University of Applied Sciences
Northwestern Switzerland

3D Vision Based Mobile Mapping and Cloud-Based Geoinformation Services

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Beyond Limits – Developments in Cadastral Domain
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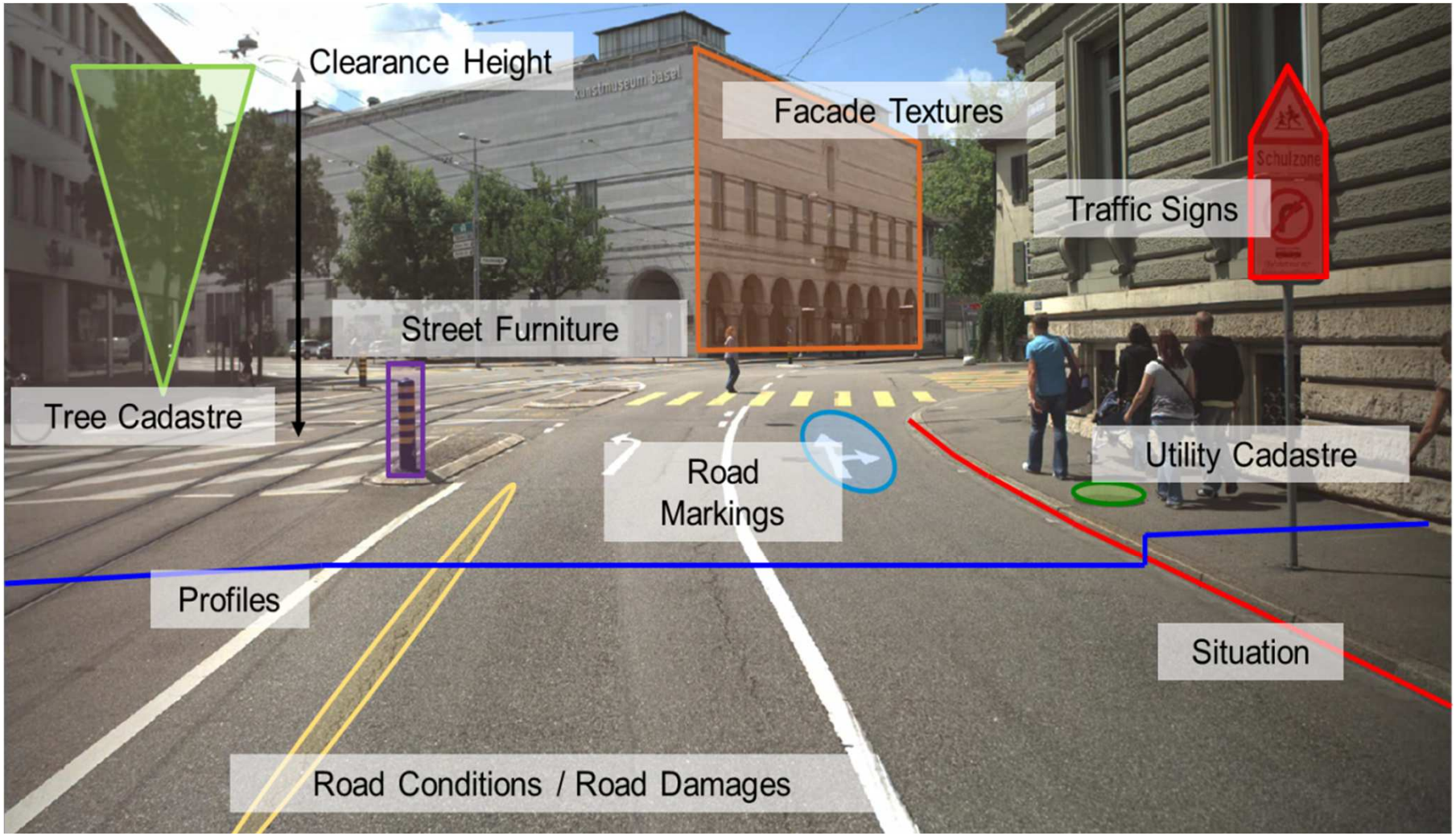
Zurich, Switzerland, 19-20 March 2015

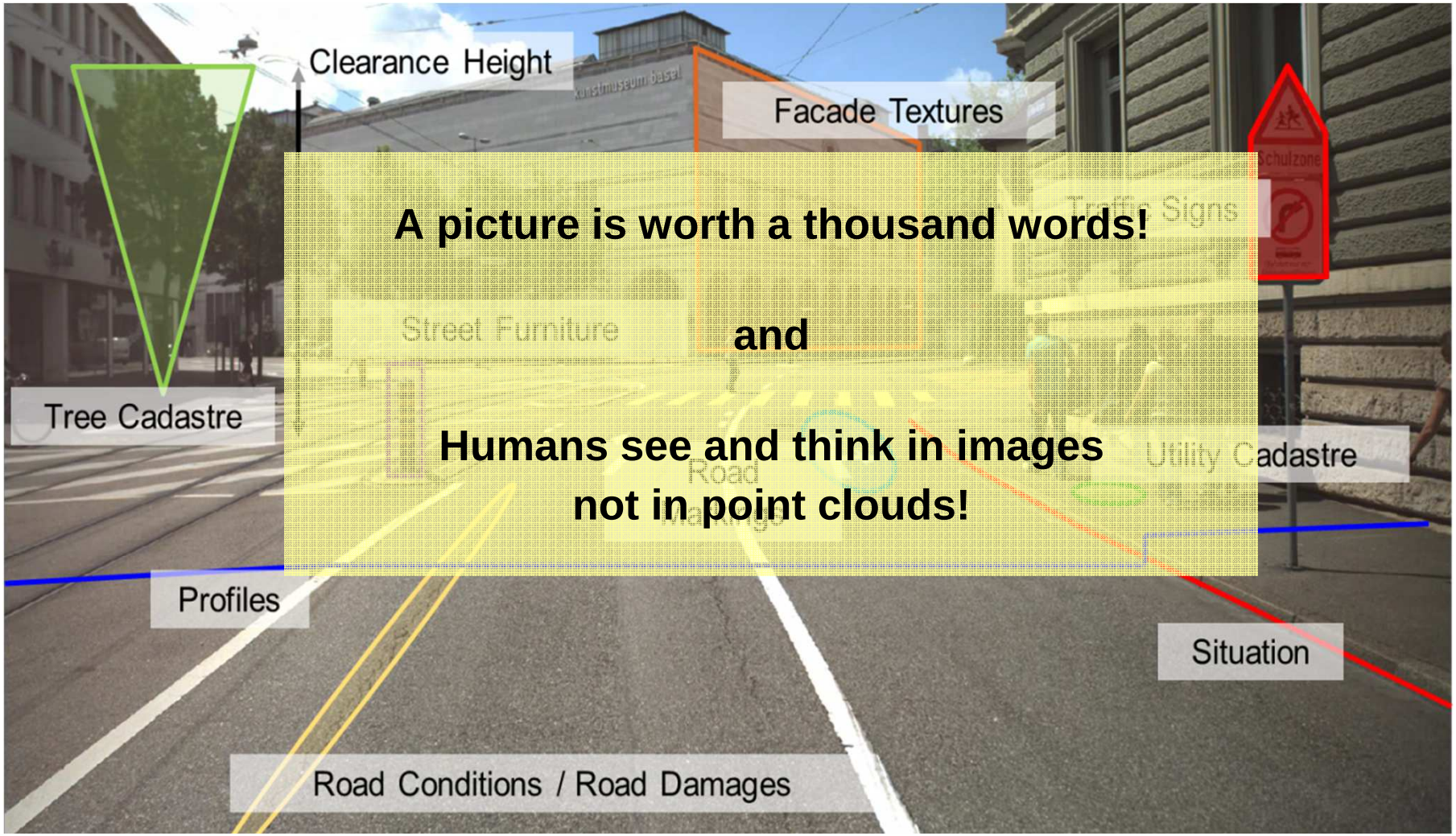
The vast majority of Mobile Mapping relies on Laserscanning

