



INSTITUT NATIONAL  
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GÉOGRAPHIQUE  
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# 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

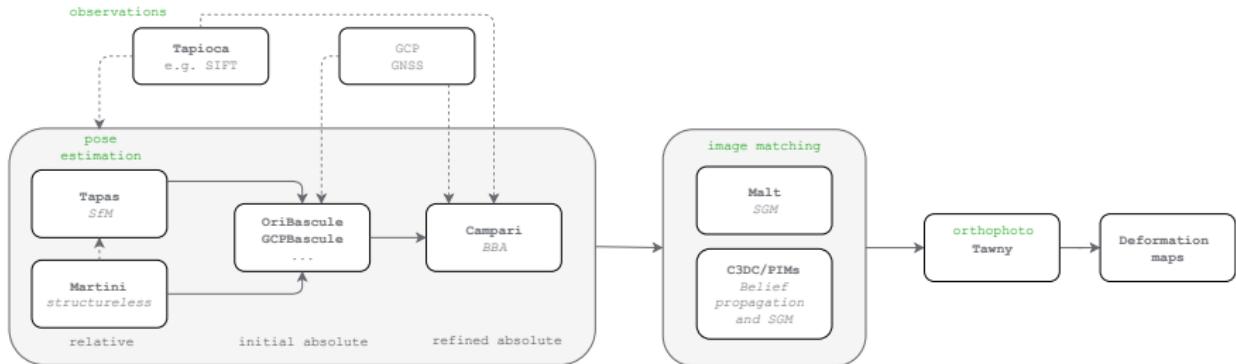
Bundle block adjustment



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 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 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

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.



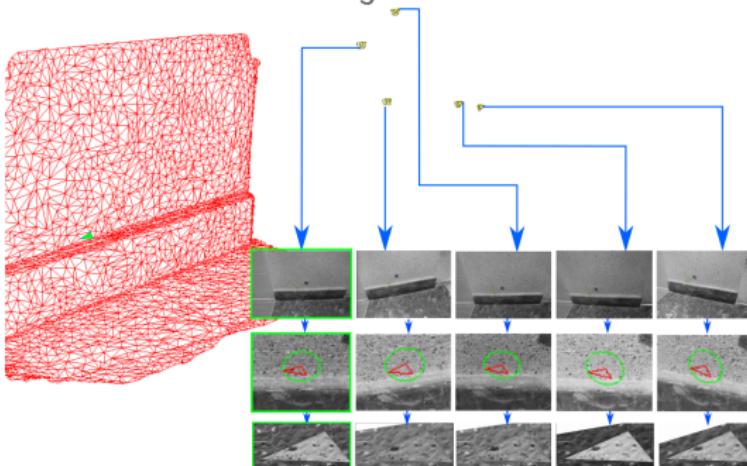
# Tie points extraction

With a priori geometry

## Tie points extraction With *a priori* geometry

- ▶ “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

Four tools are dedicated to Tie points reduction:

- ▶ **RedTieP / Schnaps** (generic case): only one point per picture part, favor manifold
- ▶ **OriRedTieP / Ratafia** (quasi-vertical case) : favor scene repartition





# Image orientation

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)

