Fiducial Jacobian

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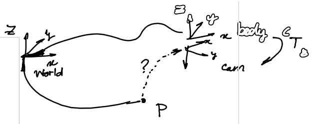
Normal Residual function is $\underbrace{}_{{}^{B}T_{W}.\text{compose}({}^{C}T_{B})}$

$$r = \hat{p} - \pi\left({}^{C}T_{B} \left({}^{W}T_{B}\right)^{-1} {}^{W}T_{O}\, {}^{O}p\right)$$



$\therefore$ r is a function of $\pi, P, {}^{B}T_{W}$ and ${}^{C}T_{B}$ (inputs are ${}^{W}T_{B}$, ${}^{C}T_{B}$ and ${}^{W}p$)

$$\frac{\partial r}{\partial \xi_{{}^{W}T_{B}}} = \left.\frac{\partial \pi}{\partial q}\right|_{q = {}^{C}T_{B} \ldots} \cdot \frac{\partial}{\partial \xi_{{}^{C}T_{B}}} {}^{C}T_{B} \cdot \frac{\partial}{\partial {}^{W}T_{B}} \left({}^{W}T_{B}^{-1}\right) \cdot {}^{W}p$$

$$= \frac{\partial \pi}{\partial q} \cdot {}^{C}T_{B} \cdot [\,T^{-1} - \,]$$

camera.project gives $\frac{\partial}{\partial \xi}\left({}^{W}T_{C}^{-1}\; p_{W}\right)$

pose.compose gives $\frac{\partial}{\partial \xi_{(f)}}(f \cdot g) \quad H_1 = f^{-1} \frac{\partial g}{\partial \xi(f)} f$

$\sim Adj_{f^{-1}} \xi_g$

and ${}^{W}T_{C}$ is a pose.compose of ${}^{W}T_{B}$, ${}^{B}T_{C}$

, from PDF,

$$\frac{\partial}{\partial \xi}(Tp) = T H(p) = T\left[-[p]_\times \;\; I_3\right]$$

$$\frac{\partial}{\partial p}(Tp) = T$$

$$\frac{\partial}{\partial \xi}(T^{-1}p) = -H(T^{-1}p) = \left[[T^{-1}p]_\times \;\; -I_3\right]$$

$$\frac{\partial}{\partial p}(T^{-1}p) = T^{-1}$$

✓

so it's like

$$\underbrace{\frac{\partial \pi}{\partial q} \cdot \frac{\partial (T^{-1}p)}{\partial \xi}}_{\text{provided by .project } H_1} \cdot \underbrace{\frac{\partial({}^{W}T_{B}, {}^{B}T_{C})}{\partial \xi}}$$

$H_1 \rightarrow Adj^{-1}$ — provided by .compose()

$H_2 \rightarrow I_{3\times3}$

$\therefore$ Jac. of pose, i.e. $\frac{\partial r}{\partial \xi_{{}^{W}T_{B}}}$ is .proj H_1 * .compose H_1

Jac. of body transform i.e. $\frac{\partial r}{\partial \xi_{{}^{B}T_{C}}}$ is .proj H_1 × .compose H_2.

For point in obj frame

$$\underbrace{\frac{\partial \pi}{\partial q} \cdot \frac{\partial (T^{-1}\,{}^{W}p)}{\partial {}^{W}p}}_{\text{.project } H_2} \cdot \underbrace{\frac{\partial T p^{o}}{\partial p^{o}}}_{\text{.Transform\_from } H_2}$$

For obj frame pose.

$$\underbrace{\frac{\partial \pi}{\partial q} \cdot \frac{\partial}{\partial {}^{W}p}(T^{-1}\,{}^{W}p)}_{\text{.project } H_2} \cdot \underbrace{\frac{\partial T p^{o}}{\partial \xi_{T_O}}}_{\text{.Transform\_from } H_1}$$