So why Imagery and why 3D Image-based Mobile Mapping?

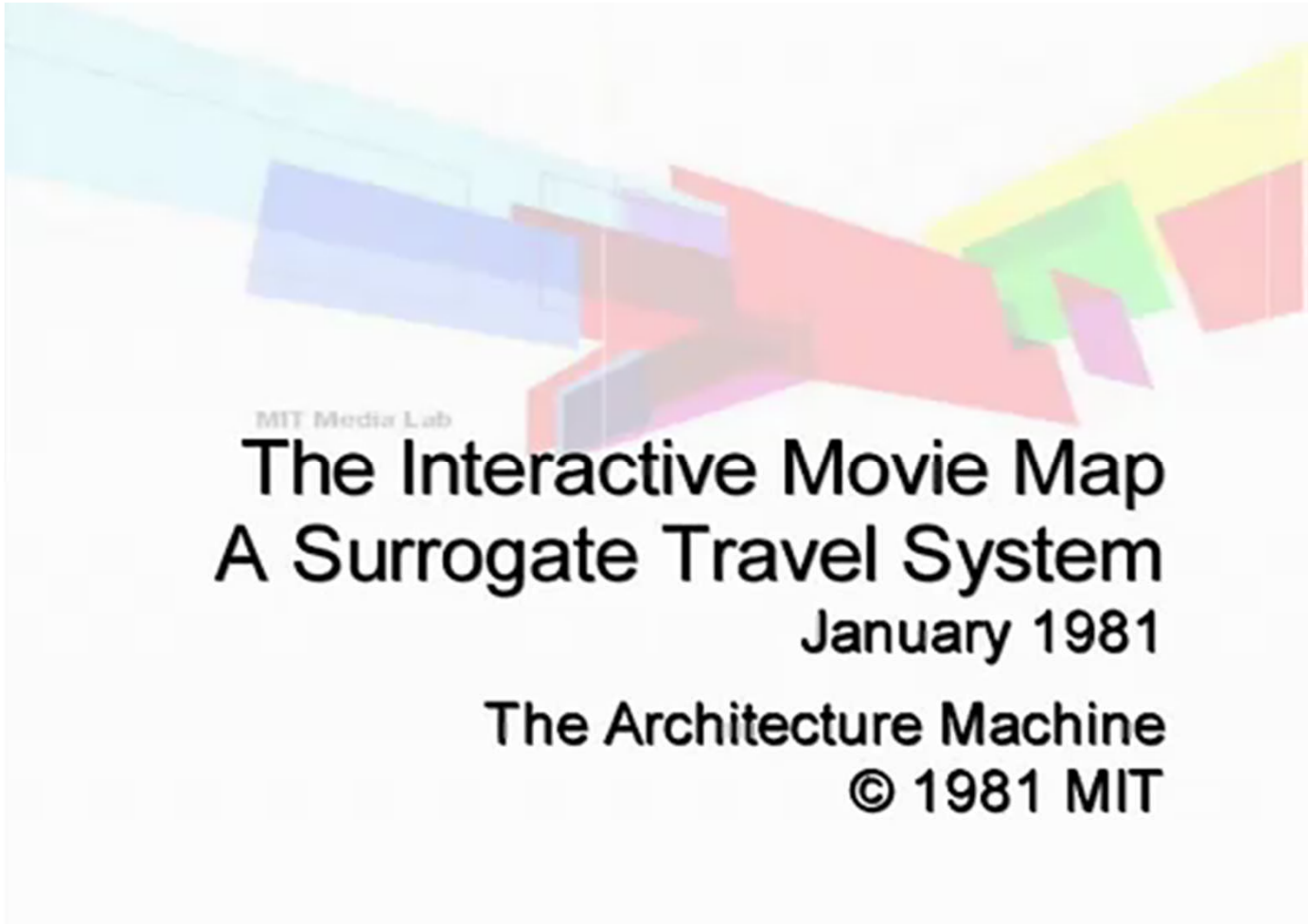


An estimated 90% of Mobile Mapping relies on Laserscanning

So why Imagery and why 3D Image-based Mobile Mapping?



Aspen Movie Map – An Early Street View Vision



Visionary Features

- Interactive navigation
- Linking of video with 2D map
- Multi-temporale imagery contents
- Multimedia contents (Images, sound, video)
- Augmented display
- Touch interface
- Voice output

Lippman, A., 1980. Movie-maps: An application of the optical videodisc to computer graphics. ACM SIGGRAPH Computer Graphics 14(3): 32-42.

Background

The Street View Idea

– There was life before Google (Street View) …

Why not successful in the 1980es – why now?

