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Full 3D Layout Reconstruction from One Single 360º Image

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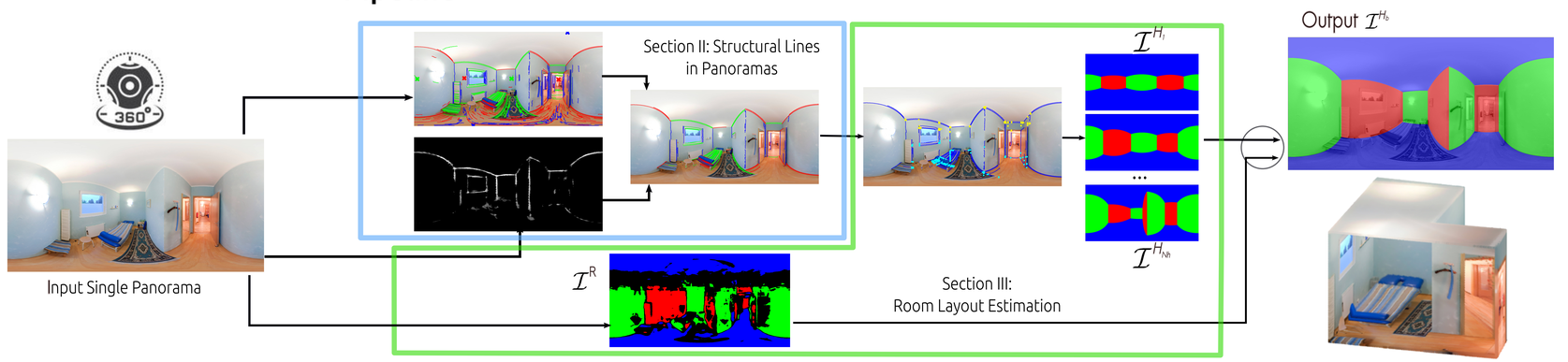
We propose a novel entire pipeline which converts 360º panoramas into flexible, closed, 3D reconstructions of the rooms represented in the images. Key ideas:

1. Explotation of deep learning techniques combined with geometric reasoning to obtain **Structural Lines**.
2. New **Normal Map** for the hypotheses evaluation step.
3. Final closed, 3D room reconstructions **faithful** to the actual shapes.

Scan the **QR Code** and see our video and paper! [1]

Pipeline



Motivation

Related Work

[1] Fernandez-Labrador, C., Perez-Yus, A., Lopez-Nicolas, G., Guerrero, J.J.: Layouts from panoramic images with geometry and deep learning. RA-L/IROS 2018.

[2] Y. Zhang, S. Song, P. Tan, and J. Xiao. "PanoContext: A whole-room 3D context model for panoramic scene understanding." ECCV 2014.

[3] A. Mallya and S. Lazebnik. "Learning informative edge maps for indoor scene layout prediction". ICCV 2015.

[4] D. Eigen and R. Fergus. "Predicting depth, surface normals and semantic labels with a common multi-scale convolutional architecture." ICCV 2015

Acknowledgements

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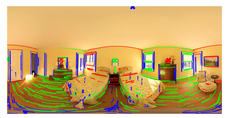
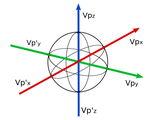
Method

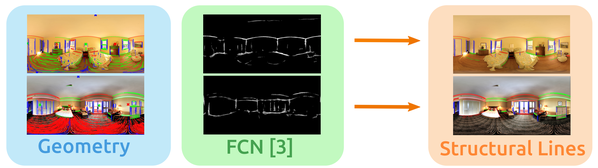
1. Lines and Vanishing Points Estimation





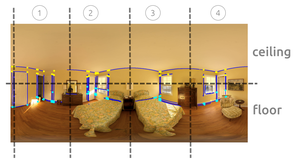
- Manhattan World Assumption
- RANSAC-based algorithm
- **Directly** on panoramas
- 8 seconds/image

2. Structural Lines: Exploiting Deep Learning



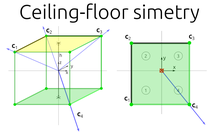
3. Candidate Corners

Intersections from Structural Lines
Classification depending on:
-Their position along the **z axis**
-Their position in the **XY-plane**



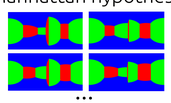
4. Layout Hypotheses Generation

Ceiling-floor simetry



Joining Corner process in 2D

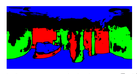
Manhattan hypotheses



5. Layout Hypotheses Evaluation

The hypothesis with **higher EOP** gives the final result

$EOP\left(\mathcal{I}^{H_i}, \mathcal{I}^R\right)$



Normal Map [4]

Evaluations and Conclusions

Datasets

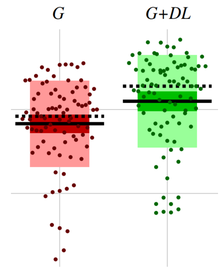
SUN360
EOP 92.7%

Stanford (2D-3D-S)
EOP 88%

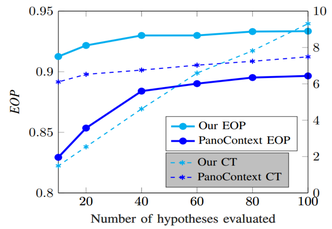
Geometry and Deep Learning combination

We demonstrate the advantages of combining both techniques to get Structural Lines

Median accuracy values are 88.9% using only geometry and **92.5% combining geometry and deep learning**



Comparison with the State of the Art [2]



-Our method shows **higher accuracy** (EOP) consuming **less computing time**
-We handle **more complex shapes**

Equally Oriented Pixels ratio

$$EOP\left(\mathcal{I}^{H_i}, \mathcal{I}^R\right) = \frac{1}{M \cdot N} \sum_{x,y,z}^{P} \sum_{i,j}^{M,N} \mathcal{I}^{H_i} \& \mathcal{I}^R$$

3D Models