GlueStick: Robust Image Matching by Sticking Points and Lines Together
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## Motivation

- Points and lines are currently matched independently.
- Yet, they are complementary: lines excel in low-texture areas such as indoors, while points are widespread in natural and textured environments.
Current point matchers lack relational information between points.


## Contributions

- We propose a joint matcher for points and lines.
- We replace previous heuristic geometric strategies for line matching with a data-driven approach.
- We exploit the local connectivity between loca features and unify points and lines into a wireframe.



## Previous Work



Line Segment Matchers (LBD, LJL, SOLD ${ }^{2}$, LineTR, etc)


Handcrafted Geometryaware Line Matchers
(Multi-line signatures, junction and coplanarity, line-point invariants, etc)


## GlueStick

1. From Points and Lines to Wireframes


Merge keypoints with close
2. Attention-based Graph Neural Network (GNN)


Combine Visual \& Geometric info. (SuperGlue, LoFTR, etc)

GlueStick!

3. Dual-Softmax for Points and Lines


## 4. Ground Truth Generation

Points and lines are reprojected using depth.


## Results

Line Matching Precision-Recall Curve on ETH3D:


Visual Localization on 7Scenes Stairs and InLoc:

|  |  | 7 Scenes [52] |  | InLoc [58] |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | T/R err. | Acc. | DUC 1 | DUC 2 |
| P | SuperGlue [47] | 4.7/1.25 | 53.4 | 48.5/68.2/80.3 | 53.4/75.6/82.4 |
|  | ClusterGNN [51] |  |  | 47.5/69.7/79.8 | 53.4/77.1/84.7 |
|  | LoFTR [57] | 4.4/0.95 | 53.9 | 47.5/72.2/84.8 | 54.2/74.8/85.5 |
|  | Gluestick | 4.4/1.21 | 55.4 | 49.0 /70.2 / 84.3 | 55.0/83.2/87.0 |
| P+L | SOLD $^{2}[40]$ | 3.2/0.83 | 75.8 | 44.9/69.7/79.8 | 54.2/75.6/80.2 |
|  | LineTR [73] | $3.7 / 1.02$ | 66.6 | 46.0/67.2/76.3 | 53.4/77.1/80.9 |
|  | L2D2 [1] | 4.1/1.15 | 55.8 | 46.5/68.7/80.3 | $51.9 / 75.6 / 79.4$ |
|  | SG + Endpts | $3.1 / 0.81$ | 75.6 | 45.5/71.2/81.8 | 45.5/71.2/81.8 |
|  | Gluestick | 2.9/0.79 | 79.7 | 47.5/73.7/85.9 | 57.3/83.2/87.0 |

## Take-aways

- Efficient matching of points and lines simultaneously.

Unifying points and lines in a wireframe is essential to leverage the local connectivity of features.

- Geometry (lines + points) is an efficient alternative to dense matching.
State-of-the-art results in multiple geometrical tasks.