Recent tremendous progress in …

– Digital cameras
– Storage capacity and performance
– Network bandwidths
– Cloud computing (massive / on-demand computing and storage capacities)
– New Web technologies (web programming language / plug-in free solutions)

Outline

Introduction / Motivation

Vision

Technology

Applications

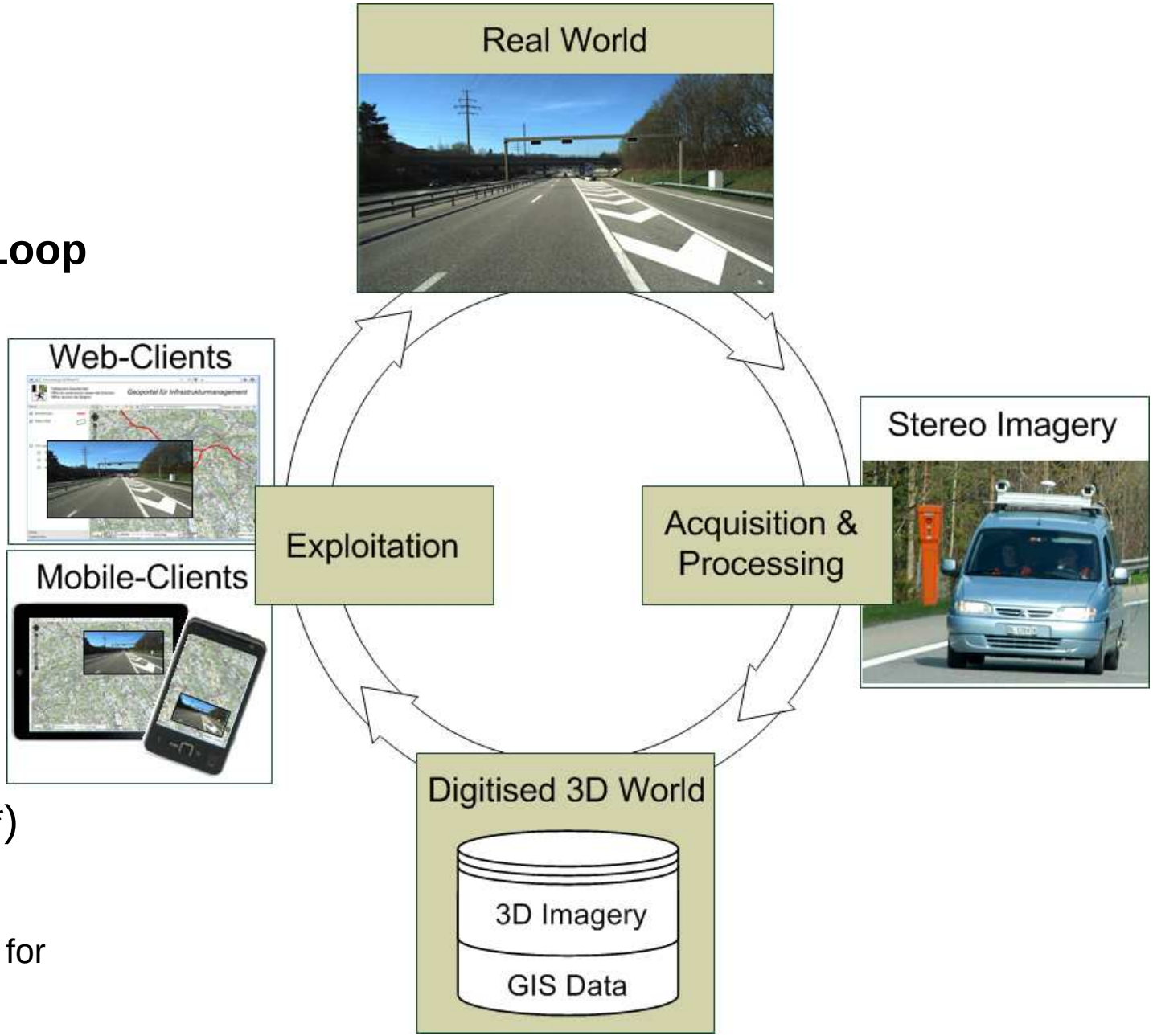
Conclusion and Outlook

Vision

The 3D Geoinformation Loop

based on

Intelligent 3D Image Spaces



Research Projects

- SmartMobileMapping (*)
- infraVIS (*)

(*) supported by the Commission for Technology and Innovation CTI

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3D Vision Mobile Mapping – Acquisition Systems

Mobile Platform

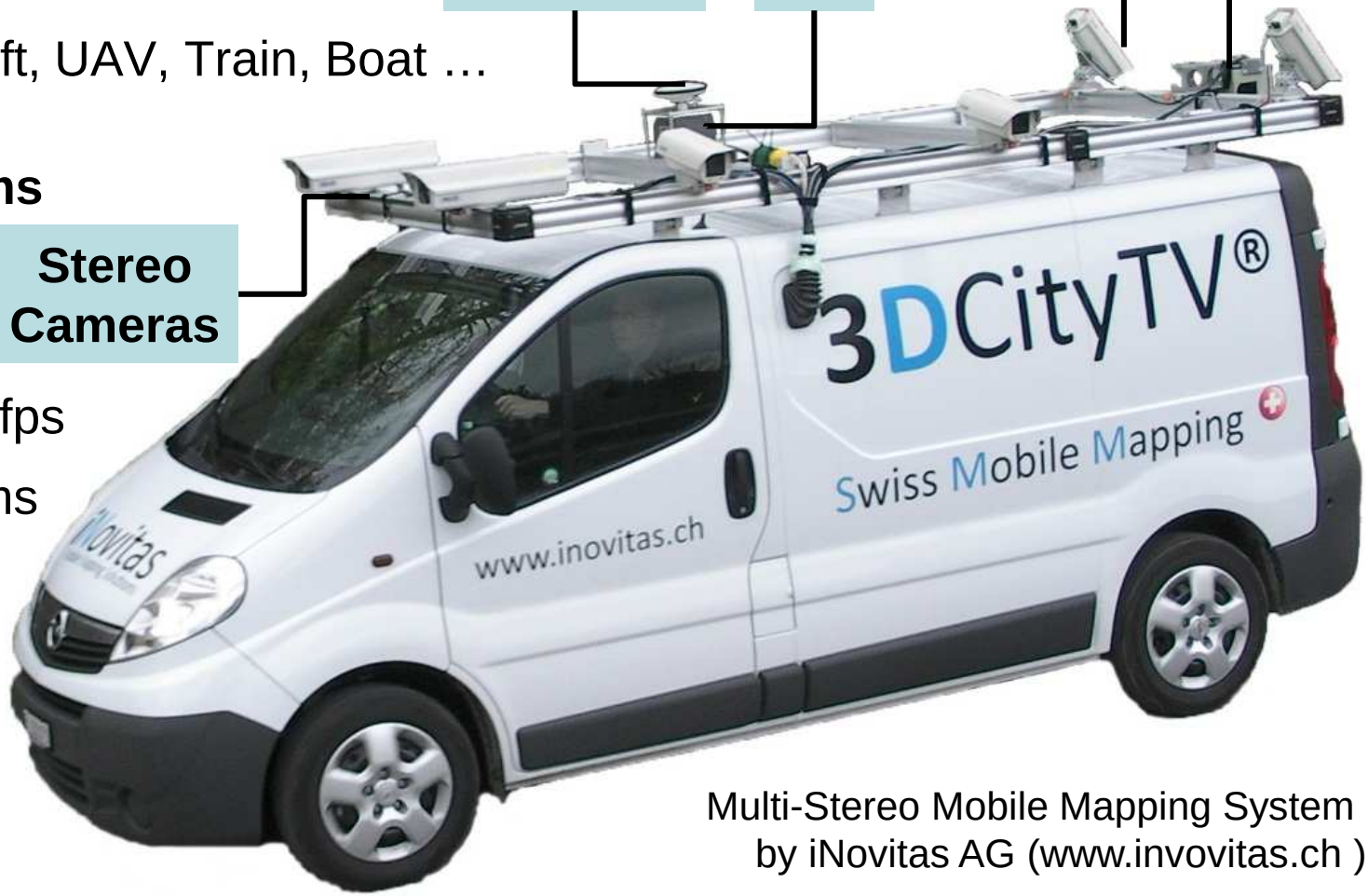
– Motor Vehicle, Aircraft, UAV, Train, Boat …

