



INSTITUT NATIONAL
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GÉOGRAPHIQUE
ET FORESTIÈRE

MicMac – a global overview

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IGN

Technical seminar

Introduction

Tie points extraction

- Without a priori geometry

- With a priori geometry

- Reduction algorithms

Image orientation

- SfM and structureless method

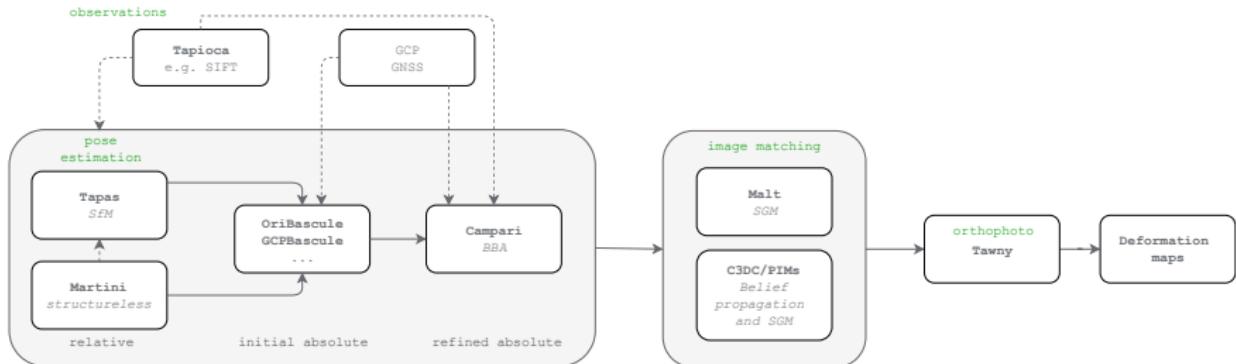
- Bundle block adjustment



1

Introduction

Overview of the processing pipeline





2

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

Tie points extraction Without *a priori* geometry

Tie points detection

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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...
- ▶ from an orientation (GPS, approximate orientation)

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

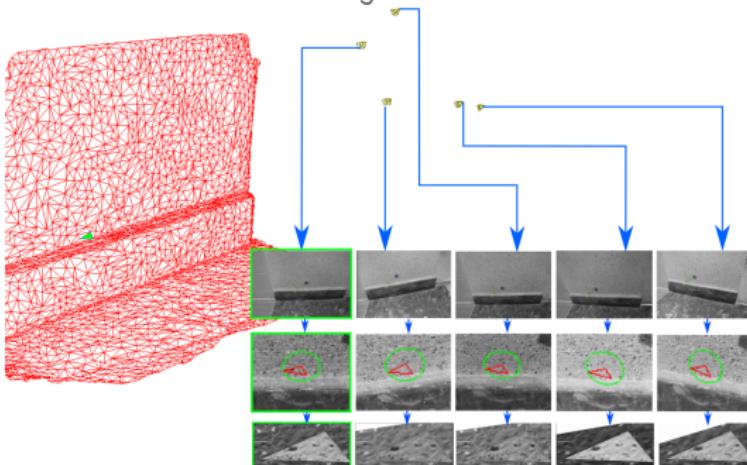
Tie points extraction

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.





2

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





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)

