INSTITUT NATIONAL
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GÉOGRAPHIQUE
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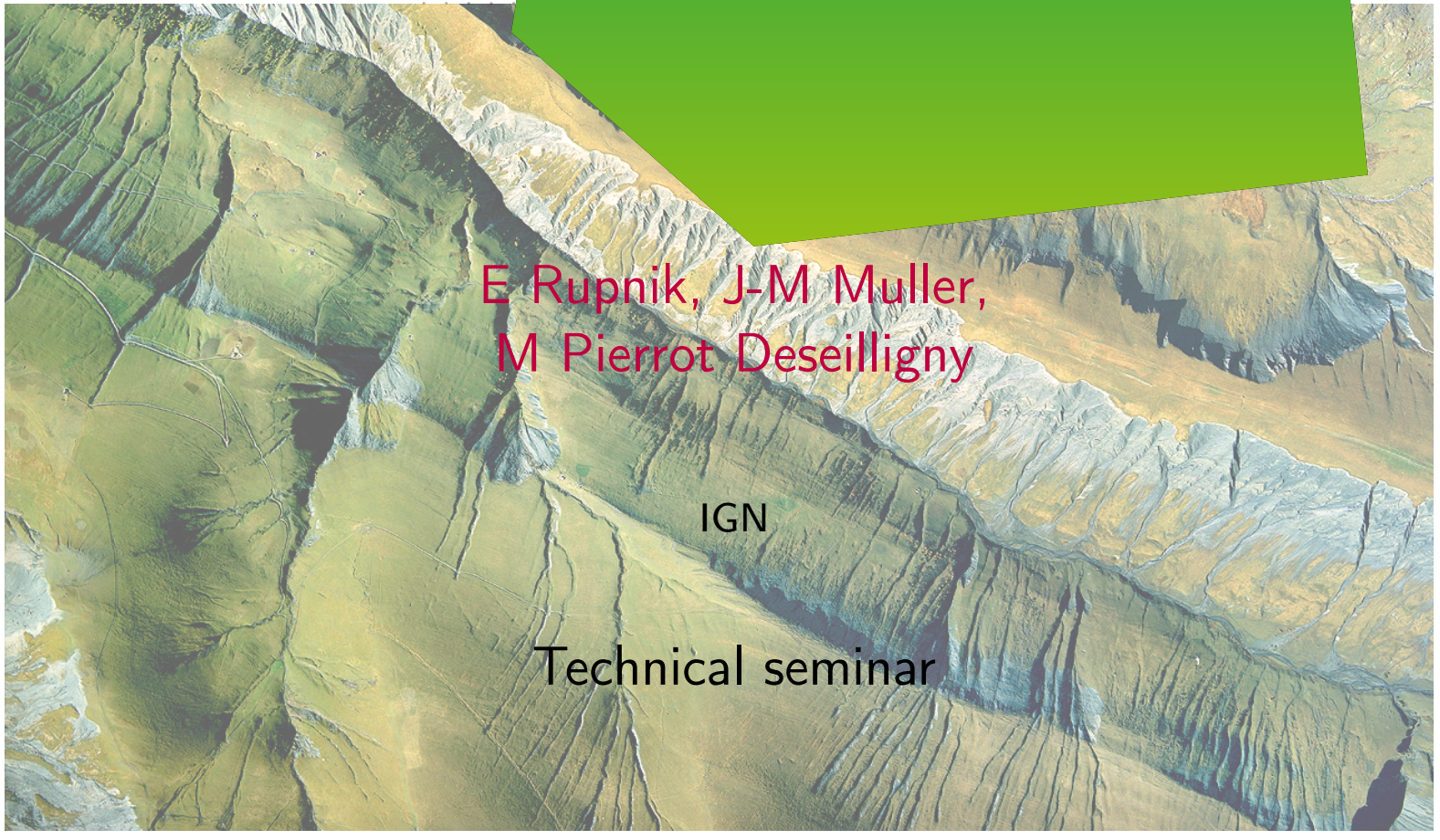
MicMac – a global overview



E Rupnik, J-M Muller,
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IGN

Technical seminar

Introduction

Introduction

Tie points extraction
- Without a priori geometry
- With a priori geometry
- Reduction algorithms