Multiple Stereo Systems

– high-performance industry cameras
– up to 11 MP, 5 to 30 fps
– up to 5 stereo systems (i.e. 10 cameras)

Onboard data storage

– highly parallel
– 1-2 TB per hour



Multi-Stereo Mobile Mapping System
by iNovitas AG (www.invovitas.ch)

3D Vision Mobile Mapping – Components and Workflow

3DCityTV®

Georeferenced
3D Imagery
& 3D Videos

Mono
Clients

Stereo
Clients

Acquisition | Processing | Hosting | Exploitation

infra3D Technology – Processing

System calibration

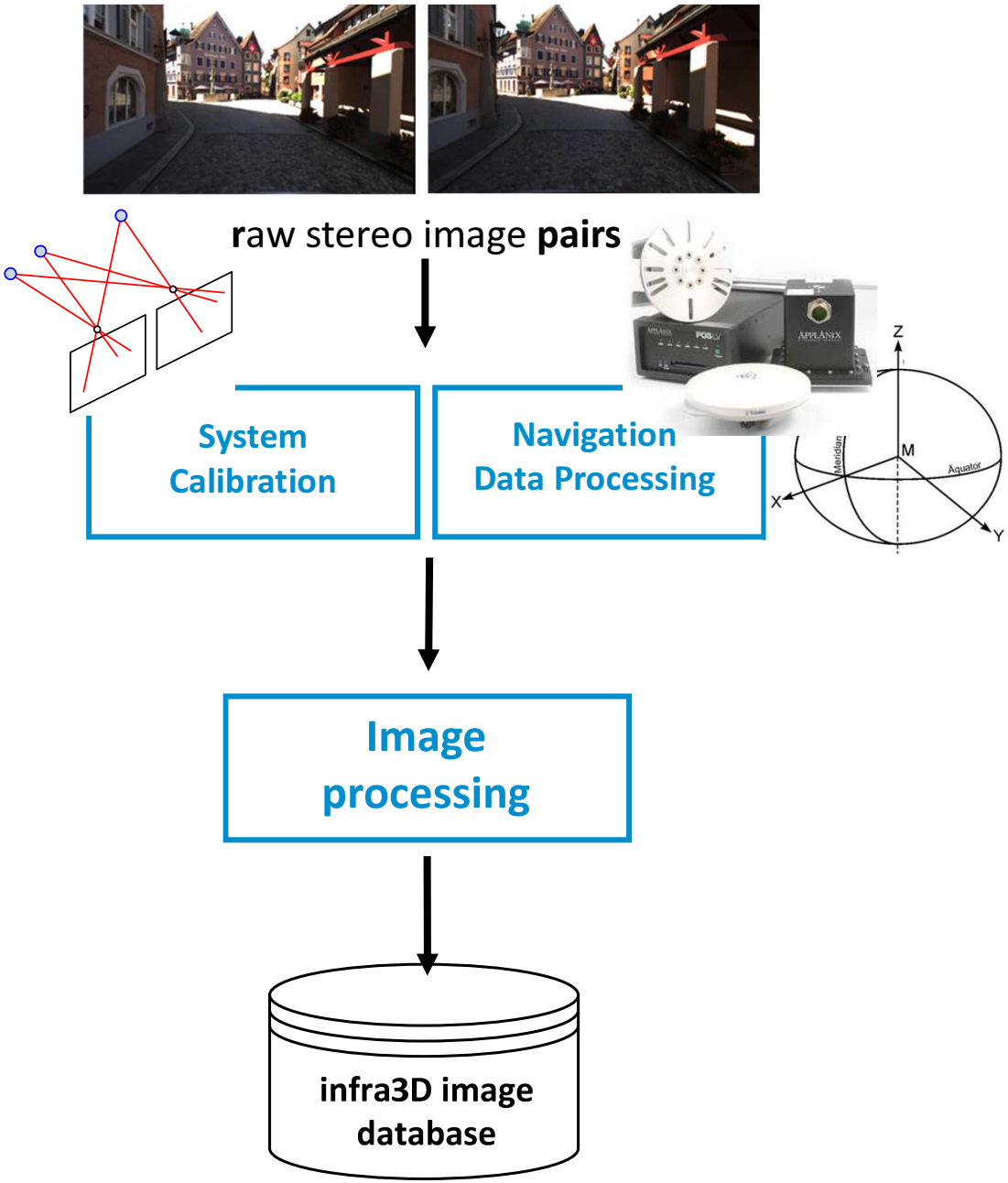
INS/GNSS navigation data processing

- Direct sensor orientation – DSO (Standard)
- Integrated sensor orientation – ISO (if required)

