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)

\[ t = (-0.0011, 0.0004, -0.0004) \]
\[ (y, p, r) = (-0.0326, 0.0606, 0.1749) \]

\[ I_2(x_i) - I_1(w(x_i, \xi_{gt})) \quad \forall i \]
\[ \|I_2(x_i) - I_1(w(x_i, \xi))\|^2 \quad \forall i; \xi \text{ is varied for different values of rotations ranging between } -10^\circ \text{ and } +10^\circ \text{ around the ground truth} \]

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

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

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)

\[ t = (-0.0011, -0.0011, -0.0011) \]
\[ (y, p, r) = (-0.0879, 0.0003, 0.0842) \]

\[ I_2(x_i) - I_1(w(x_i, \xi)) \]

Frame 10 and 20

\[ I_2(x_i) - I_1(x_i) \quad \forall i \]
Ground truth transformation (all units in metres and degrees)

\[
t = (-0.0220, 0.0004, -0.0062)
\]

\[
(y, p, r) = (0.8213, 0.5508, 0.0952)
\]

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

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

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

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

\[ t = (-0.0022, 0.0198, 0.0146) \]
\[ (y, p, r) = (2.8408, 2.5216, 2.1245) \]

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 ±5° and/or ±5cms in any or all axes, away from the ground truth.