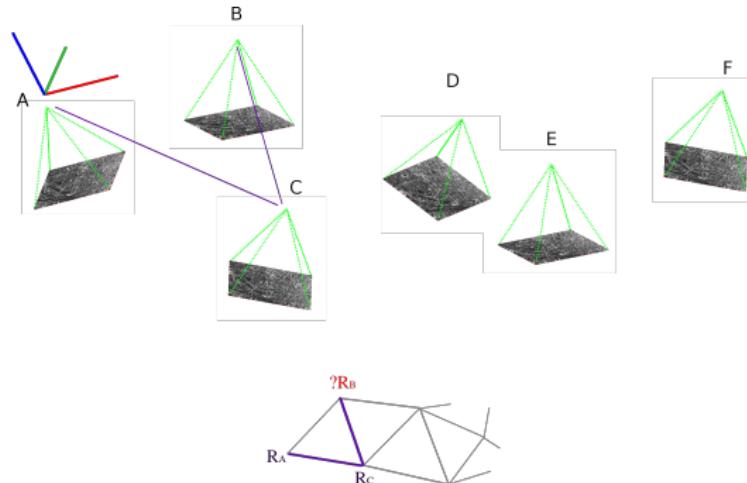


Image orientation

SfM and structureless method

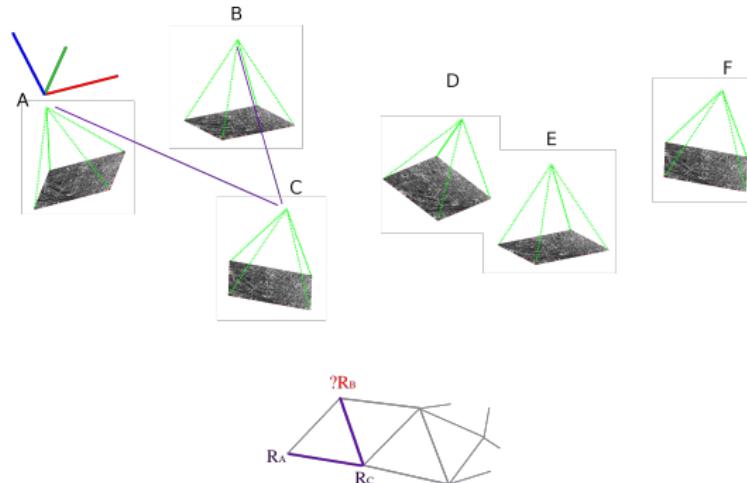
Pipeline:

- ▶ **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



Pipeline:

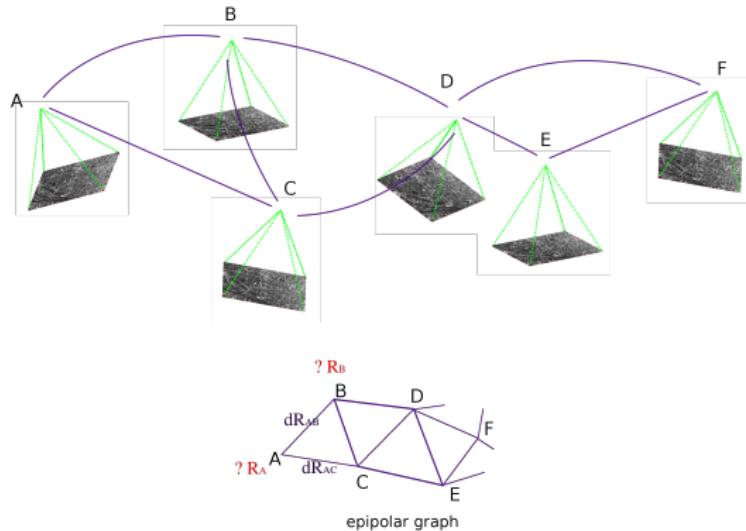
- ▶ **iterative** creation of global poses
- ▶ all poses in the coordinate system attached to a selected camera
- ▶ direct algorithms
(e.g. essential matrix, resection)
- ▶ bundle block adjustment
every n images
- ▶ **camera poses and calibrations**
are estimated



Structureless method

Pipeline:

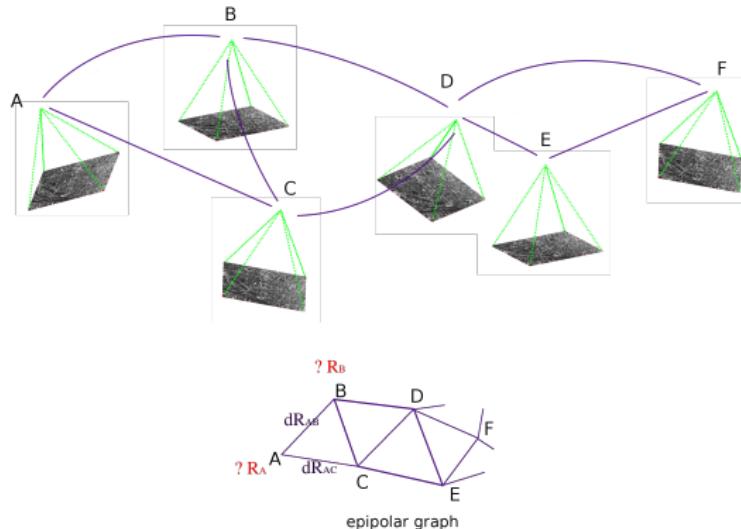
- ▶ relative poses between all possible pairs **simultaneously**
(i.e. epipolar graph)
- ▶ composition of triplets
- ▶ initialisation of global poses and error averaging



Structureless method

Pipeline:

- ▶ relative poses between all possible pairs **simultaneously**
(i.e. epipolar graph)
 - ▶ composition of triplets
 - ▶ initialisation of global poses and error averaging
-
- ▶ **only camera poses are estimated !**
 - ▶ followed by the BBA



SfM and structureless method

- ▶ in MicMac

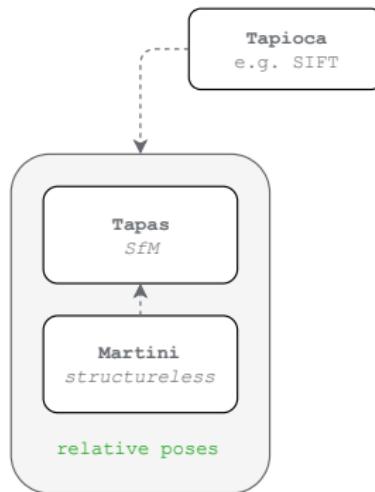




Image orientation

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 → **initial poses necessary**

BBA initial poses

BBA adopted in

1. SfM, always the same relative system initialisation not an issue

BBA initial poses

BBA adopted in

1. SfM, always the same relative system initialisation not an issue
2. absolute positioning
 - ▶ input1: poses known in relative coordinates (SfM output)
 - ▶ input2: GCP, GNSS are given in absolute coordinates

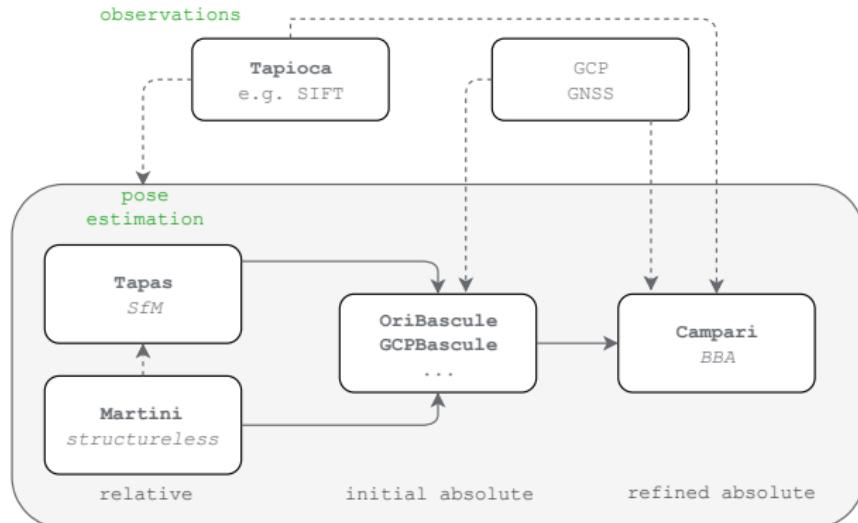
BBA initial poses

BBA adopted in

1. SfM, always the same relative system initialisation not an issue
2. absolute positioning
 - ▶ input1: poses known in relative coordinates (SfM output)
 - ▶ input2: GCP, GNSS are given in absolute coordinates
 - ▶ Spatial similarity transformation from input1 to input2 coordinates

Bundle block adjustement (BBA)

► in MicMac





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Thank you for your
attention!

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