End-to-End Wireframe Parsing

Yichao Zhou Haozhi Qi Yi Ma

University of California, Berkeley

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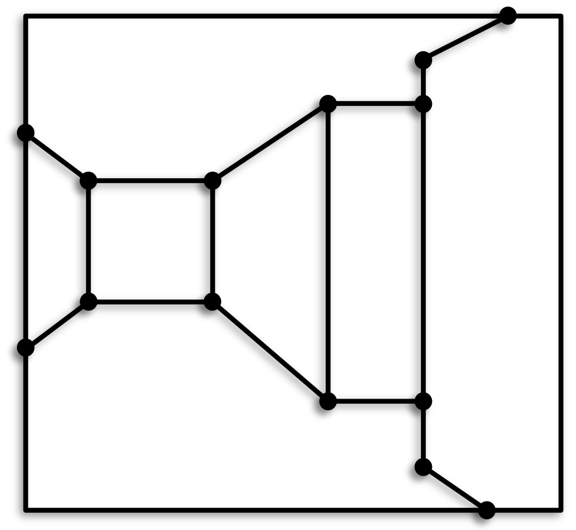
Wireframe Representation

Our representation of wireframes is based on the notation from graph theory:

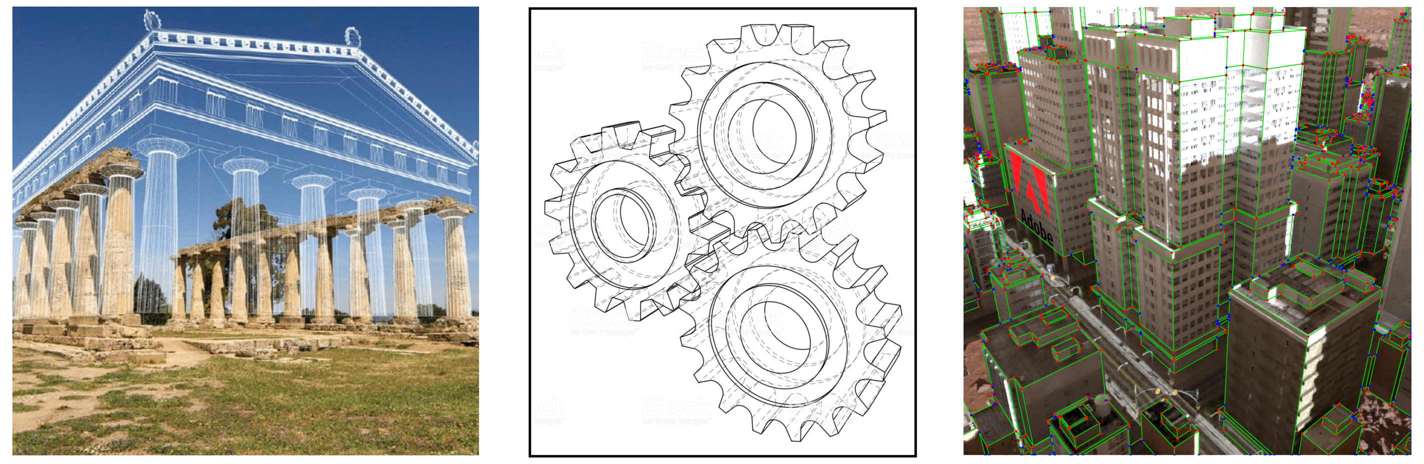
- Let $W = (V, E)$ be a wireframe;
- V is the set of junction indices;
- $E \subseteq V \times V$ is the set of lines;
- For each $\forall i \in V$: $\boldsymbol{p}_i$ represents its coordinate in image space.



Why Wireframe?

- Editable CAD representation;
- Clean geometry from priors of man-made environments;
- Compact, easy for content sharing and transmission;
- High-level structuralized features, as opposed to local features such as SIFT or line segments;
- Now possible with recent advances in deep learning.

