EDPLVO: Efficient Direct Point-Line Visual Odometry

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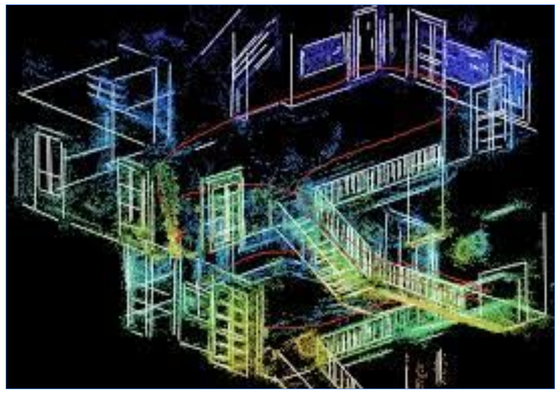
GOALS

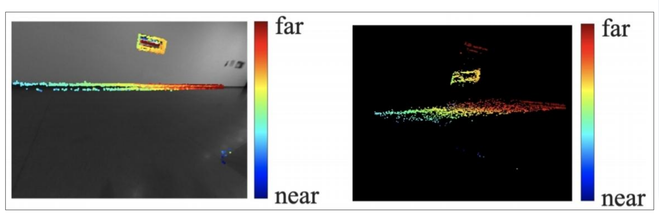
EFFICENT DIRECT VISUAL ODOMETRY ALGORITHM BY USING POINT AND LINES



CHALLENGES

1. **EXTENDS THE PHOTOMETRIC ERROR TO LINES**
2. **REDUCE COMPUTATIONAL COMPLEXITY**

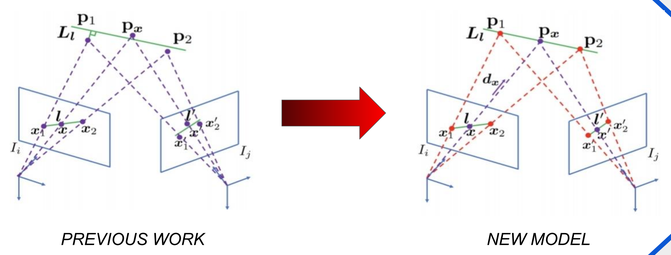
Several collinear points



DSO depth estimation

DIRECT POINT-LINE MODEL

01



THE 3D POINT OF A 2D POINT ON A 2D LINE CAN BE DETERMINED BY THE INVERSE DEPTHS OF THE TWO ENDPOINTS OF THE 2D LINE

PROVED

02

$$E_{lj} = E_{x_1 j} + E_{x_2 j} + \sum_{x \in X} E^l_{xj}$$

$$E_{\mathbf{L}} = \sum_{i \in O_{\mathbf{L}}} \frac{1}{\rho_i} (||e(\mathbf{L}, \mathbf{q}_{i,1})||_2^2 + ||e(\mathbf{L}, \mathbf{q}_{i,2})||_2^2)$$

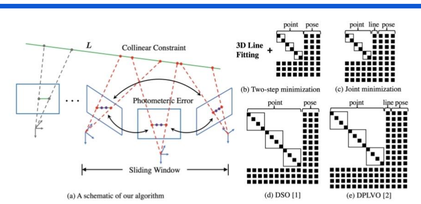
POINT PHOTOMETRIC ERROR +

LINE PHOTOMETRIC ERROR +

COLLINEARITY CONSTRAINTS =

FINAL MODEL

03



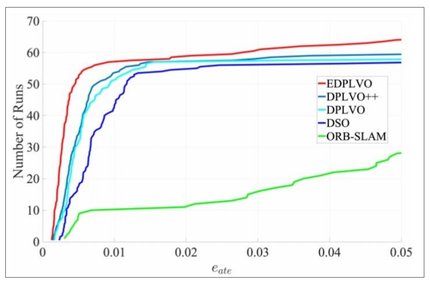
while *not converge* **do**

1) Use the latest poses and inverse depths to fit 3D lines $\hat{\mathbb{L}} = \{\hat{\boldsymbol{L}} | \hat{\boldsymbol{L}} = \arg\min_{\boldsymbol{L}} E_{\boldsymbol{L}}, \boldsymbol{L} \in \mathbb{L}\}$;
2) Fix $\hat{\mathbb{L}}$ and conduct one Levenberg-Marquardt step [38] to update poses and inverse depths to reduce the cost E;

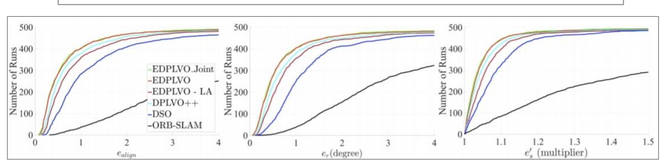
end

ALWAYS CONVERGE

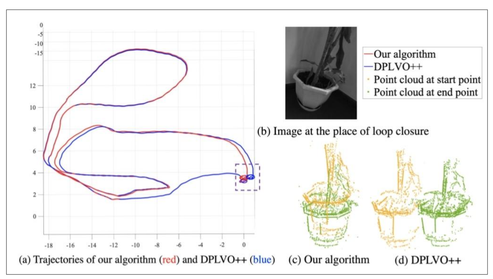
RESULTS



Cumulative error curves on the ICL_NUM dataset



Cumulative error curves on the TUM monoVO dataset



Cumulative drifts of EDPLVO and DPLVO++

RUNTIME

EDLPVO	96 ms
EDLPVO_joint	123 ms
DSO	141 ms
DLPVO++	172 ms

MACHINE USED: i7 CPU wiht 3.4 GHz and 16GB RAM