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Edge-Aware Monocular Dense Depth Estimation with Morphology

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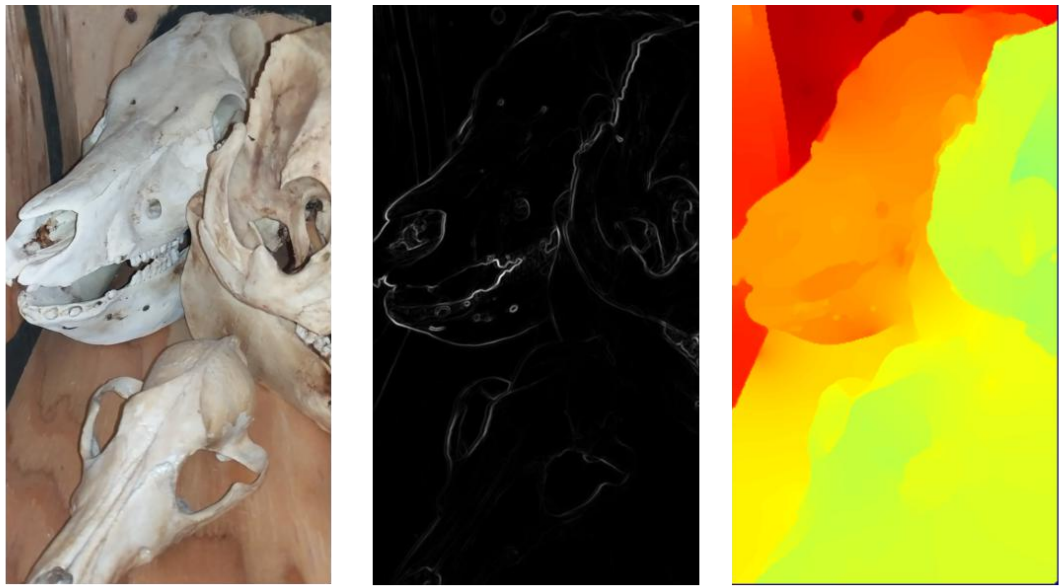
Introduction

Introduction



a: Input image b: Morphological edge c: Depth map

Fig 1. The edges and the detph map proposed in our work.

Dense depth maps play an important role in Computer Vision and **AR** (Augmented Reality).

We present a novel algorithm that produces low latency, spatio-temporally smooth **dense depth maps** using only a CPU.

The depth maps exhibit sharp discontinuities at depth edges in low computational complexity ways.

METHOD

Pipeline

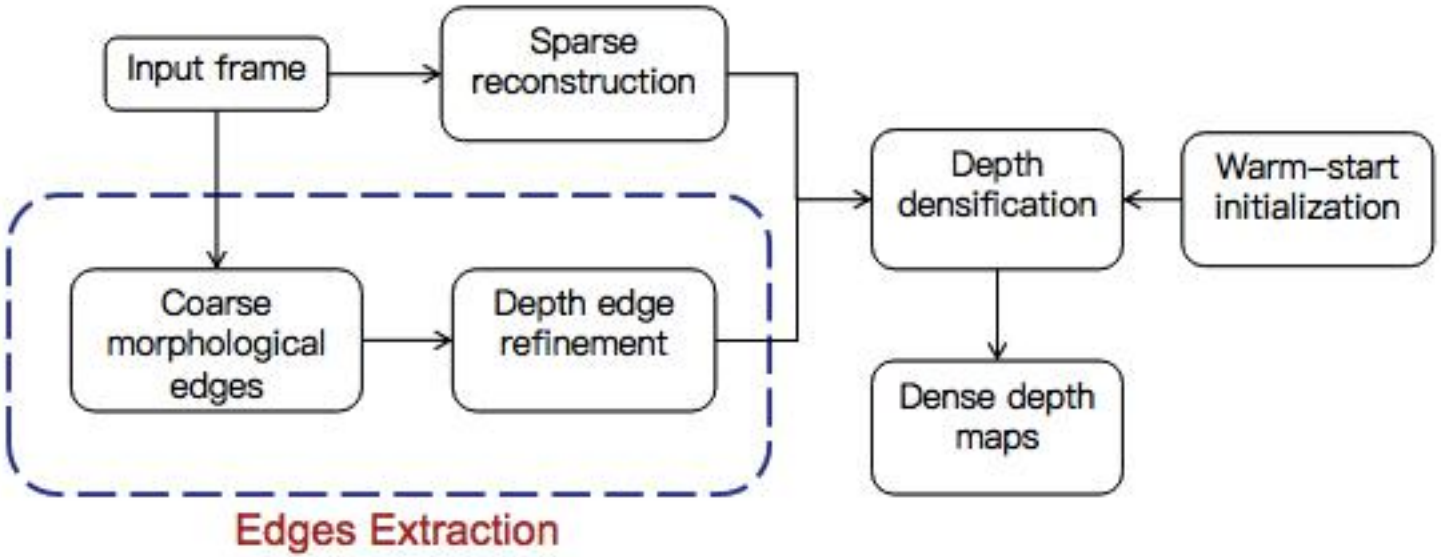


Fig 2. Our whole algorithm's pipeline

- Get the sparse reconstruction from DSO-SLAM system.
- Extract coarse depth edges by morphology operations.
- Depth edges refinement by improved Canny edge detector.
- Construct an improved optimization solver to propagate the sparse depth values and achieve depth densification.

METHOD

Depth edges

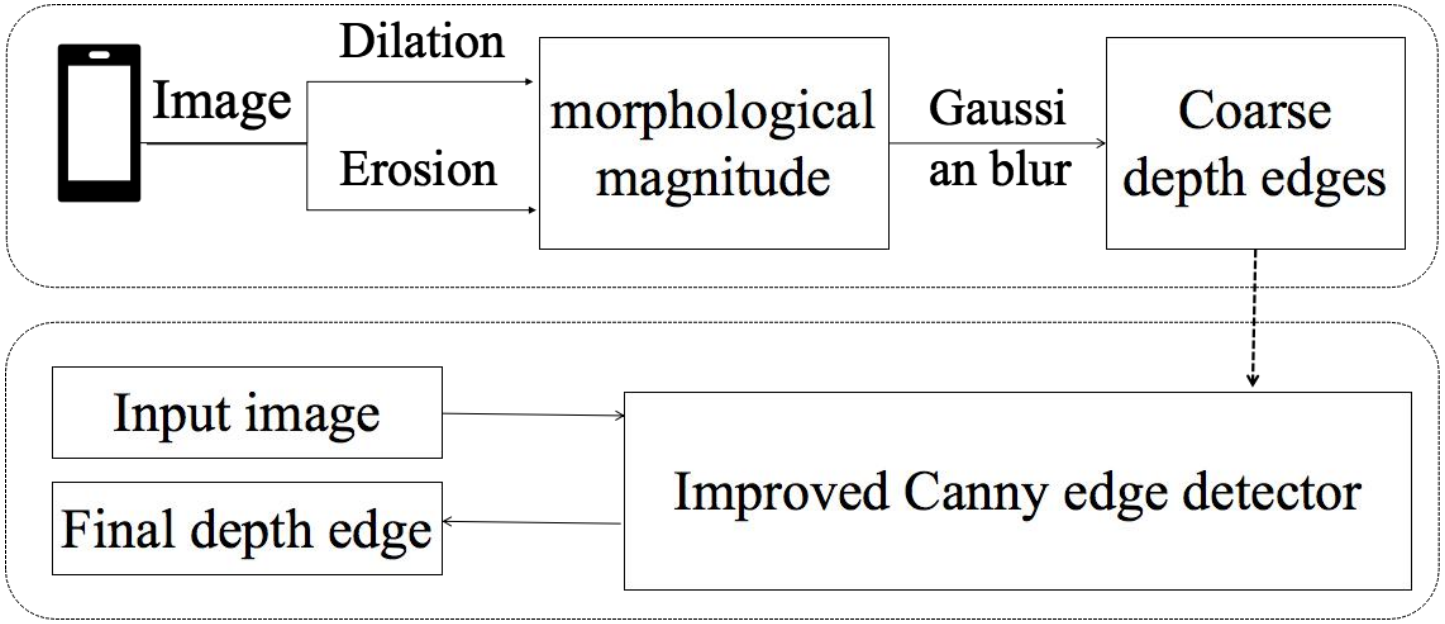


Fig 3. The whole depth edges extraction

- Extract coarse depth edges by morphology operations.
- Depth edges refinement by improved Canny edge detector.

METHOD

Densification

We propose a **novel optimization problem** to propagate the sparse depth values.

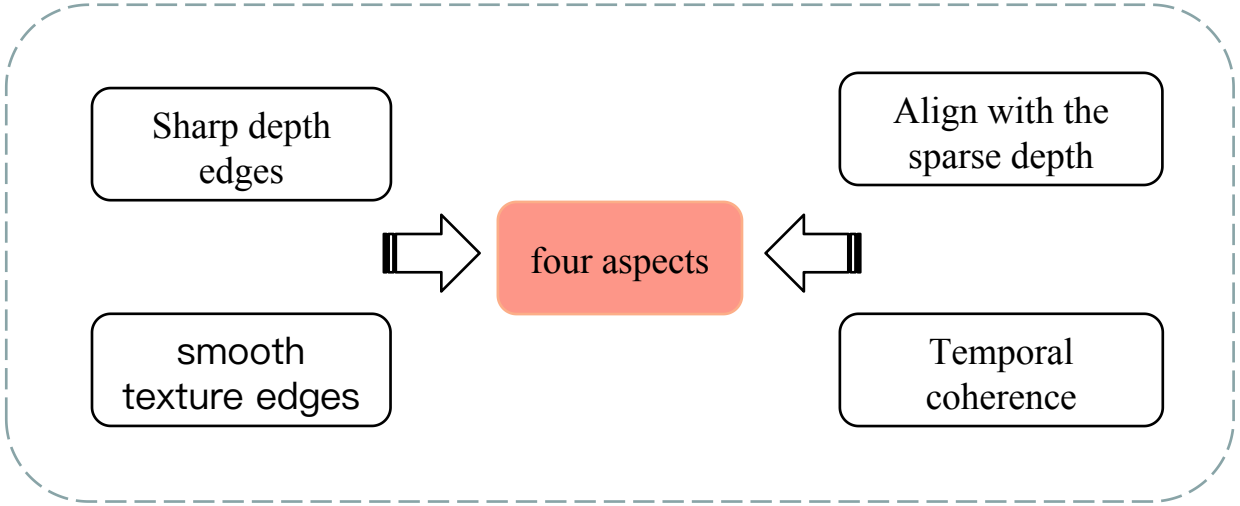


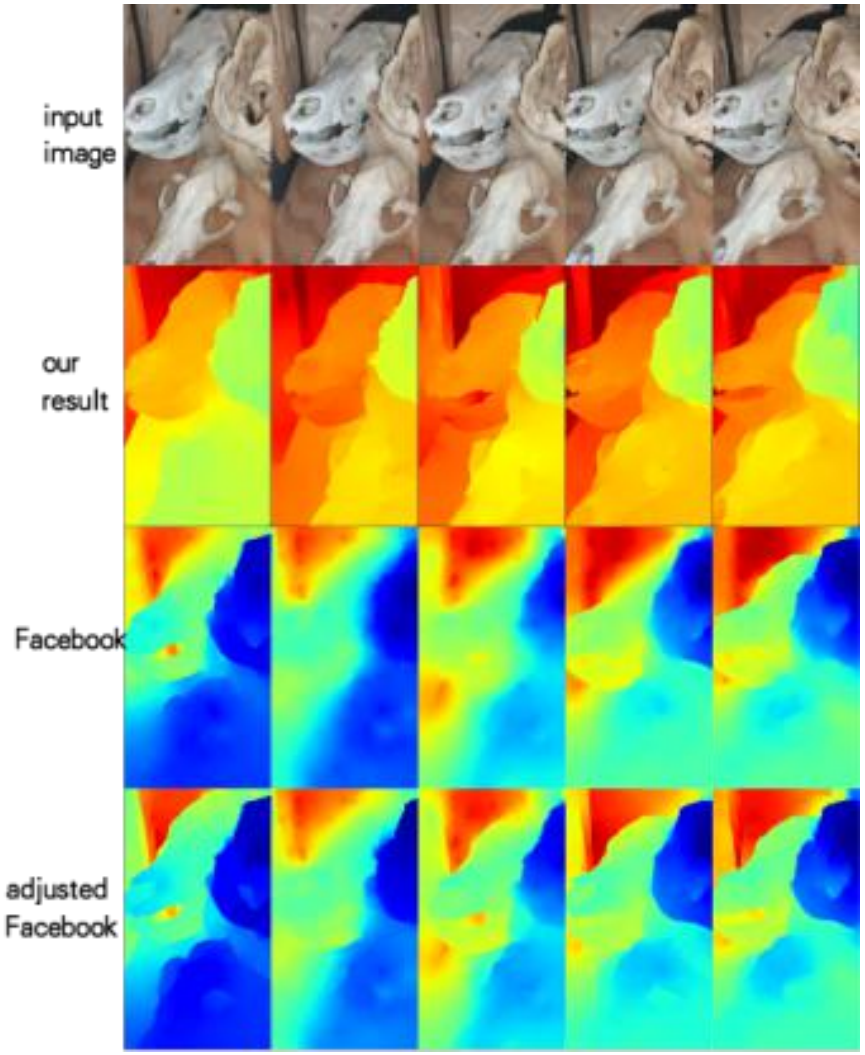
Fig 4. four aspects included by The depth densification

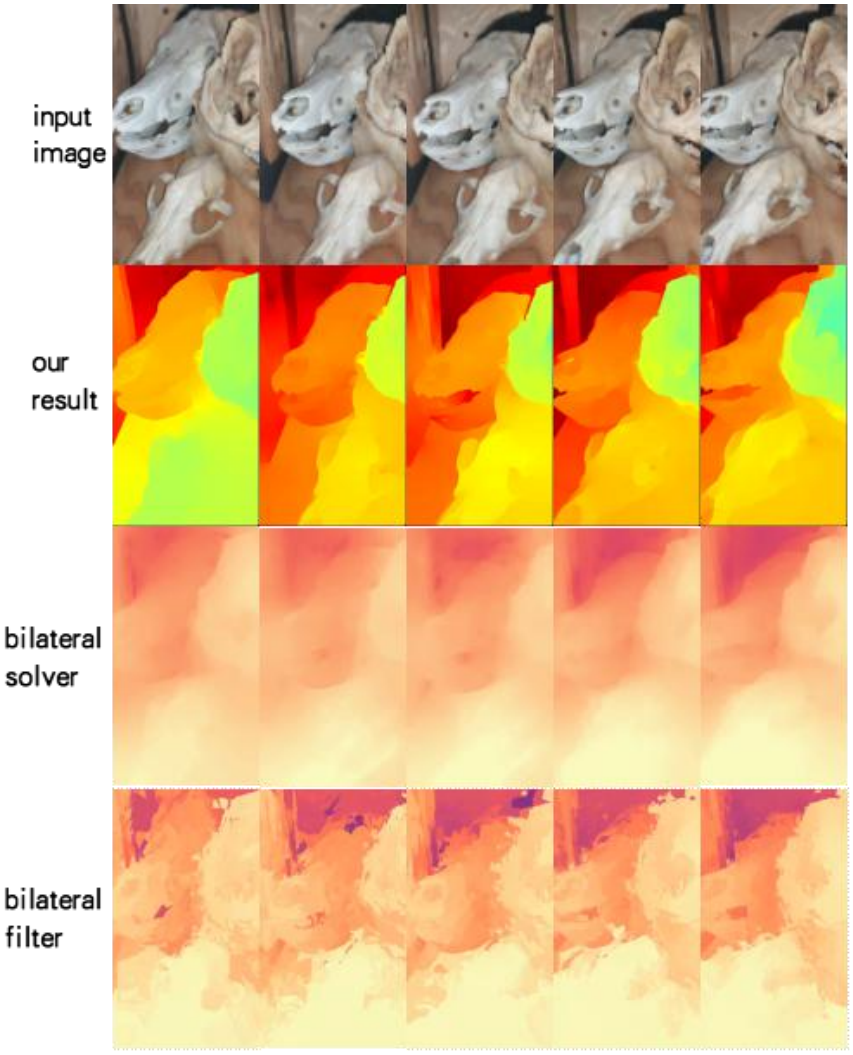
Speed up the solver :

- hierarchical iteration.
- an effective initialization
- different numbers of iterations divided by keyframes.
- a bilateral filter

Results

Qualitative Comparisons





Results

Quantitative Comparisons

Two Evaluation Metrics:

- Sharp depth edges

Dense depth maps need to produce a sharp depth distribution across the depth edges.

- Smooth texture edges

The texture areas should maintain smoothness without large depth differences.

Algorithm	Edge Error	Texture Error
Petschnigg et al	/	4.12
Barron et al	/	5.10
Holynski et al	0.95	2.52
Ours	0.34	2.13

1、G. Petschnigg, R. Szeliski et al. Digital photography with flash and no-flash image pairs.”
2、J. T. Barron and B. Poole, “The fast bilateral solver “in European Conference on Computer Vision.
3、A. Holynski and J. Kopf, “Fast depth densification for occlusion-aware augmented reality.”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THANK YOU!