Stereo image normalisation

3D image generation

3D image database population



3D Image Generation by Dense Image Matching

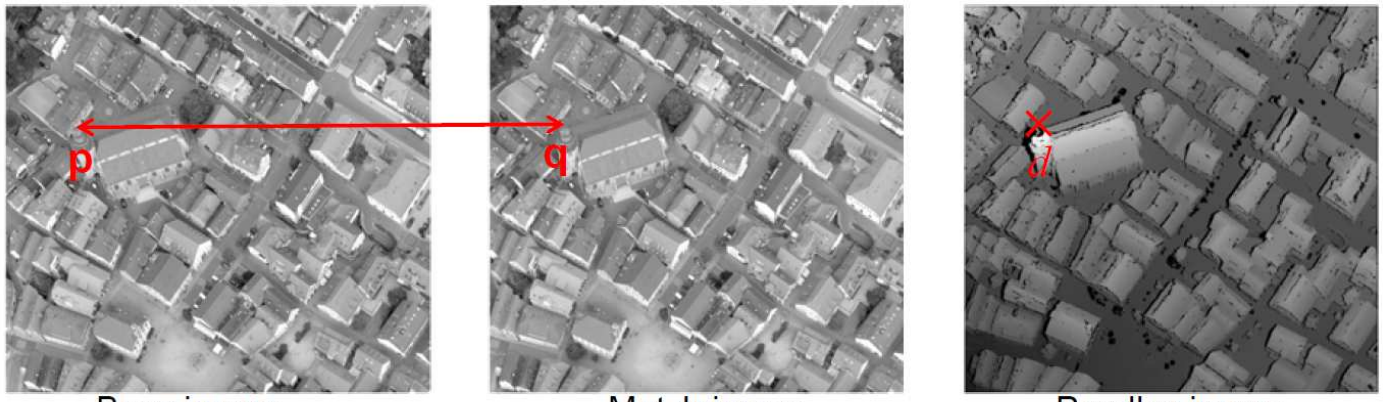
Goal: depth / distance computation for each pixel

Semi-Global Matching (SGM)

Hirschmüller, H., 2008. Stereo processing by semiglobal matching and mutual information. IEEE transactions on pattern analysis and machine intelligence, 30(2), pp.328–41.

Dense matching of aerial stereo image pair and resulting disparity map

Haala, N., 2011. Multiray Photogrammetry and Dense Image Matching.

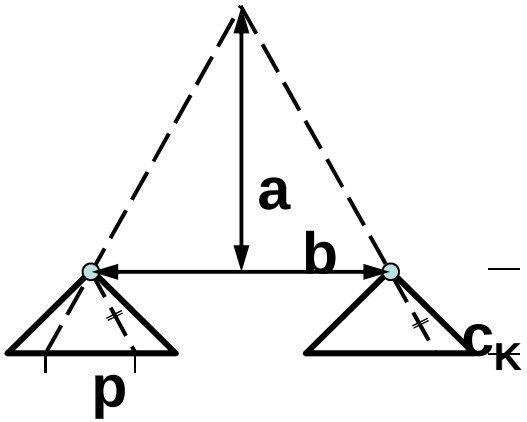


Base image | Match image | Parallax image

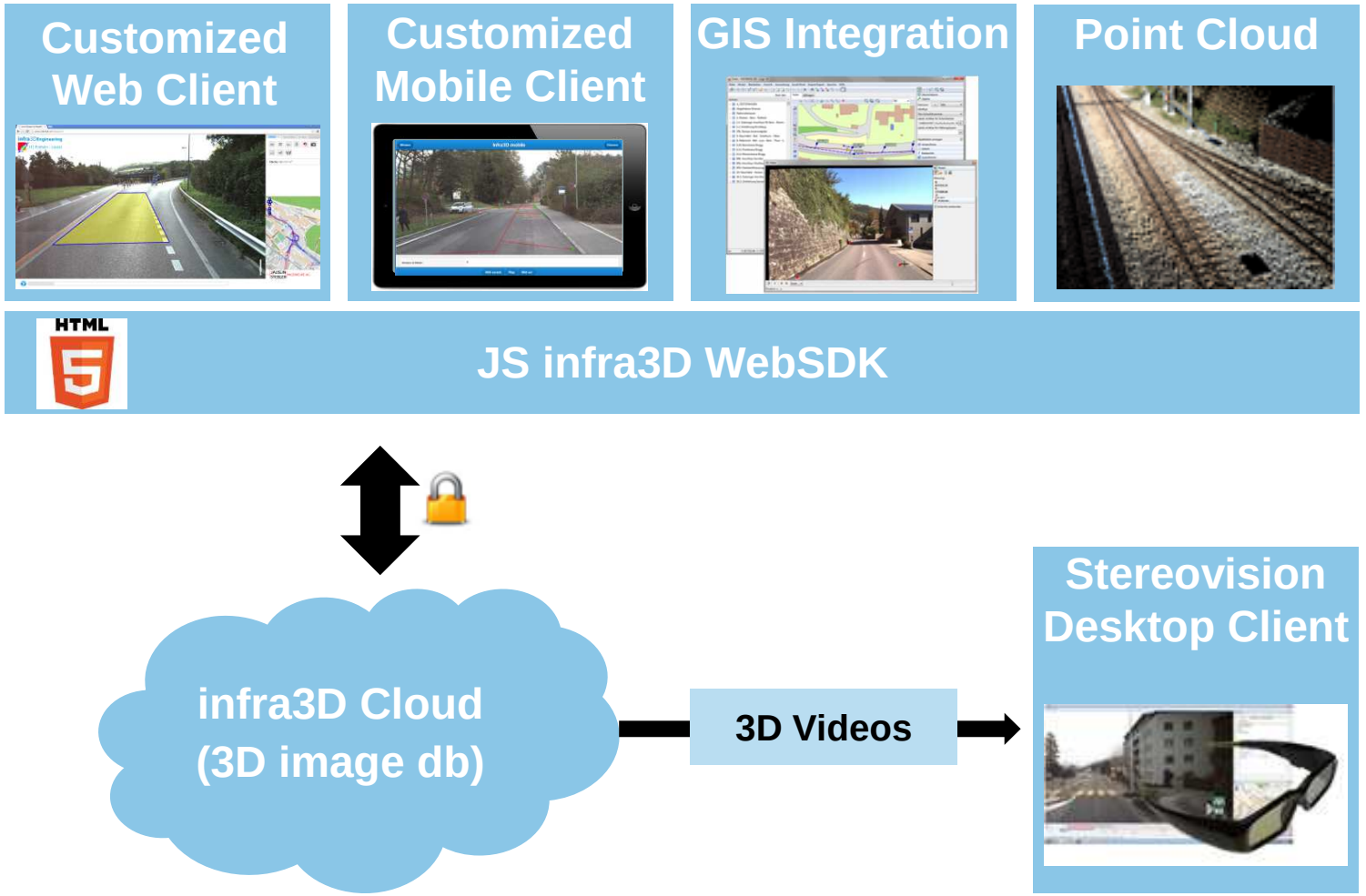
Mobile Mapping Stereo Scene and Depth Maps from Dense Image Matching