Applications



(a) Augmented Reality (b) CAD Reconstruction (c) 3D Editing

Related Work

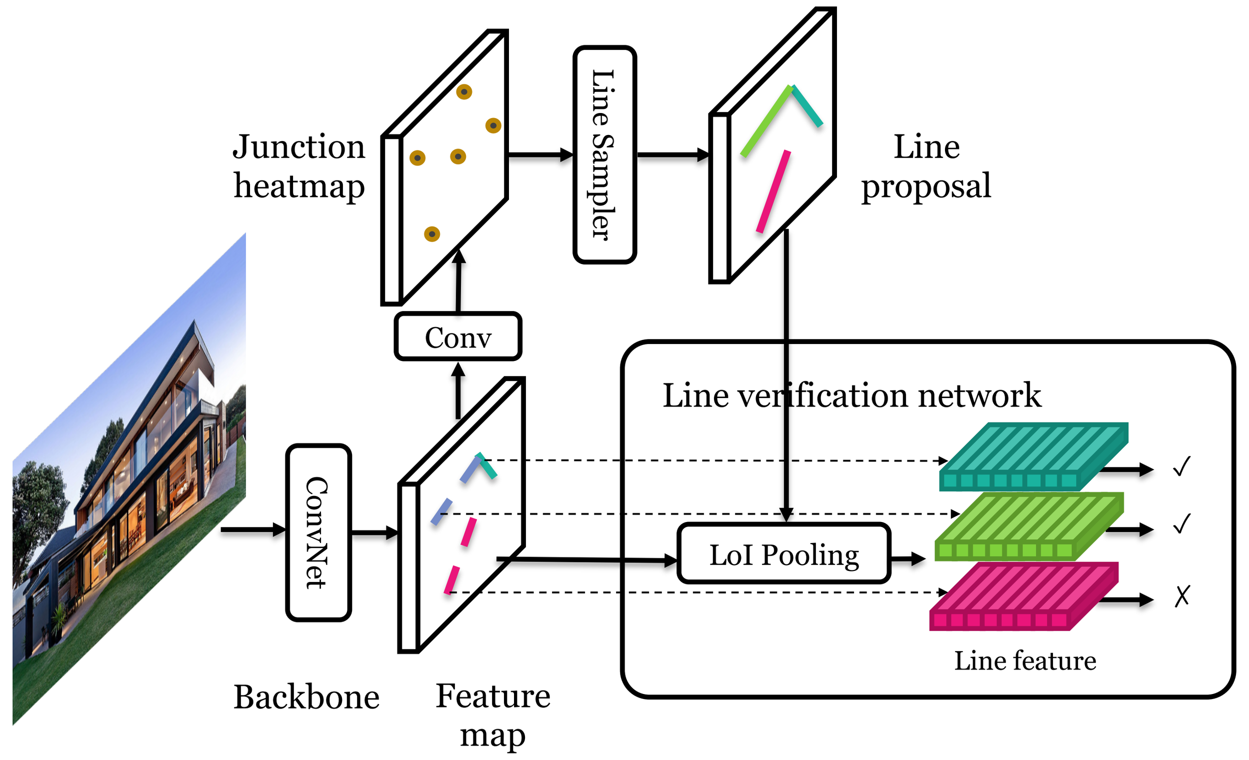
Previous Methods [1,2,3]

- Two-stage algorithms
- First, use neural networks to predict pixelwise heat maps
- Next, apply heuristic algorithms to turn the pixel-wise heat maps into a vectorized format

Our Method (L-CNN)

- End-to-end trainable
- Directly outputs vectorized wireframe, including junctions and lines
- Easy to implement in modern neural network frameworks