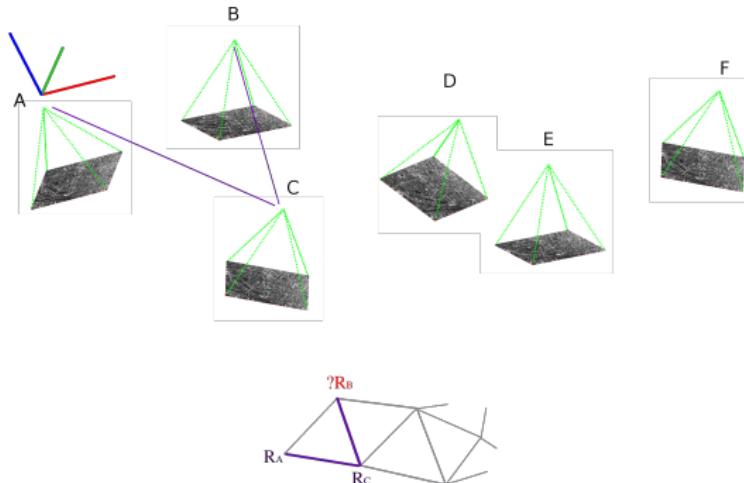


# Image orientation

SfM and structureless method

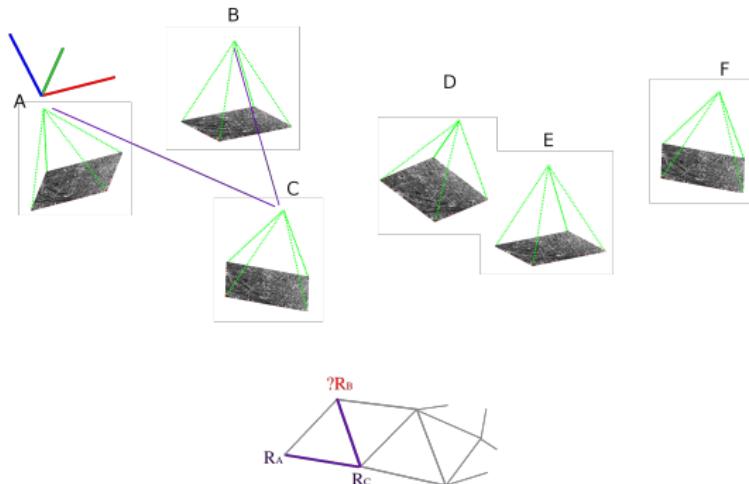
## Pipeline:

- ▶ **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:

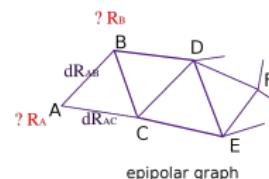
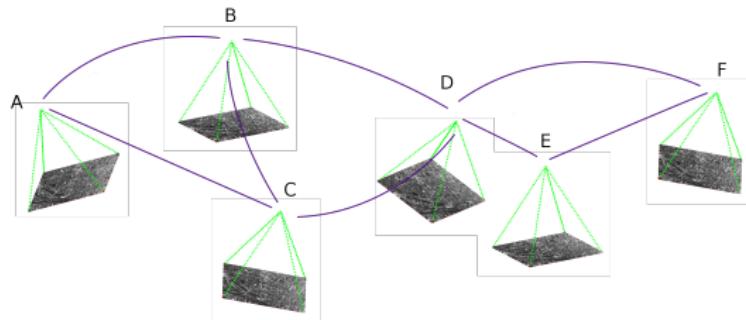
- ▶ **iterative** creation of global poses
- ▶ all poses in the coordinate system attached to a selected camera
- ▶ direct algorithms  
(e.g. essential matrix, resection)
- ▶ bundle block adjustment  
every  $n$  images
  
- ▶ **camera poses and calibrations**  
are estimated



# Structureless method

## Pipeline:

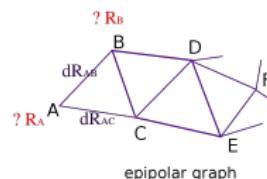
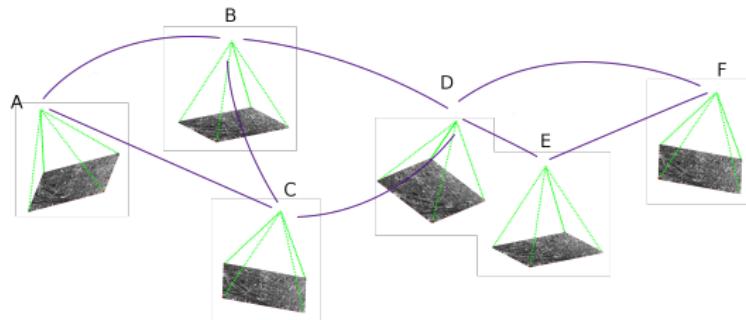
- ▶ relative poses between all possible pairs **simultaneously** (i.e. epipolar graph)
- ▶ composition of triplets
- ▶ initialisation of global poses and error averaging



# Structureless method

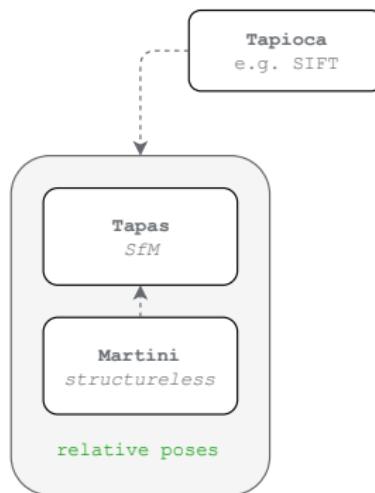
## Pipeline:

- ▶ 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

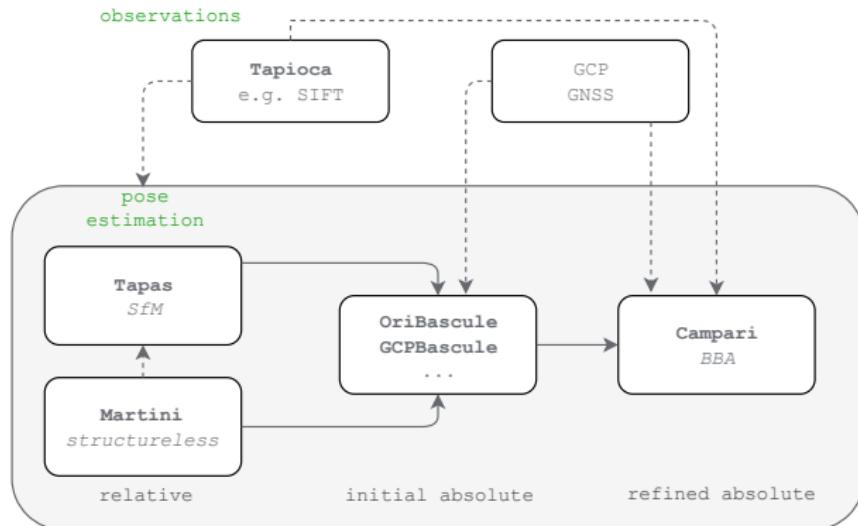
1. SfM, always the same relative system initialisation not an issue
2. absolute positioning
  - ▶ input1: poses known in relative coordinates (SfM output)
  - ▶ input2: GCP, GNSS are given in absolute coordinates

BBA 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)

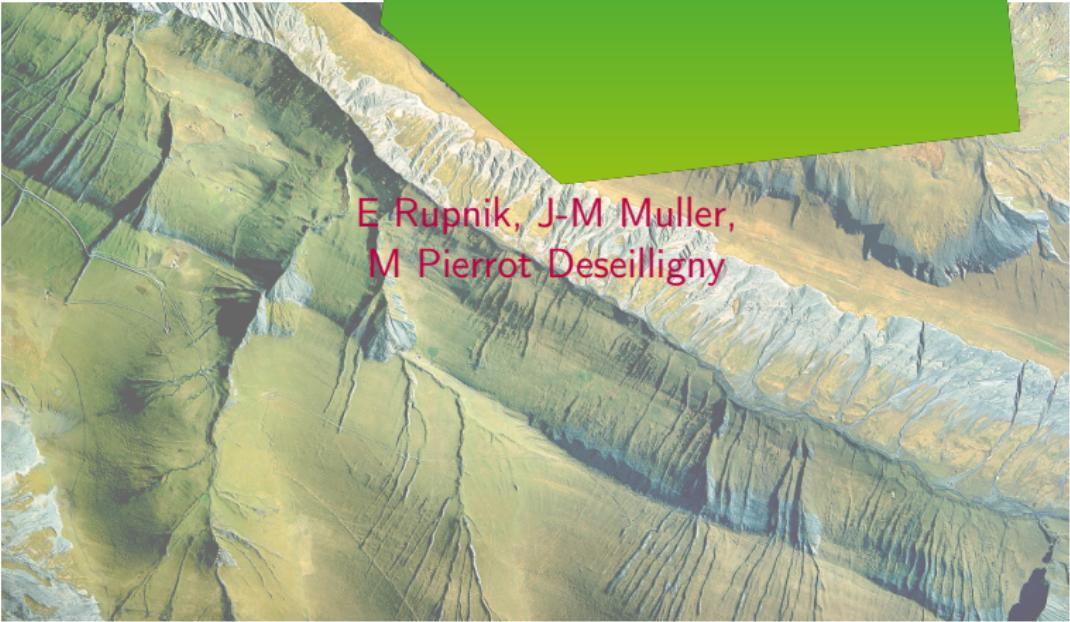
## ► in MicMac





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Thank you for your  
attention!



A large aerial photograph of a mountainous region, likely the Alps, occupies the lower half of the slide. The terrain is a mix of green pastures or forests on the slopes and several large, blue-colored lakes in the valleys. The lighting suggests a bright day with long shadows cast by the ridges.

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