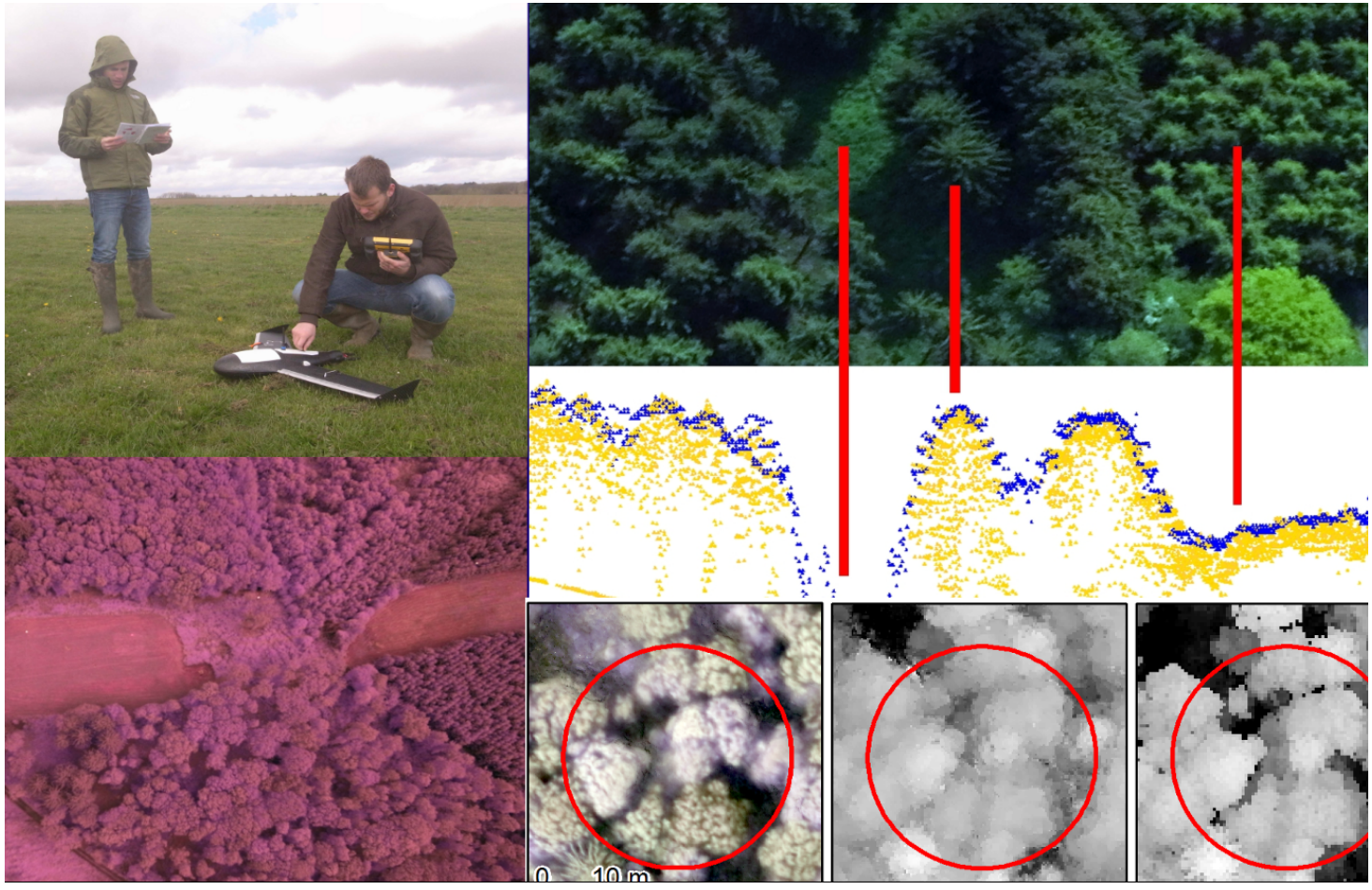
Image orientation
- SfM and structureless method
- Bundle block adjustement