Top: stereo scene acquired with IVGI Stereovision MMS

Bottom: disparity maps extracted using SURE dense matching software



infra3D Technology - Exploitation



3D Point Coordinate Determination Accuracy

(MSc Project Cavegn, 2010; Bachelor Thesis Arnold, 2011)

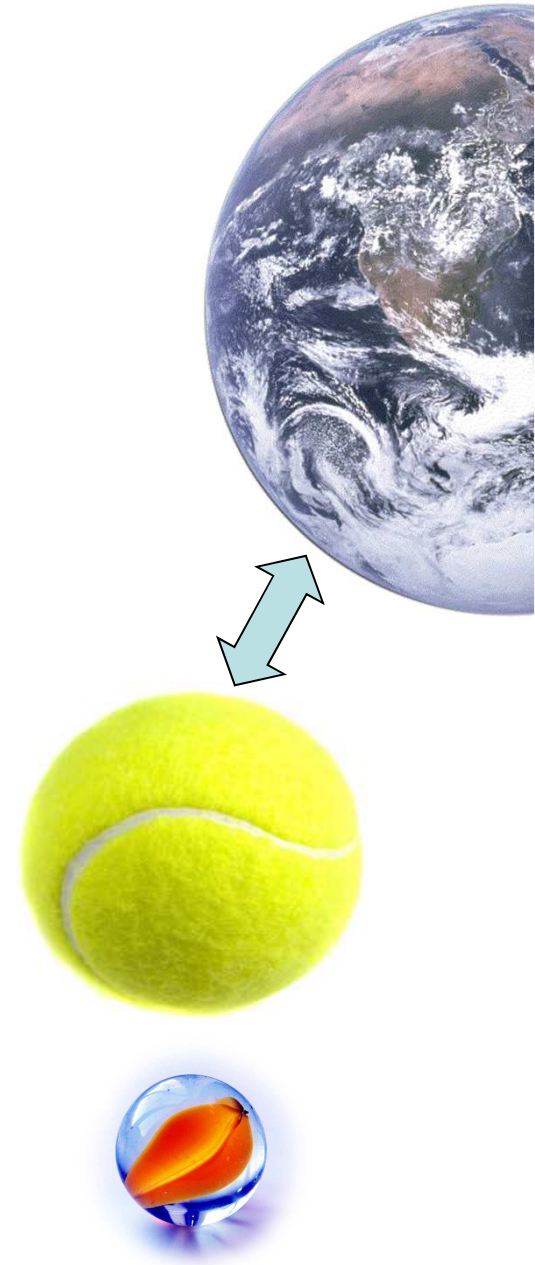
Empirical Standard Deviations of Coordinate Differences

– stereovision mobile mapping vs. tachymetry (reference)

