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► **To cite this version:**

Antoine Billy, Sébastien Pouteau, Serge Chaumette, Pascal Desbarats, Jean-Philippe Domenger. Adaptive frames selection for SLAM algorithms on real and synthetic stereo datasets. Journée de l'école doctorale Mathématiques et Informatiques, Apr 2019, Talence, France. hal-02066025

HAL Id: hal-02066025

<https://hal.science/hal-02066025v1>

Submitted on 13 Mar 2019

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Adaptive frames selection for SLAM algorithms on real and synthetic stereo datasets

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Context

From a stereovision acquisition, it is possible to build a 3D point cloud of the environment. For a moving cameras pair, we can use SLAM to merge the generated clouds of points, and create a dense 3D scene surrounding the sensors, without any other sensor than the two cameras.

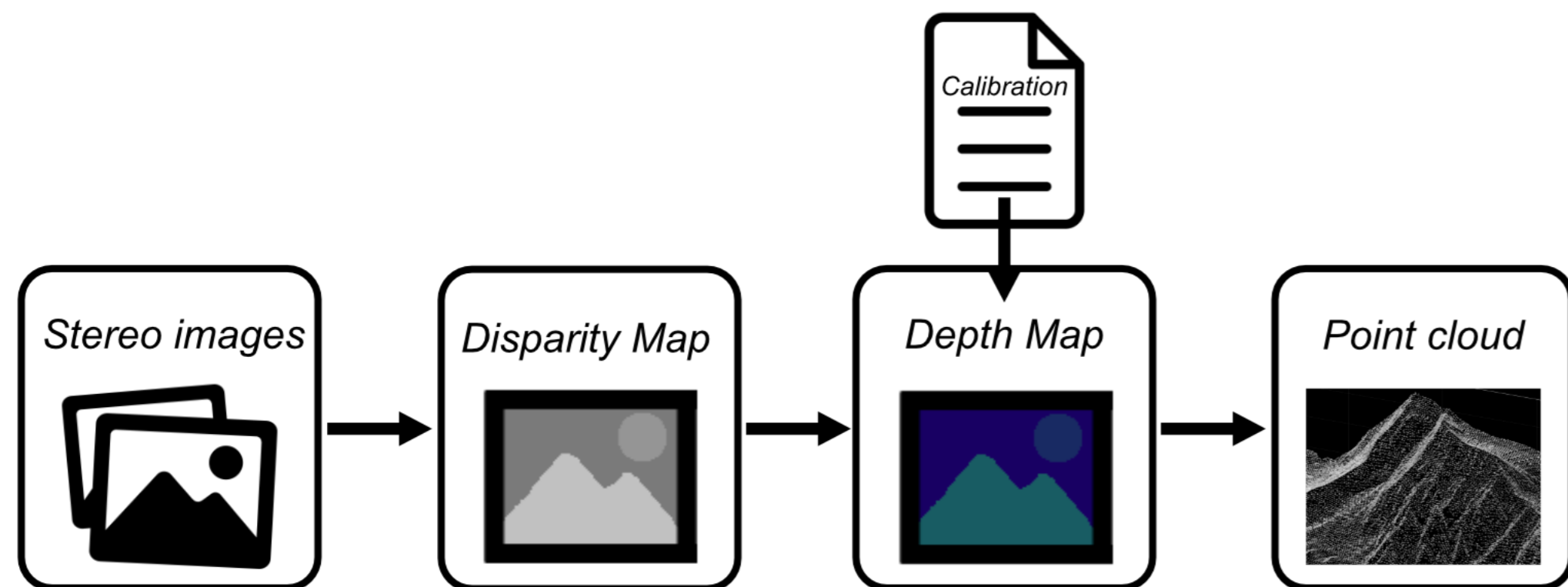


Figure: Point cloud generation from a stereo acquisition.

To carry out this task on computationally limited devices, we offer a solution to efficiently reduce the number of processed frames without increasing the generated error.

Adaptive frames selection

Our algorithm focuses on strongly reducing the number of frames when the trajectory is mostly straight, and keeping a high frame rate during rotations. The figure below illustrates two outputs of the same SLAM algorithm with the same number of input frames with and without our adaptive frames selection.

