S2P:
a reproducible
Satellite Stereo Pipeline

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OVERVIEW
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1. Description of the s2p software

2. Some github "drama" (licensing, collaboration)

3. Two forms of reproductibility
   3.1. pip install s2p
   3.2. online jupyter notebook
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THE PROBLEM : COMPUTE 3D MODELS FROM OPTICAL IMAGES

Input: multiple views   **Output:** 3D reconstruction

Images: WorldView3 from the MVS benchmark dataset of [Bosch et al 2016]

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* Other users:
  - Random chinese developers asking questions on github
  - Oleg Alexandrov (from NASA)

OTHER SATELLITE STEREO PIPELINES

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* NASA : AMES stereo pipeline

Neo-Geography Toolkit

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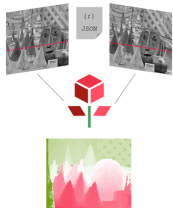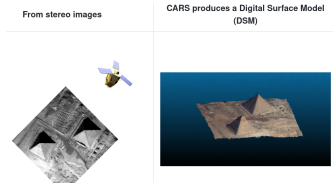
* NASA : AMES stereo pipeline

Neo-Geography Toolkit

* CNES : CARS+Pandora (used for CO3D)

From stereo rectified images to disparity map

Pandora is working with cost volumes

From stereo images

CARS produces a Digital Surface Model (DSM)

SPECIFIC DIFFICULTIES OF SATELLITE STEREO

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* Easy: Single-date image pair from one satellite

* More than two images: need for a "fusion" strategy

* Multi-date difficulties (hard matching)

* Multi-satellite difficulties (super-hard matching)

* Degenerate bundle adjustment

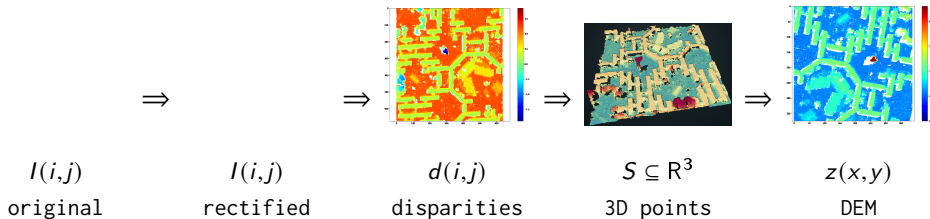easy   shadows   vegetation   wide baseline

OVERVIEW OF THE WHOLE PIPELINE

1. Jérémy: Super-resolution

2. Carlo: Crop and local RPC refinement

3. Roger: **Bundle adjustment**

4. Gabriele: **Correlation**

5. Roger: DEM filtering and fusion

6. Marie: texturing

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INNER CORE OF THE PIPELINE
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Four steps to convert a pair of images to a DEM:

1.rectification   2.matching   3.triangulation   4.projection

$\Rightarrow$ $\Rightarrow$ $\Rightarrow$ $\Rightarrow$

$I(i,j)$ $I(i,j)$ $d(i,j)$ $S \subseteq \mathsf{R}^3$ $z(x,y)$

original   rectified   disparities   3D points   DEM

PERSPECTIVES

1. Find industrial partners with exciting new problems

2. Refactor legacy parts of the code

3. Try/develop **GPU-based correlators**

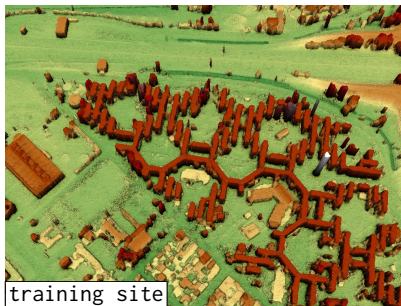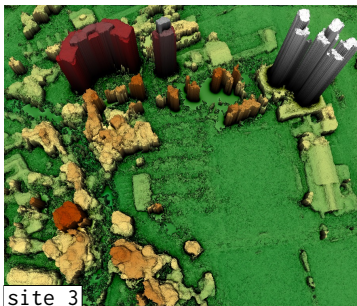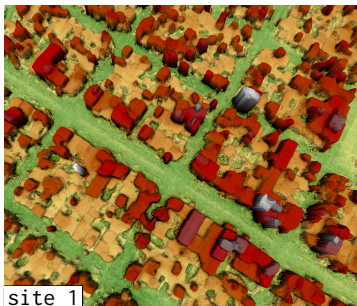4. (Optionally) integrate **single-image 3D methods**

texturing by simple averaging

texturing with shadow removal

S2P OUTPUT RESULTS

site 1

site 2

site 3

training site

(browse github repo, issues, etc)

github.com/cmla/s2p

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CONCLUSIONS ABOUT THE GITHUB DRAMA
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Three independent issues:
    1. Licensing (AGPL, GPL, MIT, Apache, BSD, dual)
    2. Contribution license agreement
    3. Contribution guidelines

The most critical decision is probably the CLA, and it
is nearly impossible to change later on. Copyright
holders can agree to change the license as they want.
```