– approx. 50 check points

	Position	Height	3D
Absolute	3-4 cm	2 cm	4 cm

	3D Distance
Relative	< 1 cm



➢ **With ground control points & integrated sensor orientation**

➢ **1-2 cm absolute 3D accuracy (even in tunnels)**

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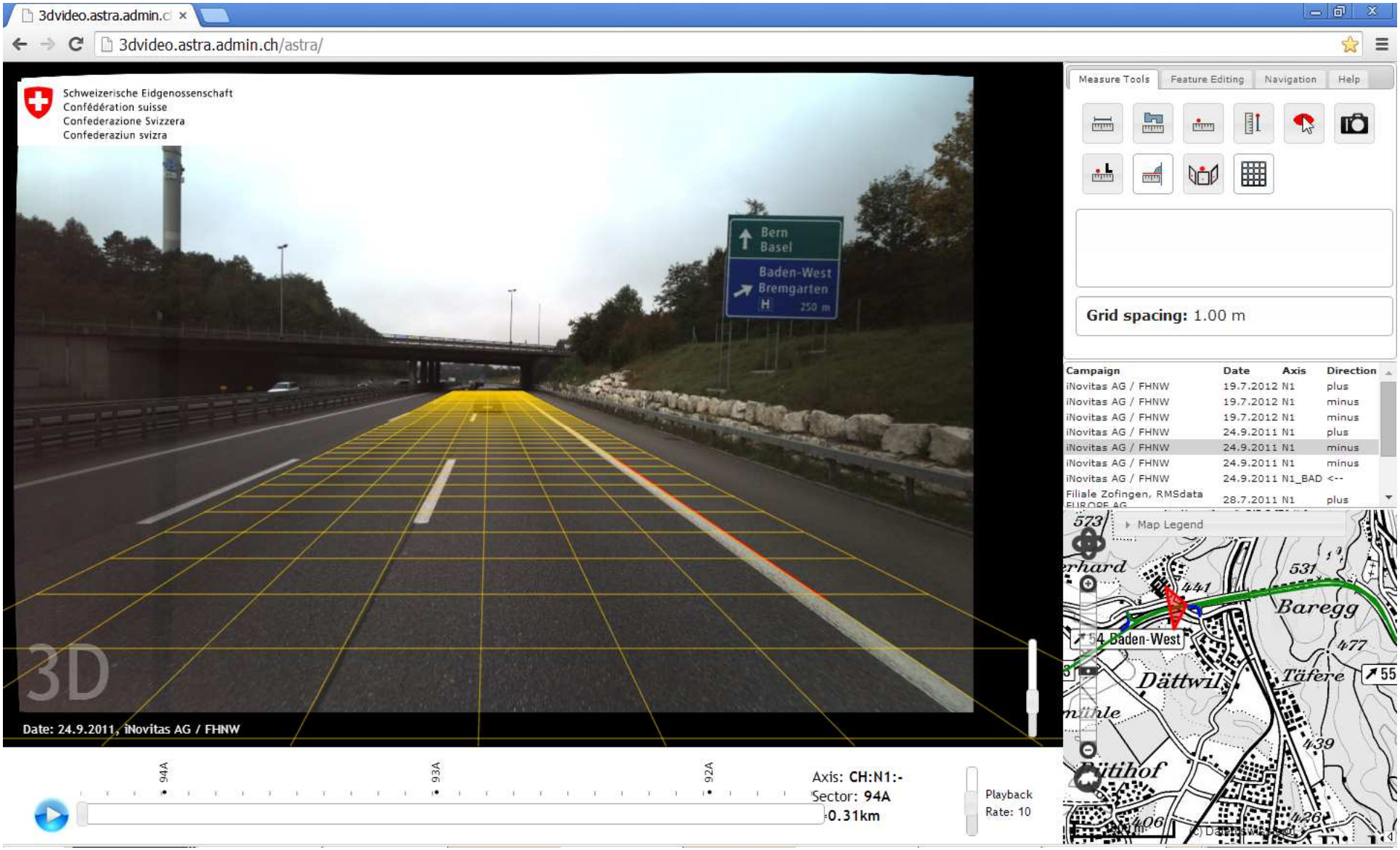
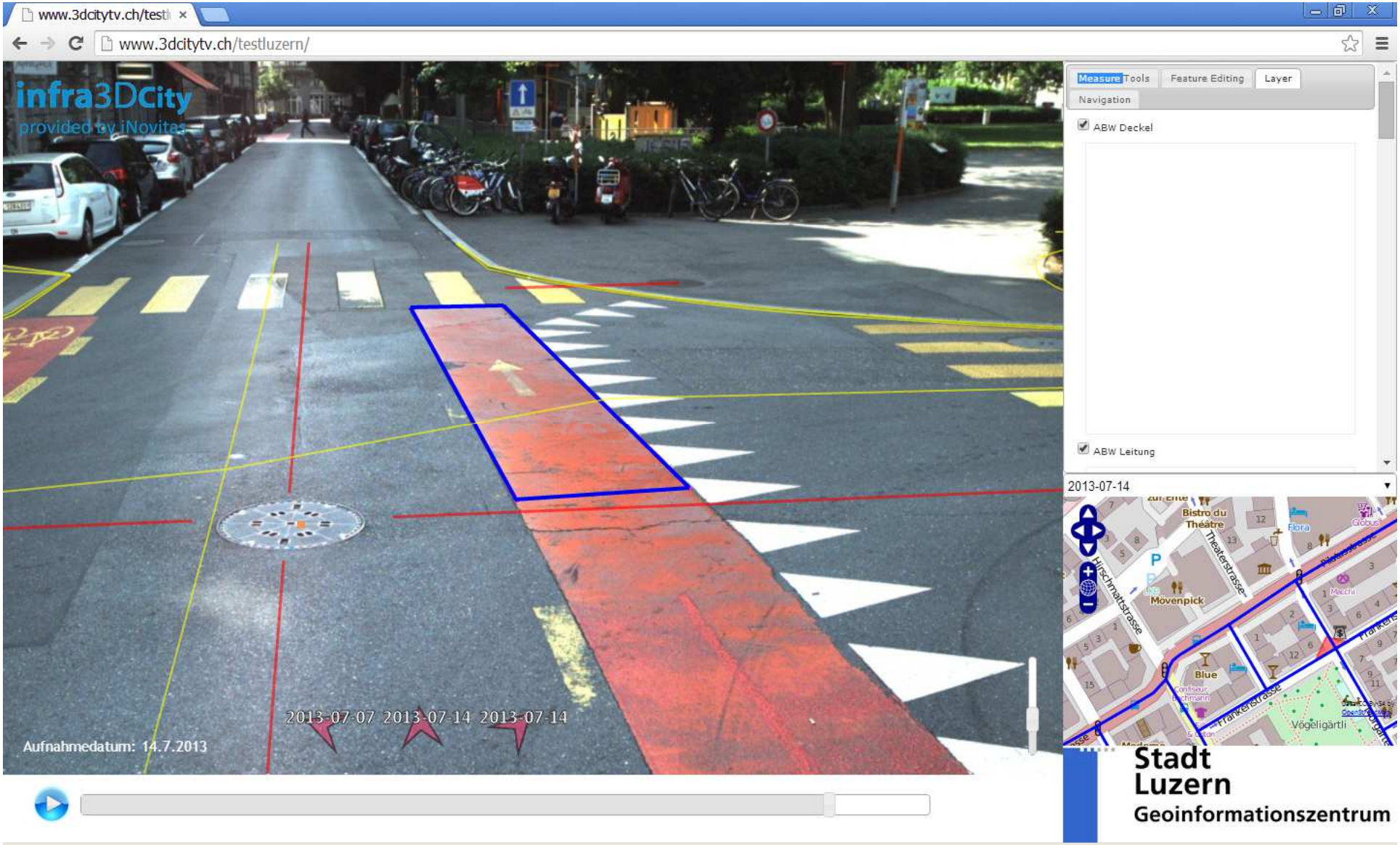
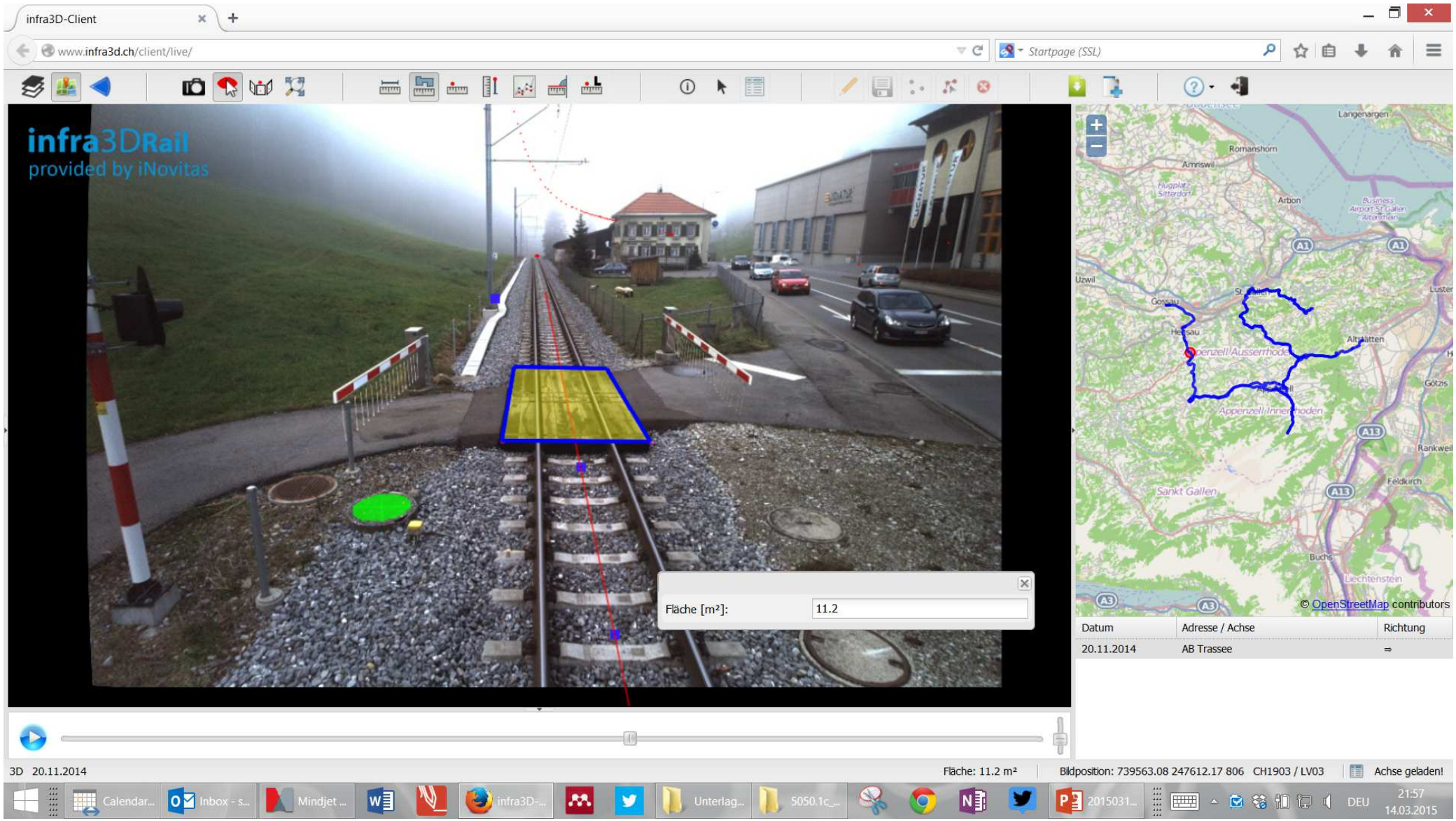
infra3D – ASTRA / FEDRO Swiss Federal Roads Office