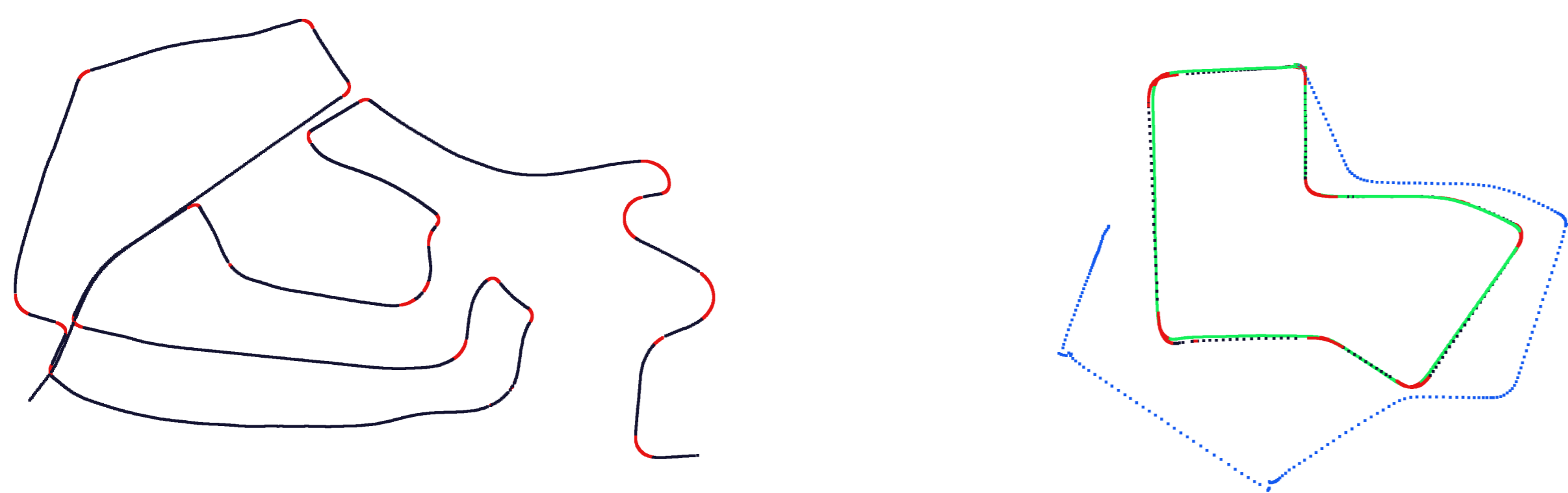


Figure: Adaptive frames selection. With our method (in black and red), the estimated trajectory fits perfectly the ground truth (in green). Whereas a naive frame selection (in blue) strongly moves away.

Real-time Dense 3D Reconstruction Pipeline

Our adaptive SLAM method lets us build a real-time dense 3D reconstruction process on a small device (such as a Raspberry Pi) without the need of a huge computational cost.

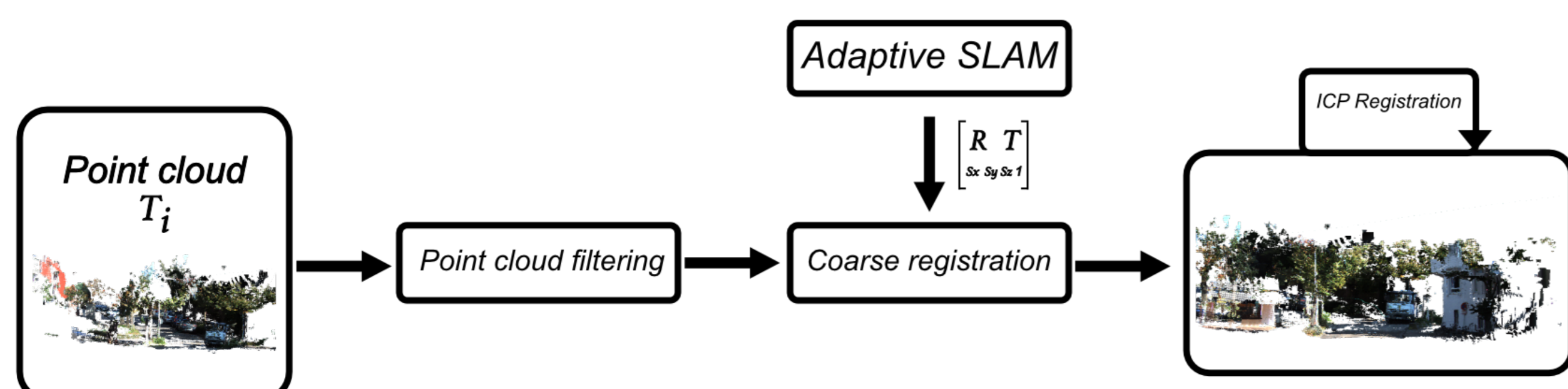


Figure: Real-time dense 3D reconstruction pipeline.



Figure: reconstructed point cloud correctly fitting the GPS coordinates (in red).

