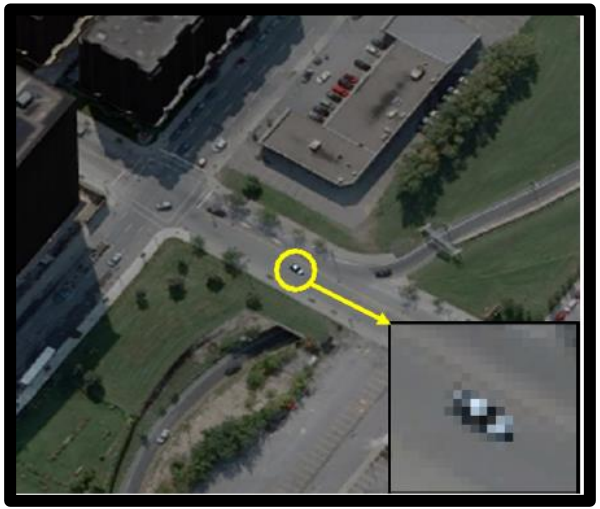

Conclusion

The proposed M&S framework provides tools to study the factors impacting the processing of aerial images using computer vision approaches.

The analysis tools are especially useful:

- for examining scenarios where the camera geometries are close to degenerate configurations.
- for the simulation of airborne data collection in varied urban environments.

THANKS

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