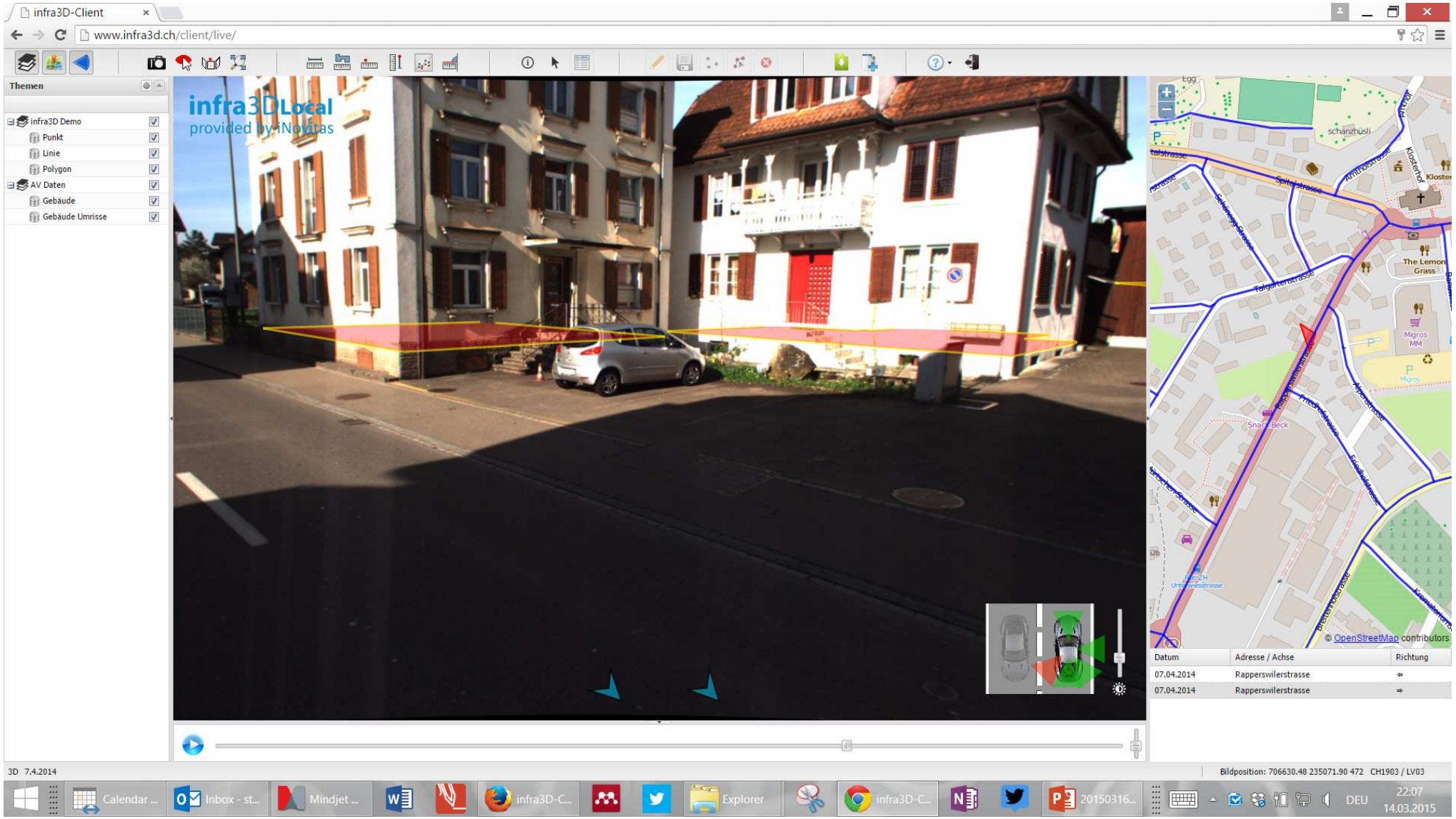
infra3DCity – Lucerne, Switzerland



infra3DRail – Appenzeller Bahnen



infra3DLocal – City of Rüti with Integration of Cadastral Data



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A (Mobile) 3D Vision for Cadastre

Interactive and semi-automatic verification and updating of cadstral data

– road network, buildings, landcover in general, DSM / DTM

Automatic conversion of 2D to 3D cadastres

– e.g. gullies / underground utilities

Mobile Augmented Reality Clients

– in-field inspection / verification
– measurements
– staking-out ?
– etc.

Source: http://labs.blogs.com/its_alive_in_the_lab/2012/09/check-out-this-simulated-augmented-reality-with-autodesk-infrastructure-modeler.html

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Thank you! Questions / discussion ?

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