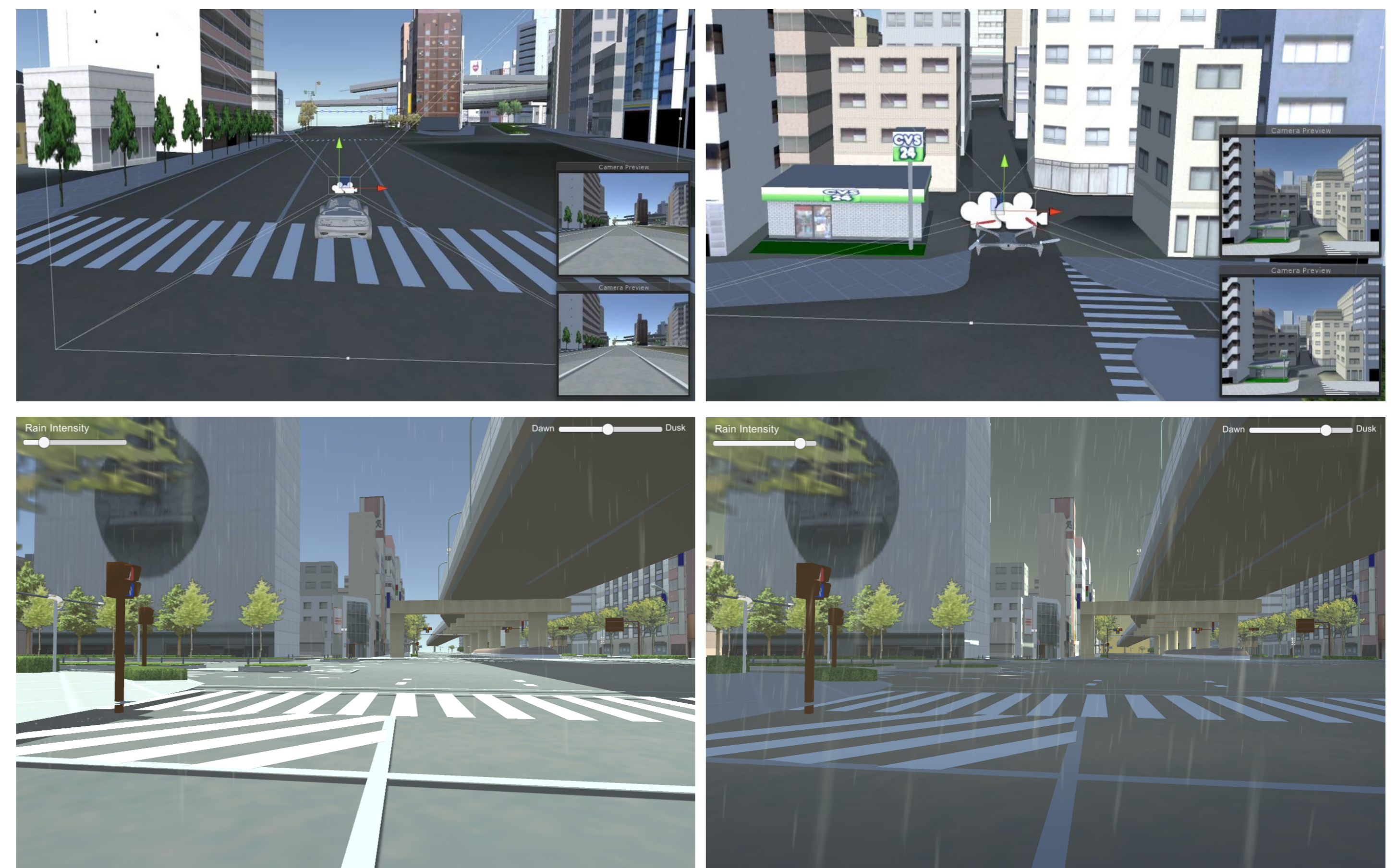
Contact informations

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The Alastor Dataset: alastor.labri.fr

Alastor is, to our knowledge, the first synthetic stereo dataset for SLAM algorithms. The real advantages of synthetic dataset:

- ▶ Alastor allows you to switch to any vector car or UAV.
- ▶ Alastor comes with absolute ground truth.
- ▶ Alastor lets you adjust the frame rate you need.
- ▶ Alastor can simulate any lightning conditions.



Results

Those diagrams show that we efficiently reduce the number of processed frames without increasing the overall error.