Misc

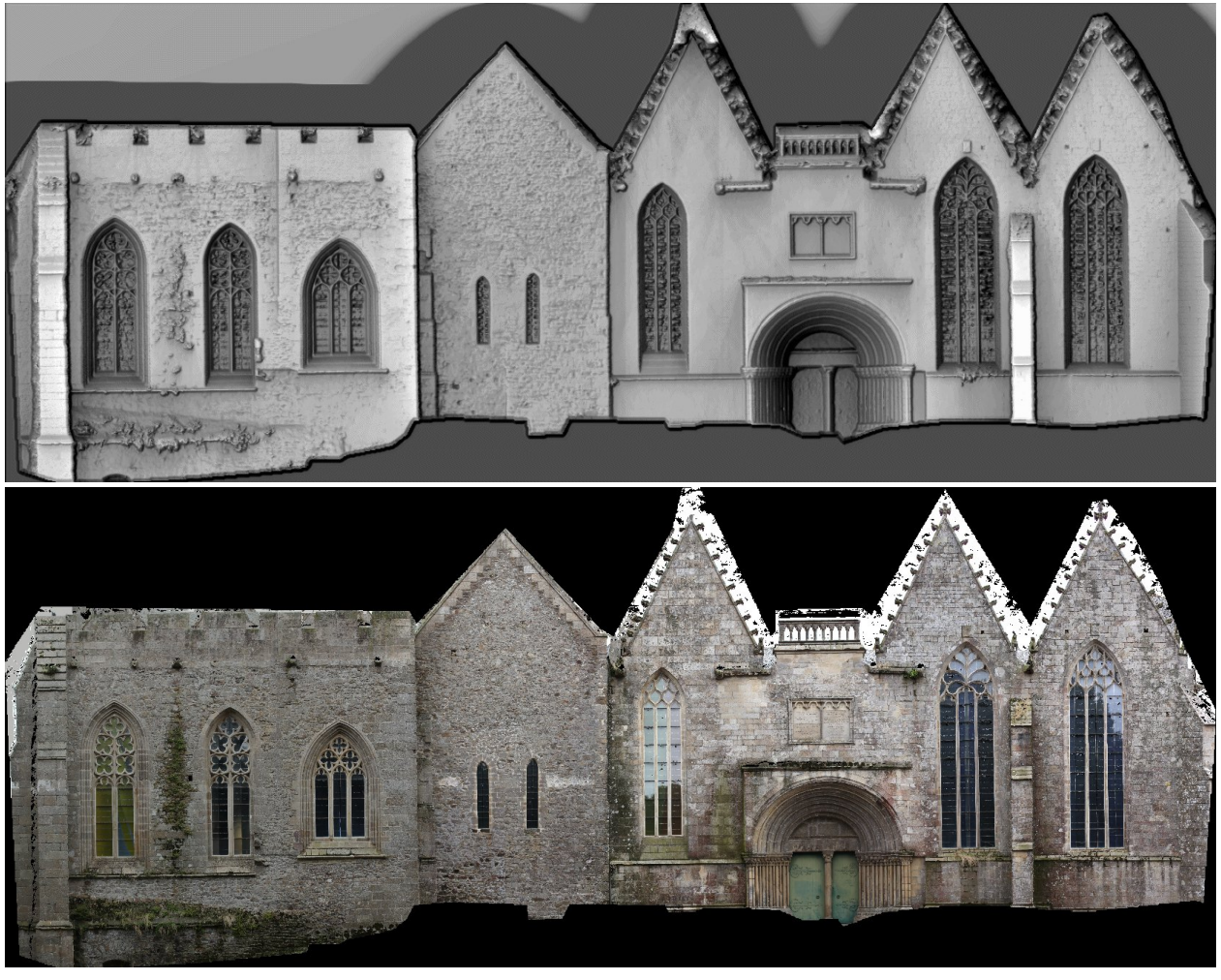
Introduction

Applications

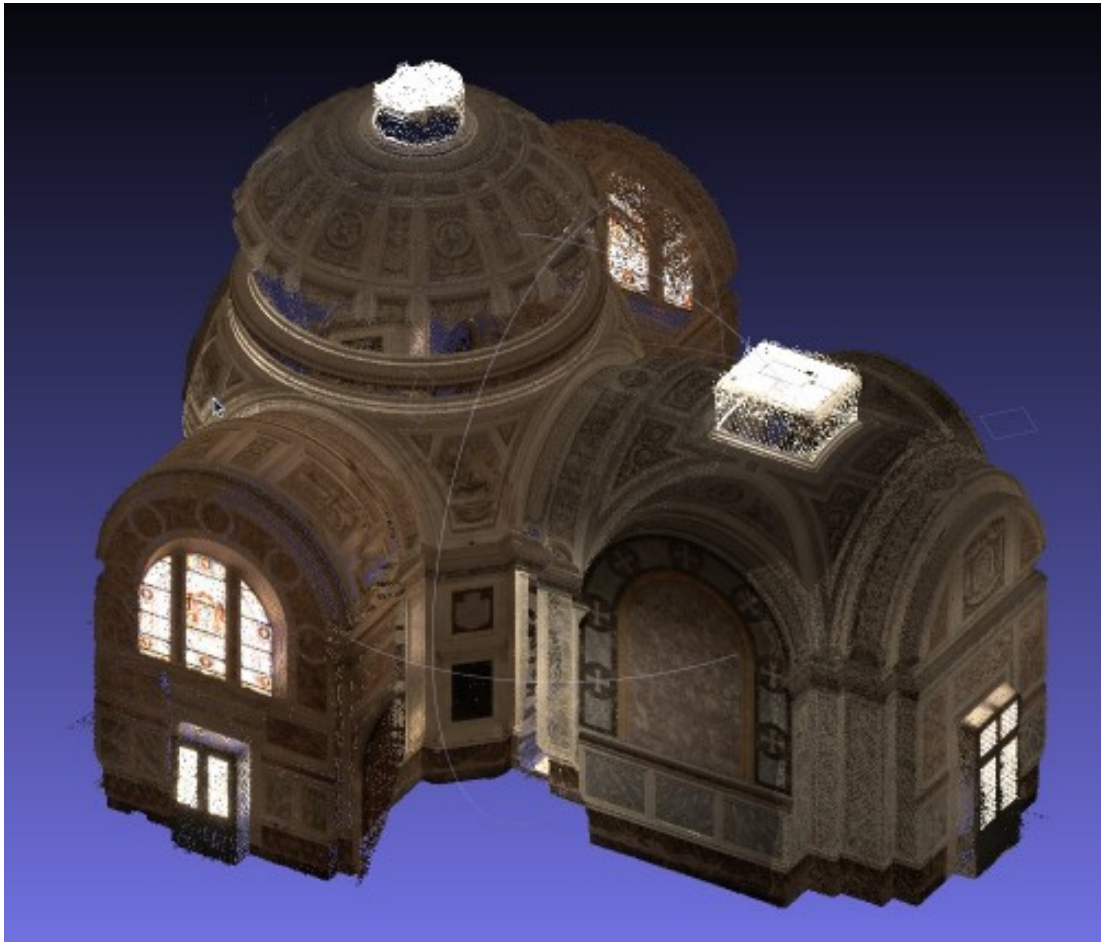
Applications



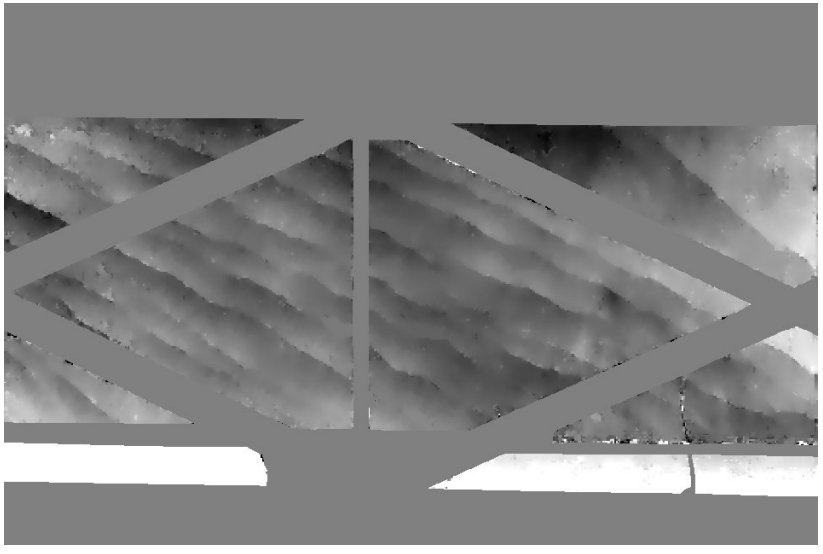
Applications



Applications



Applications



Applications

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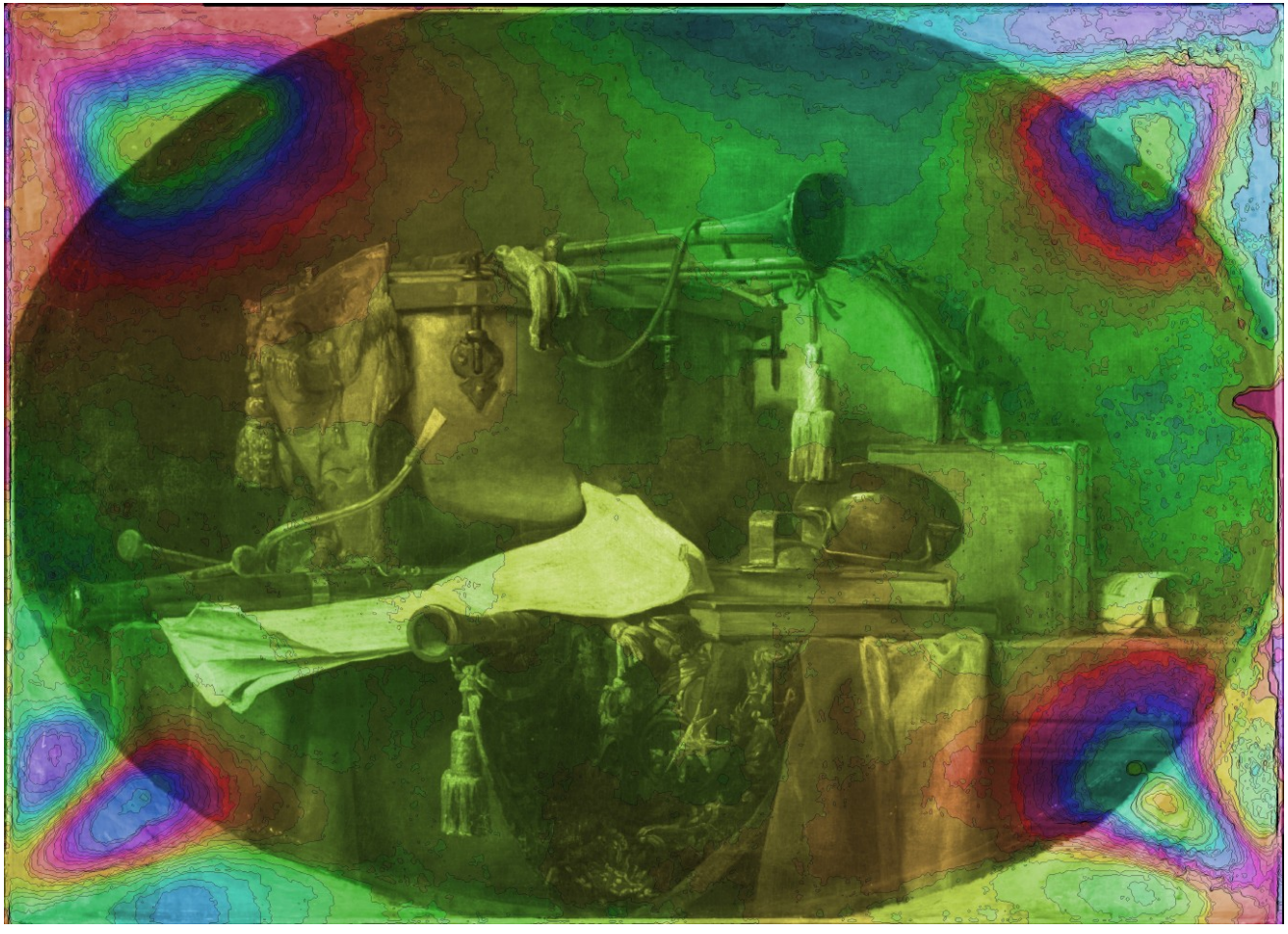
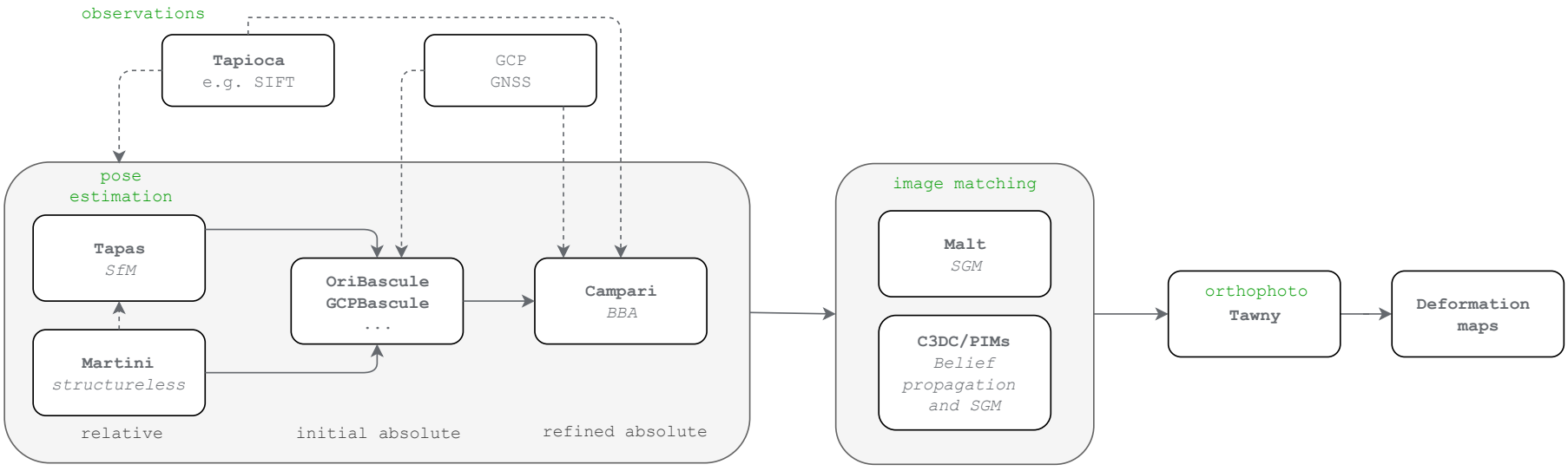


At IGN

At IGN, MicMac is used for production and innovation:

- Aerial images correlation for France digital terrain model
- 3D modelization for metrology
- mobile mapping trajectories
- research
- education

Overview of the processing pipeline



Tie points extraction

Tie points extraction

Without a priori geometry

Tie points extraction
Without *a priori* geometry

Tie points extraction
Without *a priori* geometry

Tie points detection

- SIFT : default
- Digeo : slightly faster, possibility to use only max or min
- AIME (presented by MPD during spotlight), under developpment; generally faster than SIFT

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Without *a priori* geometry

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Tie points Matching

- ANN (Approximate Nearest Neighbor)
- for a point in pic A, find best and second best points in pic B. The best point is accepted if his score is high and second best score is low.

Tie points extraction
Without *a priori* the geometry

Tie points extraction
Without *a priori* the geometry

Extraction organization : lists of pictures pairs

- All, MulScale, Line...
- from an orientation (GPS, approximate orientation)

Tapioca command. See §3.3 and §16 of documentation.

Tie points extraction
Without *a priori* the geometry

Extraction organization : lists of pictures pairs

- All, MulScale, Line...
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Tapioca command. See §3.3 and §16 of documentation.

