EXERCISE 2 - GLOBAL OPTIMIZATION

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1 Reformulation in the canonical form of Linear Programming

$$\max_{\theta, S_I} \quad card(S_I) \tag{1}$$

$$s.t \quad |x_i + T_x - x_i'| \leq \delta. \quad \forall i \in S_I \tag{2}$$

$$|y_i + T_y - y_i'| \leq \delta \quad \forall i \in S_I \tag{3}$$

with the identification binary variable z_i=1 if the i-th correspondence is an inlier. Otherwise, z_i=0; And the auxiliary variables $w_i x = z_i T_x w_i y = z_i T_y$

$$Tx.lb \geq Tx \geq Tx.ub \tag{4}$$

$$Ty.lb \geq Ty \geq Ty.ub \tag{5}$$

$$z_i \in (0, 1) \tag{6}$$

converted in the canonical form with relaxation $0 \leq z_i \leq 1$:

$$\max_{\theta, \mathbf{Z}} \quad \sum_{i=1}^{n} z_i \tag{7}$$

$$(x_i - x_i' - \delta) z_i + w_x i \leq 0 \tag{8}$$

$$(x_i - x_i' - \delta) z_i + w_{xi} \leq 0 \tag{9}$$

$$-(x_i - x_i' + \delta) z_i - w_{xi} \leq 0 \tag{10}$$

$$(y_i - y_i' + \delta) z_i + w_{yi} \leq 0 \tag{11}$$

$$-(y_i - y_i' + \delta) z_i - w_{yi} \leq 0 \tag{12}$$

$$z_i T_x.lb - w_{xi} \leq 0 \tag{13}$$

$$-z_i T_x.ub + w_{xi} \leq 0 \tag{14}$$

$$T_x + z_i T_x.ub - w_{xi} \leq T_x.ub \tag{15}$$

$$-T_x - z_i T_x.lb + w_{xi} \leq -T_x.lb \tag{16}$$

$$T_y + z_i T_y.ub - w_{yi} \leq T_y.ub \tag{17}$$

$$-T_y - z_i T_y.lb + w_{yi} \leq -T_y.lb \tag{18}$$

$$1 \geq z_i \geq 0 \tag{19}$$

$$Tx.lb \geq Tx \geq Tx.ub \tag{20}$$

$$Ty.lb \geq Ty \geq Ty.ub \tag{21}$$

in matrix form:

$$\max_x < f, x > \tag{22}$$

with

$$x = [Tx.opt, Ty.opt, z, w_x, w_y] \tag{23}$$

$$f = [0, 0, 1_n, 0_{2n}] \tag{24}$$

s.t:

$$Ax \leq b \tag{25}$$

$$lb \leq x \leq ub \tag{26}$$

with

$$b = [0_{8n}; Tx.ub_n; -Tx.lb_n; Ty.ub_n; -Ty.lb_n]; \tag{27}$$

$$lb = [Tx.lb; