Unifying-VSLAM@RSS 2025:
https://visual-slam-lab.github.io/unifying-visual-slam

Structureless VIO

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$$x = \begin{bmatrix} x_{c_0}^T & \cdots & x_{c_N}^T & \lambda_{f_1} & \cdots & \lambda_{f_M} \end{bmatrix}^T$$
$$x_{c_k} = \begin{bmatrix} {}^G p_{I_k}^T & {}^G v_{I_k}^T & {}^{I_k}_G q^T & b_{a_k}^T & b_{g_k}^T \end{bmatrix}^T$$

The state variables of structureless VIO is obtained by deleting the environmental feature points. Structureless VIO can be expressed as

$$\min_x \left\{ \|r_p\|^2 + \sum_{k=1}^{N} \left\| r_{I_{k-1,k}} \right\|^2_{\Sigma_{I_{k-1,k}}} + \sum_{l=1}^{M} \sum_{(i,j)\in \mathrm{K}^l} \rho_{Hub}\left(\left\| r_{ij}^n \right\|^2_{\Sigma_C} \right) \right\}$$

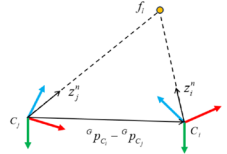

Fig. 1: Epipolar constraint.

Fig. 2: Corridor scene.

$$r_{ij}^n(x_{c_i}, x_{c_j}) = \left({}^G_{I_j} R^I_C R z_j^n \right)^T \left[\frac{t}{\|t\|} \right]_\times \left({}^G_{I_i} R^I_C R z_i^n \right)$$
$$t = {}^G p_{C_i} - {}^G p_{C_j}$$
$$= {}^G p_{I_i} + {}^G_{I_i} R^I p_C - {}^G p_{I_j} - {}^G_{I_j} R^I p_C$$

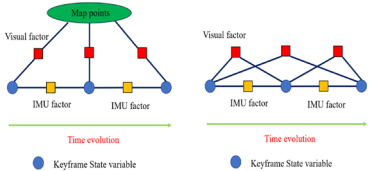

Fig. 3: Left: factor graph for classical structure-based VI-BA. Right: factor graph for novel structureless VI-BA.

Performance comparison on TUM-VI Dataset.

Sequence	ATE (m)		Avg solve time (ms)	
	VINS-Mono	Ours	VINS-Mono	Ours
room1	0.067	**0.051**	20.19	**11.56**
room2	**0.068**	0.104	22.67	**12.58**
room3	0.121	**0.114**	19.73	**11.89**
room4	**0.048**	0.063	21.03	**13.14**
room5	0.217	**0.127**	18.17	**11.27**
room6	**0.076**	0.085	26.24	**15.04**
Avg	0.100	**0.091**	21.34	**12.58**
corridor1	0.629	**0.398**	18.62	**11.46**
corridor2	**0.933**	0.956	19.06	**12.13**
corridor3	1.978	**0.893**	16.75	**10.98**
corridor4	0.315	**0.224**	19.92	**12.69**
corridor5	0.689	**0.456**	19.56	**12.36**
Avg	0.909	**0.585**	18.78	**11.92**

- A novel structureless VIO that adopts epipolar constraint instead of reprojection error or photometric error.
- Results demonstrate that our method reduces the optimization time by a large margin and offers improvement in accuracy.