Tie points files format (binary and ASCII)

- Default : 1 file per pair, simple and universal
- New format : 1 file with points multiplicity, faster but only usable with few commands

mm3d TestLib ConvNewFH command. See §16.8 of documentation.

Tie points extraction

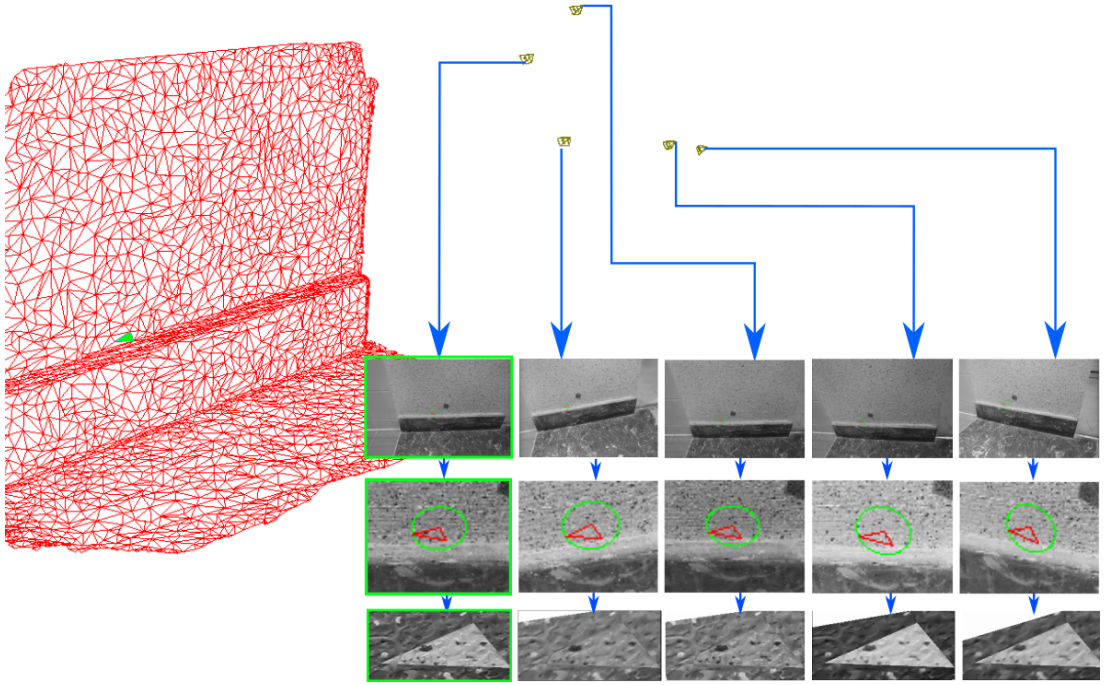
With a priori geometry

Tie points extraction
With *a priori* geometry

Tie points extraction
With *a priori* geometry

- "Second iteration": using camera orientations and a 3d mesh
- finds tie points with good repartition on pictures and 3d mesh
- use orientations for perspective corrections before correlation

mm3d TiePTri command. See §16.9 of documentation.



Tie points extraction

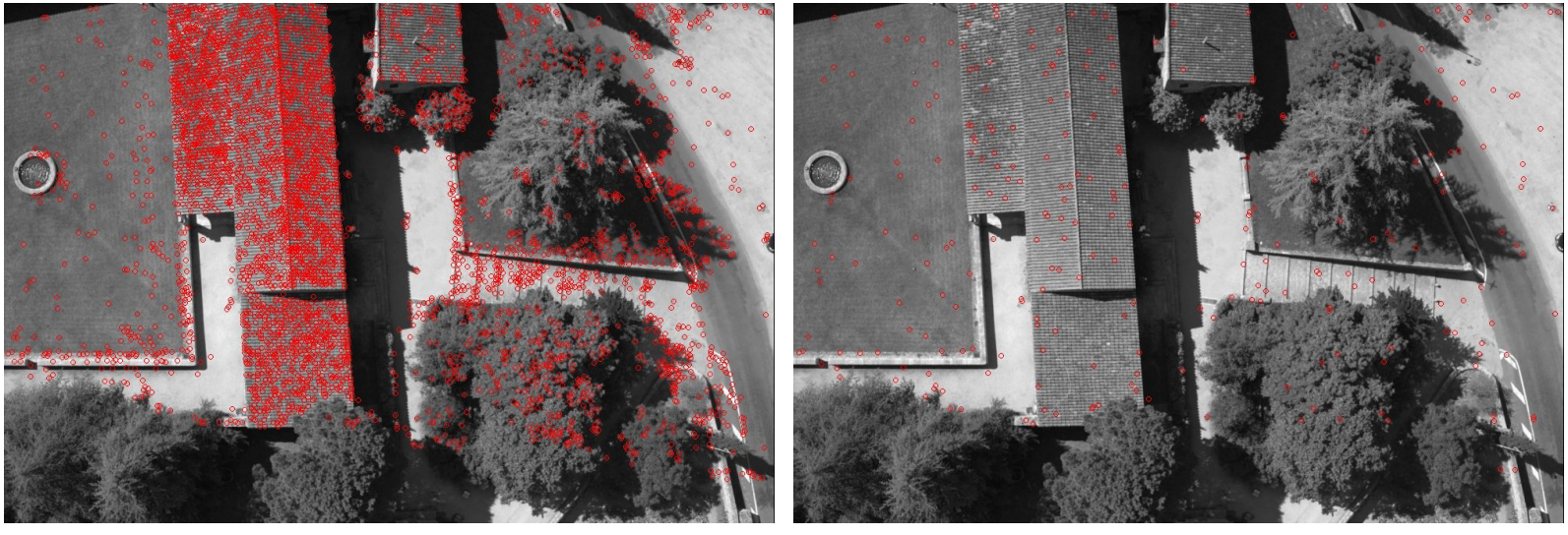
Reduction algorithms

Tie points reduction algorithms

Tie points reduction algorithms

Four tools are dedicated to Tie points reduction:

- **RedTieP** / **Schnaps** (generic case): only one point per picture part, favor manifold
- **OriRedTieP** (quasi-vertical case) : favor scene repartition and minimize reprojection errors
- **Ratafia** : use local orientations, works with any geometry



3 Image orientation

Image orientation
Approaches

1. no *a priori*, iterative (i.e. SfM)
2. no *a priori*, structureless method (aka *global motion first*)
3. initial orientations are known,
   collinearity-based bundle block adjustment (BBA)

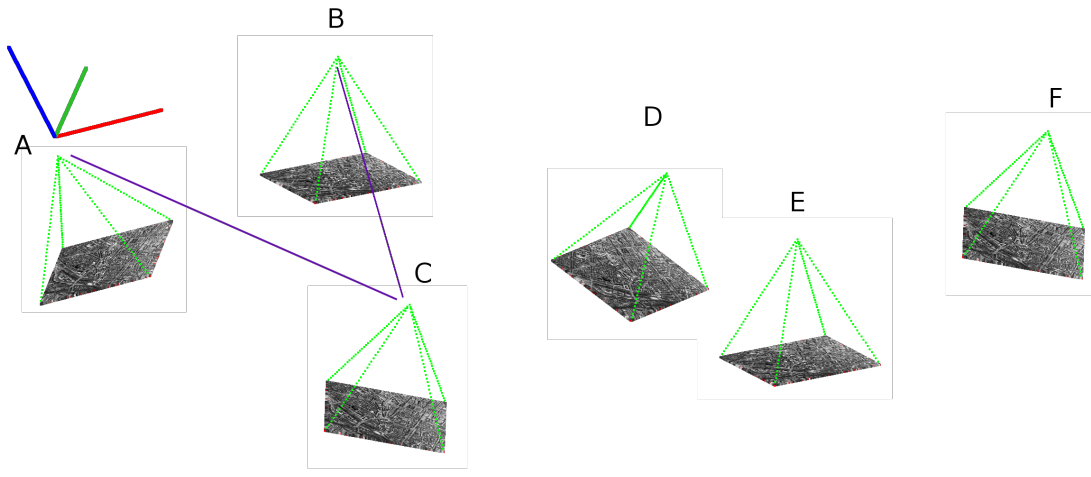
Image orientation

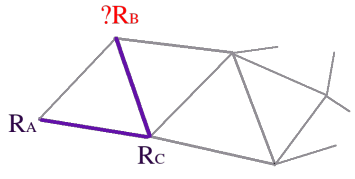
SfM and structureless method

SfM

Pipeline:

- **iterative** creation of global poses
- all poses in the coordinate system attached to a selected camera
- direct algorithms (e.g. essential matrix, resection)
- bundle block adjustment every *n* images





SfM

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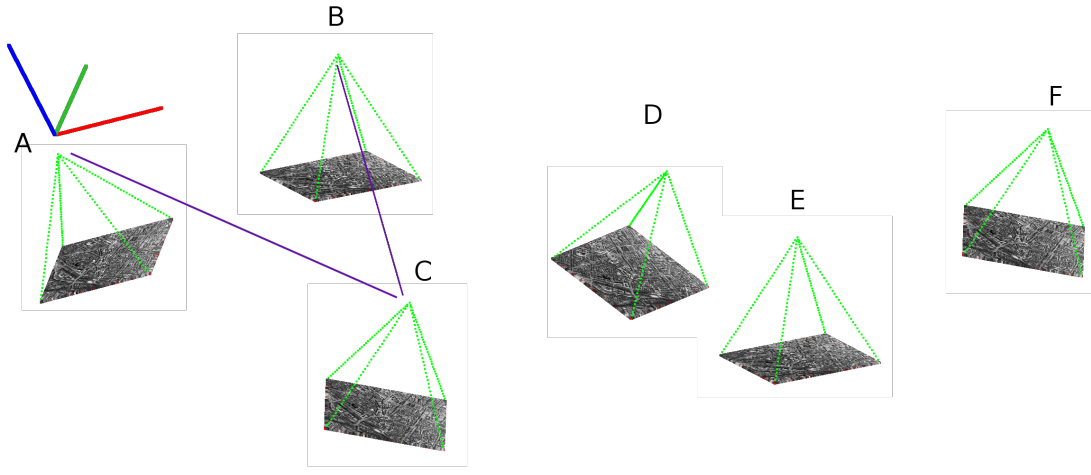
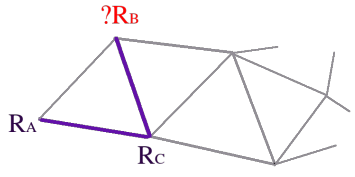


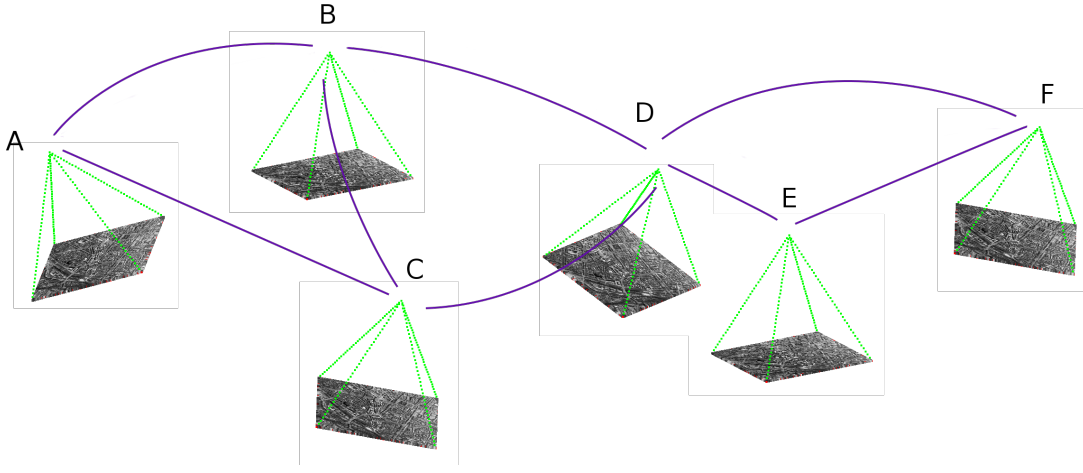


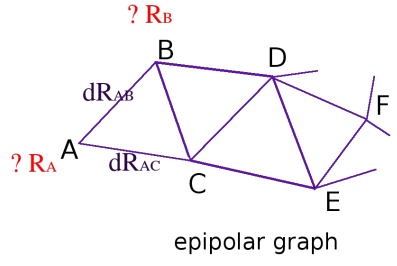
- camera poses and calibrations are estimated

