TDB

21 FEB 2023

Stereo Localization (New Substitution)

$$\min_{\underline{T}} \sum_k \left\| y_k - \underline{M} \frac{1}{\underline{e}_3^T \underline{T} f_k} \underline{T} f_k \right\|^2$$

(stereo camera matrix)

$\Downarrow$ vectorize $\underline{T}$: $\underline{T} f_k = (f_k^T \otimes \underline{I})\, \underline{D}\, \underline{t}$, with $\underline{t} = \mathrm{vec}(\underline{T})$ and $\underline{P}_k = (f_k^T \otimes \underline{I})\, \underline{D}$

$$\min_{\underline{t}} \sum_k \left\| y_k - \underline{M} \underline{P}_k \frac{\underline{t}}{\underline{e}_3^T \underline{P}_k \underline{t}} \right\|^2$$

$\Downarrow$ new substitution: $\underline{t}_k = \dfrac{\underline{t}}{\underline{e}_3^T \underline{P}_k \underline{t}}$

homog. QCQP:

$$\min_{\underline{t}, \underline{t}_k} \sum_k \left\| w_0 y_k - \underline{M} \underline{P}_k \underline{t}_k \right\|^2$$

s.t. $(\forall k)\ \underline{t}_k \underline{t}^T \underline{P}_k^T \underline{e}_3 = \underline{t}\, w_0$ (substitution)

$(\forall i)\ \mathrm{tr}(\underline{A}_i \underline{t} \underline{t}^T) = b_i$ (6 rotation constraints: $s_i^T s_j = s_{ij}$ + 1 to make last element a 1)

$w_0^2 = 1$ (homog. variable)

redundant constraints:

$(\forall k)\ \underline{t} \underline{t}_k^T = \underline{t}_k \underline{t}^T$

$(\forall k, \ell)\ \underline{t}_k \underline{t}_\ell^T = \underline{t}_\ell \underline{t}_k^T$ (new)

} all of $\underline{t}, \underline{t}_k$ are parallel (more like fine-line note)

$(\forall k)\ \underline{e}_3^T \underline{P}_k \underline{t}_k w_0 = w_0^2\ (= 1)$

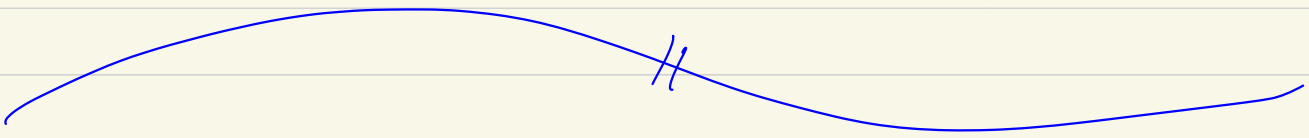
(combine substitution w/ rotation constraints) new

$$(\forall k,i) \quad tr\left(\underline{A}_i \underline{t}_k \underline{t}^T\right) = b_i \; \underline{e}_3^T \underline{P}_k \underline{t} \, w_0$$

new

$$(\forall k,l,i) \quad tr\left(\underline{A}_i \underline{t}_k \underline{t}_l^T\right) = b_i \; \underline{e}_3^T \underline{P}_k \underline{t} \, \underline{t}^T \underline{P}_l^T \underline{e}_3$$

are there more?



comments:

- the substitution produces 13 variables per landmark instead of 3
- there seem to be a lot more redundant constraints including the important cross-coupling between 'k' and 'l' variables
- substitution is more similar to fine-line and teaser