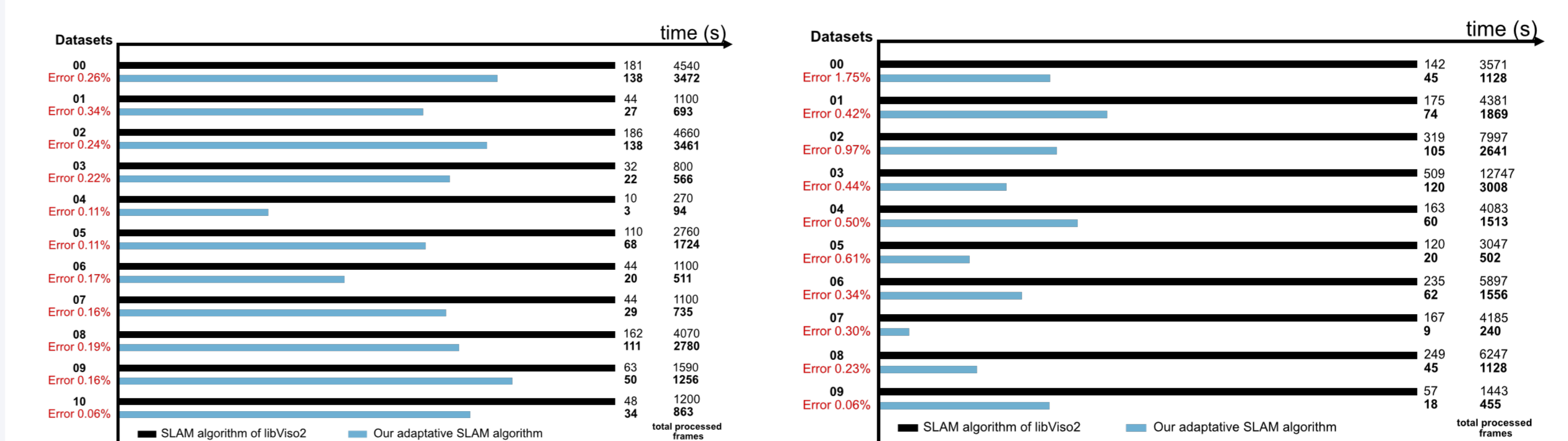


Figure: Evaluation of adaptive SLAM algorithm using to libviso2: on the KITTI dataset (left) and on the Alastor dataset (right).

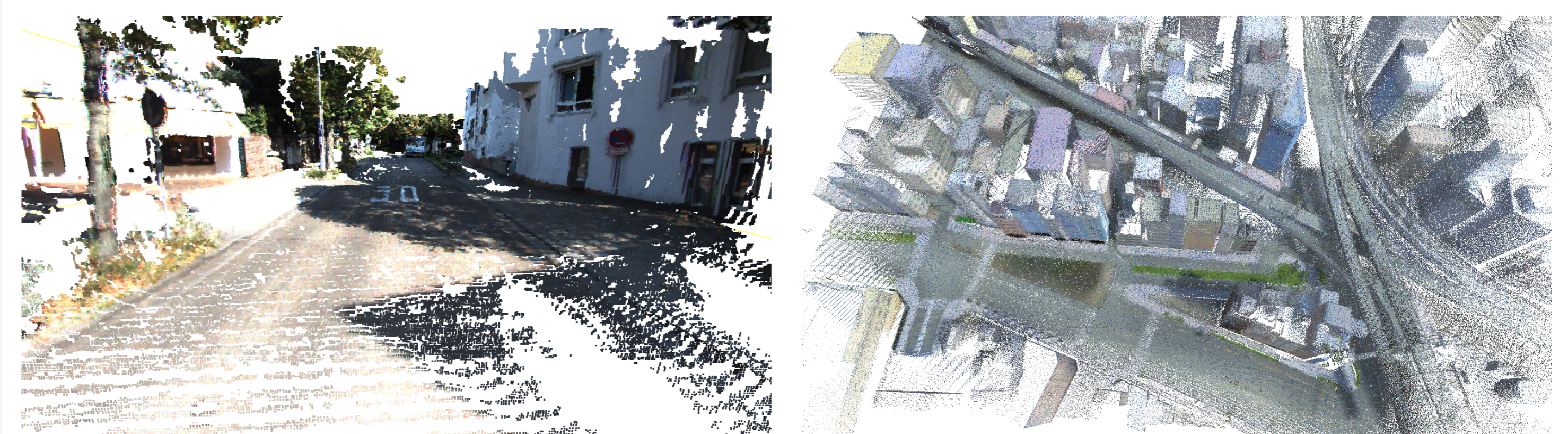


Figure: Examples of generated dense point clouds for each dataset.

Conclusions

- ▶ Reducing the frame rate in the straight lines strongly enhance SLAM algorithms speed without increasing the global error.
- ▶ Synthetic dataset allows to test SLAM algorithms in unseen situations such as illumination changes or rainy weather.

Main references

- ▶ A. Geiger, P. Lenz, and R. Urtasun. Are we ready for autonomous driving? the kitti vision benchmark suite. In *CVPR, 2012 IEEE Conference on*, pages 3354–3361. IEEE, 2012.
- ▶ A. Howard. Real-time stereo visual odometry for autonomous ground vehicles. In *IROS 2008. IEEE/RSJ International Conference on*, pages 3946–3952. IEEE, 2008.