Structureless method

Pipeline:

- relative poses between all possible pairs **simultaneously** (i.e. epipolar graph)
- composition of triplets
- initialisation of global poses and error averaging





epipolar graph

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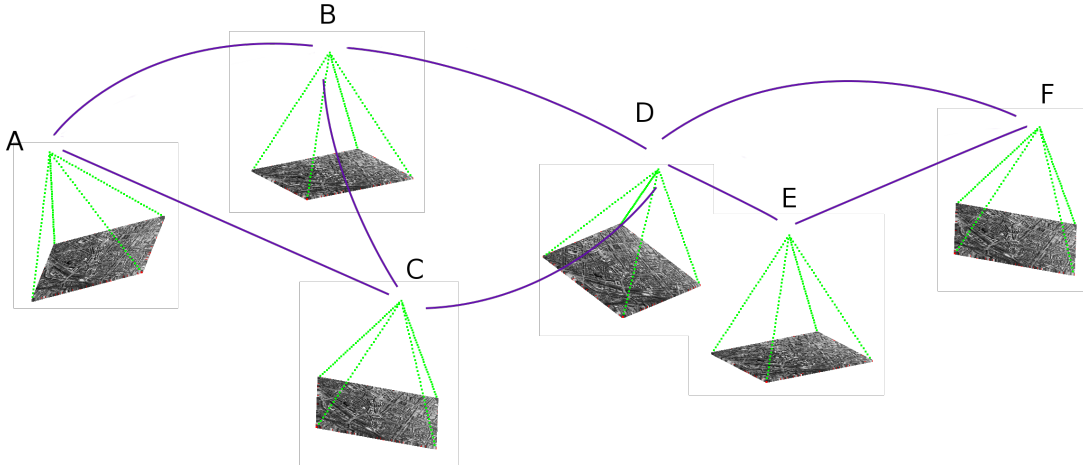

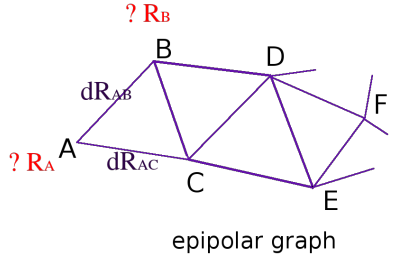

epipolar graph

- only camera poses are estimated !
- followed by the BBA to refine camera calibrations

SfM and structureless method

- in MicMac

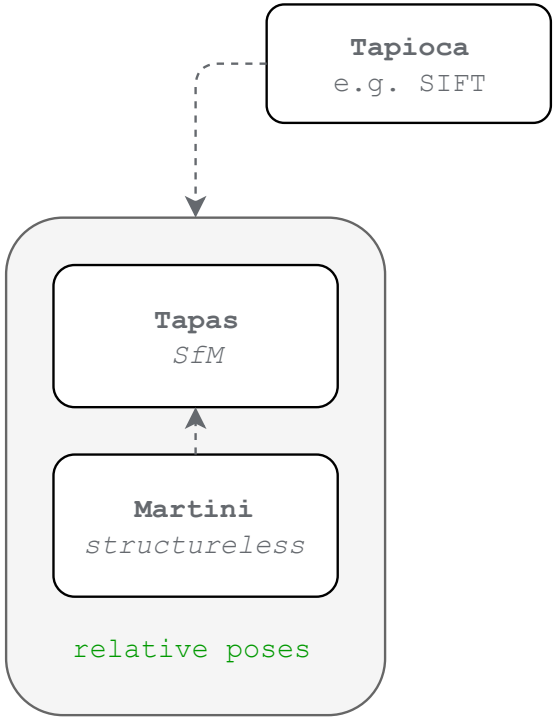

Image orientation

Bundle block adjustement

Bundle block adjustement (BBA)

Generalities:

- collinearity equations
- heterogenous observations/parameters possible, e.g.:
  - Ground Control Points (GCP),
  - GNSS,
  - lever-arm,
  - rigid bloc
- non-linear $\rightarrow$ initial poses necessary

