

Direct Dense Image Registration

Final Results

Frames 3 and 4

$$I_2(x_i) - I_1(x_i) \quad \forall i$$



Ground truth transformation (all units in
metres and degrees)

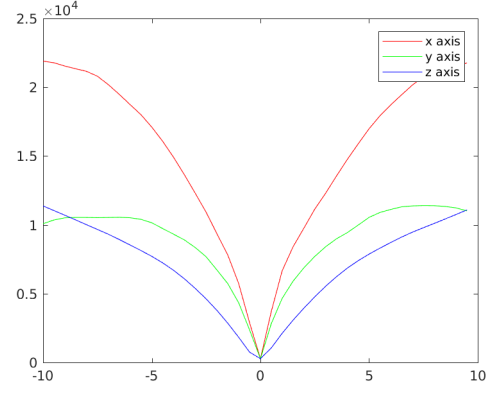
$$t = (-0.0011, 0.0004, -0.0004)$$

$$(y, p, r) = (-0.0326, 0.0606, 0.1749)$$

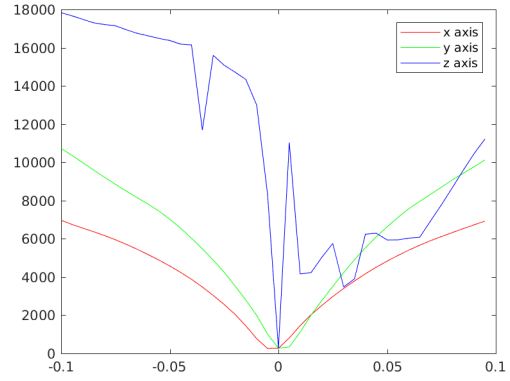
$$I_2(x_i) - I_1(w(x_i, \xi_{gt})) \quad \forall i$$



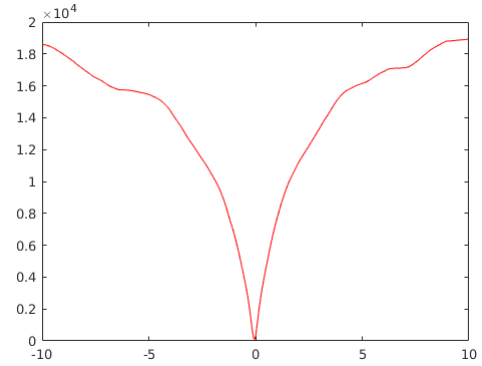
$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi$ is varied for
different values of rotations ranging
between -10° and $+10^\circ$ around the
ground truth



$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi$ is varied for
different values of translations ranging
between -10cm and +10cm around the
ground truth



$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi$ is varied for
different values of *both* rotations and
translations ranging between -10cm and
+10cm, and -10° and $+10^\circ$ around the
ground truth respectively



Initial value of transformation (all units in
metres and degrees)

$$t = (0.0790, 0.0805, 0.0796)$$

$$(y, p, r) = (-8.0386, -0.9397, -3.8216)$$

$$I_2(x_i) - I_1(w(x_i, \xi_{init}))$$



Optimized value of transformation (all
units in metres and degrees)

$$t = (-0.0011, -0.0011, -0.0011)$$

$$(y, p, r) = (-0.0879, 0.0003, 0.0842)$$

$$I_2(x_i) - I_1(w(x_i, \hat{\xi}))$$



Frame 10 and 20

$$I_2(x_i) - I_1(x_i) \quad \forall i$$



Ground truth transformation (all units in metres and degrees)

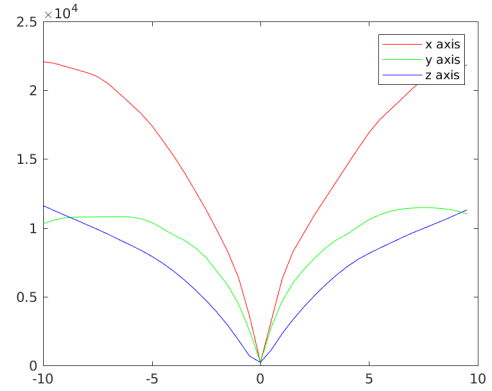
$$t = (-0.0220, 0.0004, -0.0062)$$

$$(y, p, r) = (0.8213, 0.5508, 0.0952)$$

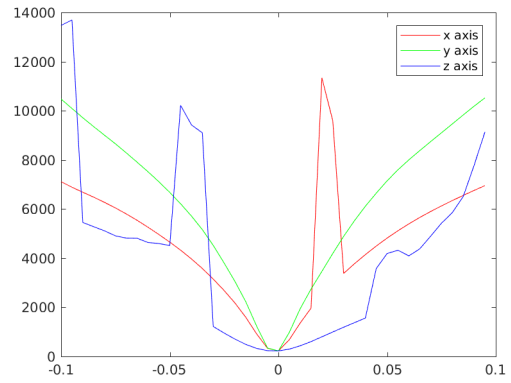
$$I_2(x_i) - I_1(w(x_i, \xi_{gt})) \quad \forall i$$



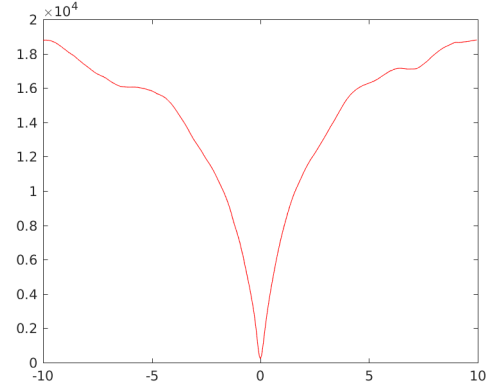
$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi$ is varied for different values of rotations ranging between -10° and $+10^\circ$ around the ground truth



$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi$ is varied for different values of translations ranging between -10cm and +10cm around the ground truth



$\|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i$; ξ is varied for different values of *both* rotations and translations ranging between -10cm and +10cm, and -10° and $+10^\circ$ around the ground truth respectively



Initial value of transformation (all units in metres and degrees)

$$t = (-0.0022, 0.0198, 0.0146)$$

$$(y, p, r) = (2.8408, 2.5216, 2.1245)$$

$$I_2(x_i) - I_1(w(x_i, \xi_{init}))$$



Optimized value of transformation (all units in metres and degrees)

$$t = (0.0008, -0.0069, -0.0051)$$

$$(y, p, r) = (0.7400, 0.0328, -0.0310)$$

$$I_2(x_i) - I_1(w(x_i, \hat{\xi}))$$



Remark: When the optimizer is initialized to any point lying in the convex region of the curves shown above, or close to it, the residual converges consistently to the global minimum. Loosely, I'd say it converges well to the ground truth for any initialization that's around $\pm 5^\circ$ and/or $\pm 5\text{cms}$ in any or all axes, away from the ground truth.