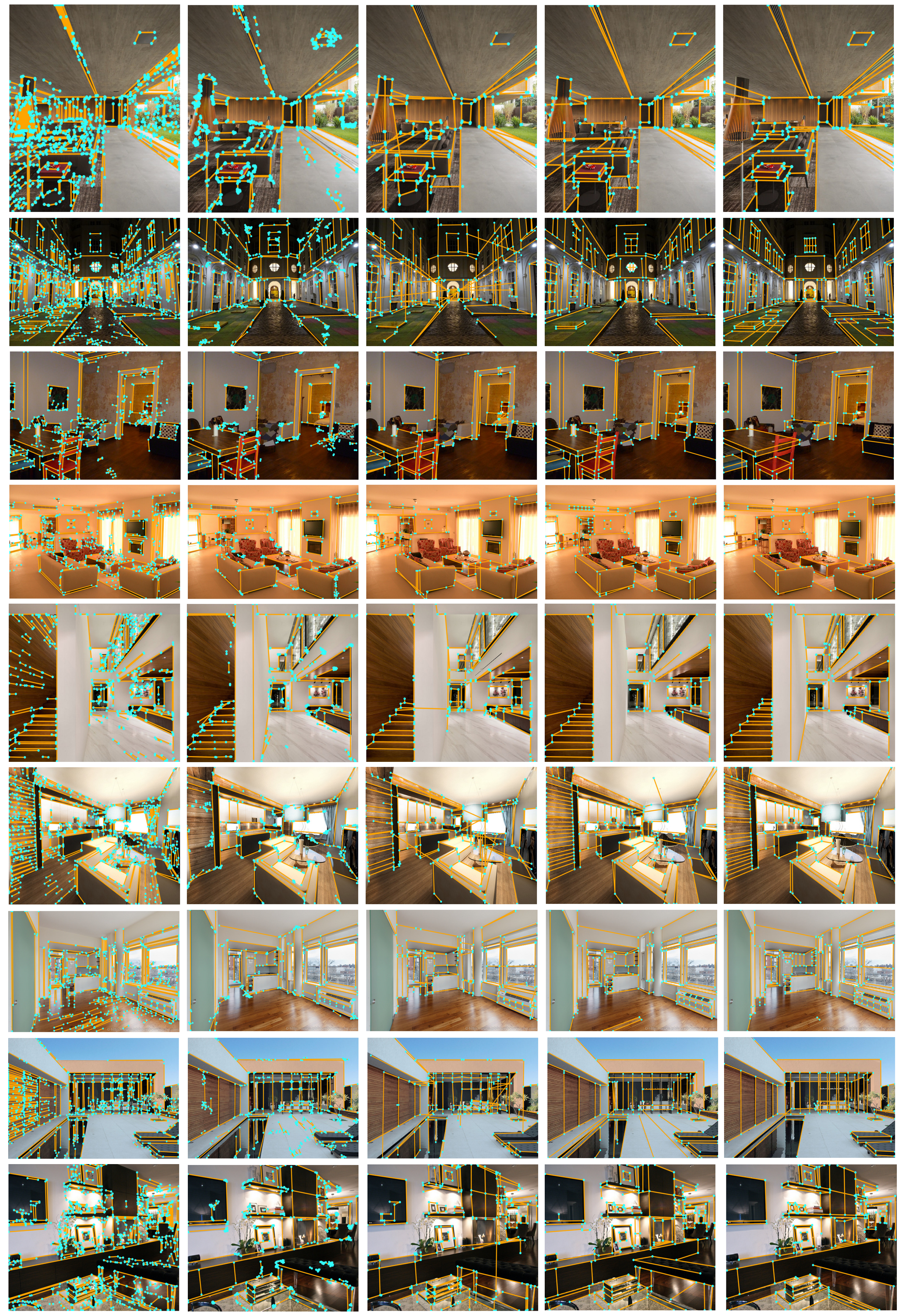
Methods



Datasets and Settings

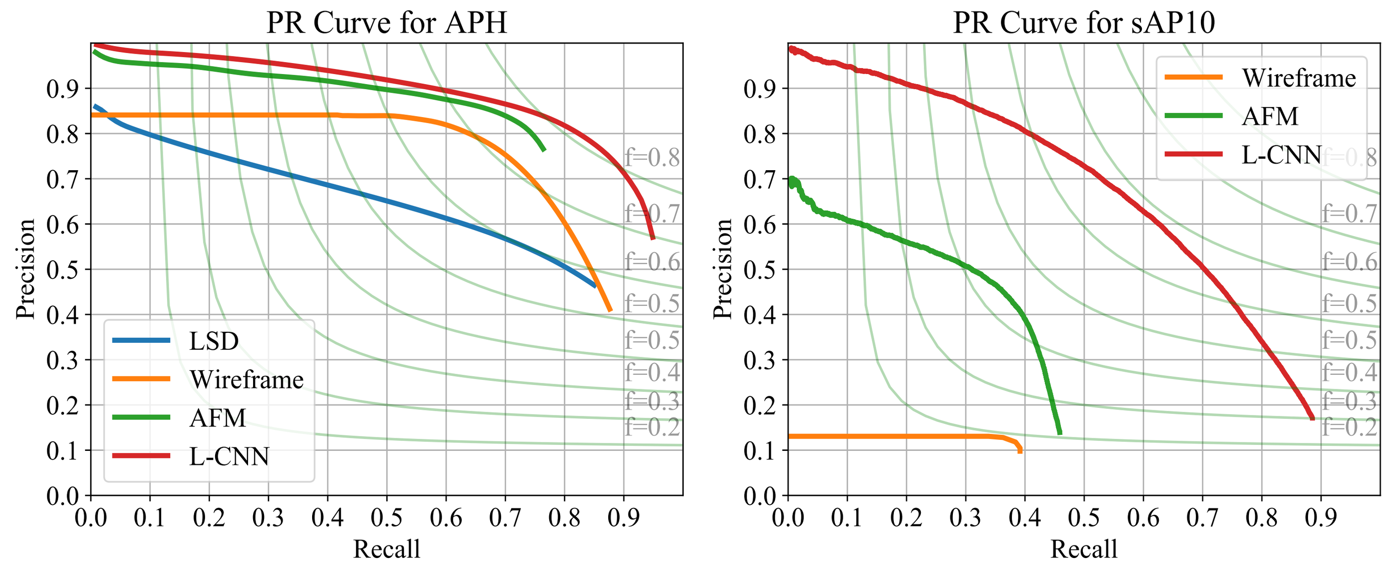
- Experiments on ShanghaiTech dataset [1];
  - Training set: **5,000** images;
  - Testing set: **462** images;
- Trains and tests on a single NVIDIA GTX 1080Ti.

Qualitative Measures



(a) LSD [2] (b) AFM [3] (c) Wireframe [1] **(d) L-CNN** (e) Ground Truth

Quantitative Measures



	sAP[10]	mAP[J]	AP[H]	F[H]
LSD [2]	/	/	52.0	61.0
Wireframe [1]	5.1	40.9	67.8	72.6
AFM [3]	24.4	23.3	69.5	77.2
L-CNN	**62.9**	**59.3**	**83.0**	**81.2**

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Reference

1. Kun Huang, Yifan Wang, Zihan Zhou, Tianjiao Ding, Shenghua Gao, and Yi Ma. Learning to parse wireframes in images of man-made environments. In CVPR, 2018.
2. Rafael Grompone Von Gioi, Jeremie Jakubowicz, Jean-Michel Morel, and Gregory Randall. LSD: A fast line segment detector with a false detection control. PAMI, 2010.
3. Nan Xue, Song Bai, Fudong Wang, Gui-Song Xia, Tianfu Wu, and Liangpei Zhang. Learning attraction field representation for robust line segment detection. In CVPR, 2019.

Berkeley UNIVERSITY OF CALIFORNIA