BBA initial poses

BBA adopted in

1. SfM, alternates with direct methods
   always the same relative system initialisation not an issue

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   - input1: poses known in relative coordinates (SfM output)
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   - Spatial similarity transformation
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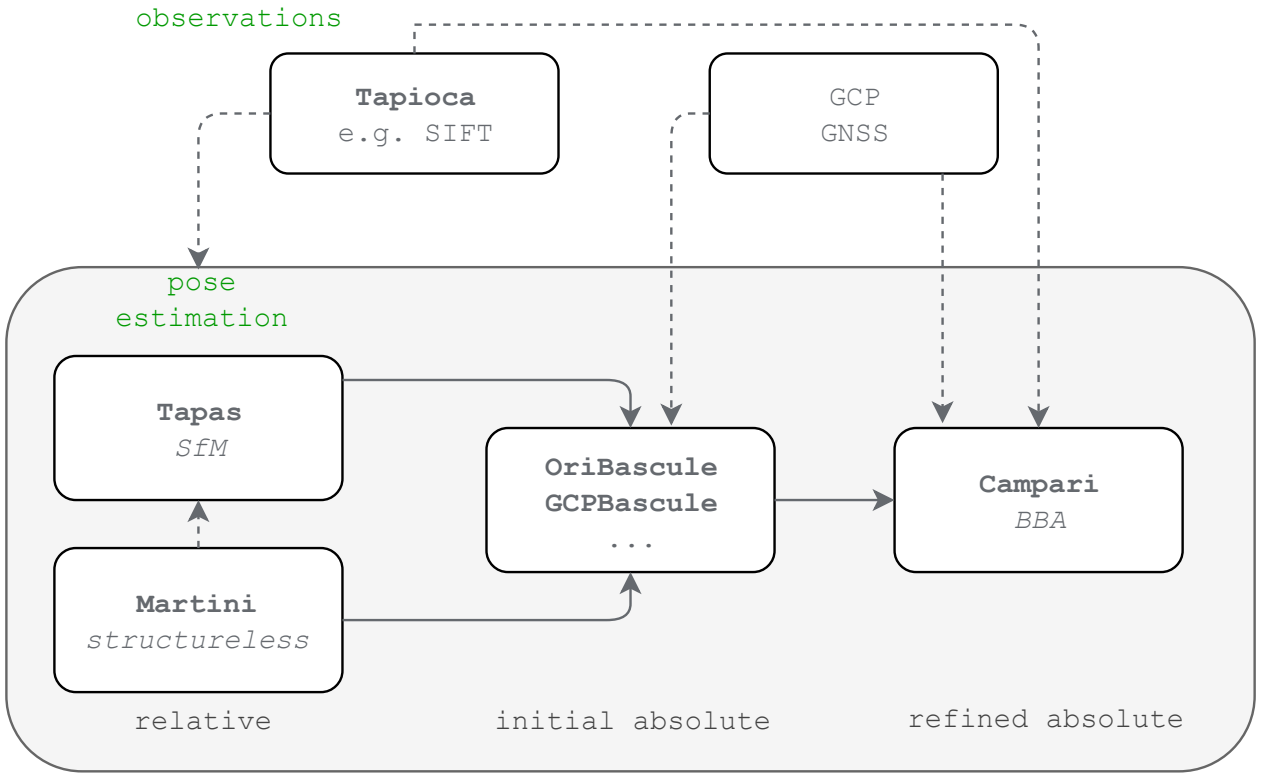
   - followed by BBA

Image orientation

- in MicMac



Misc

MicMac vs other software tools

Some unique MicMac features

- access to intermediary results, no black box
- MicMac as a library
- qualitative evaluation of the results
- a wide range of camera calibration models
- processing of frame camera and pushbroom images
- ...

Community

?

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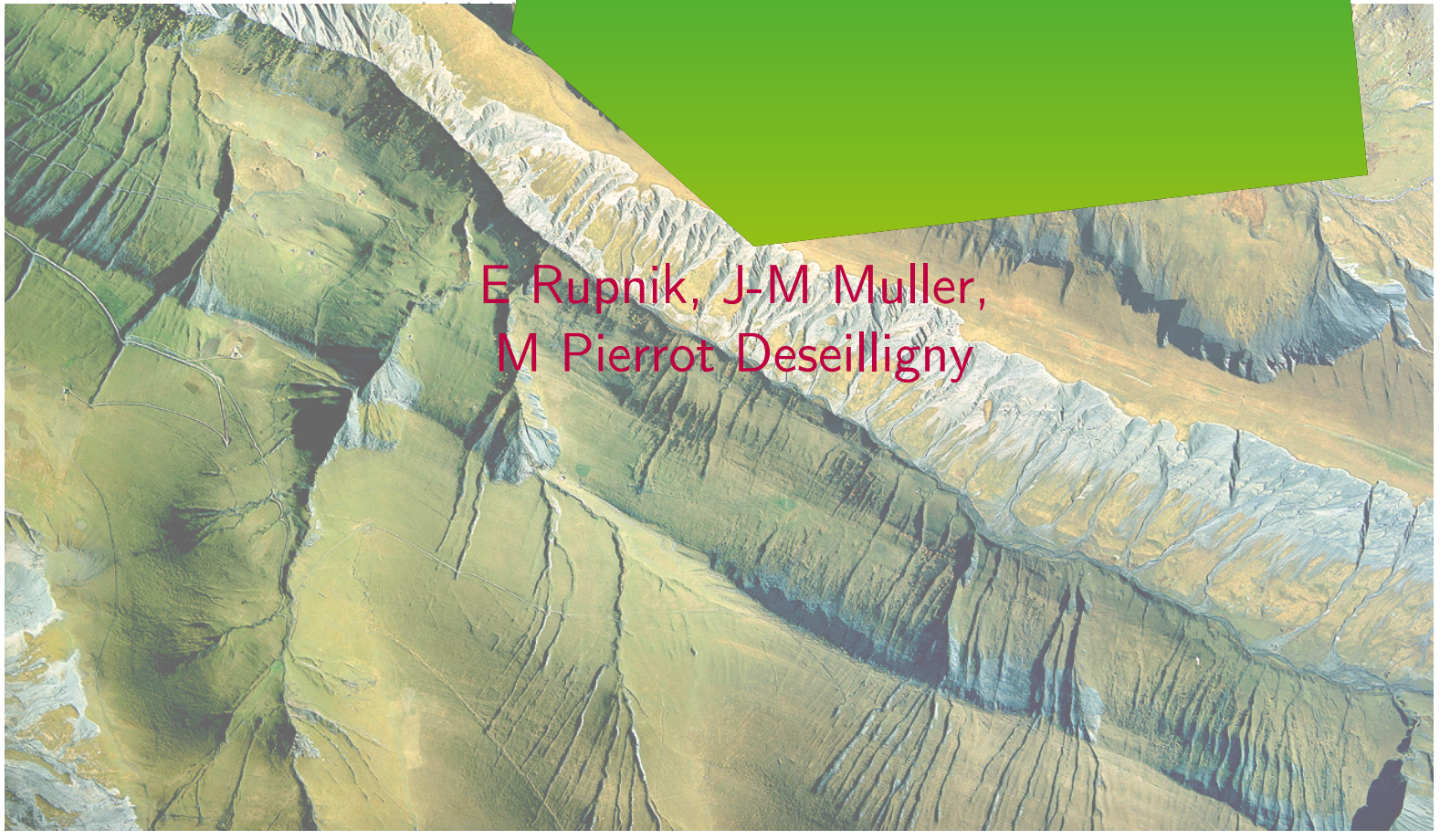
Thank you for your attention!



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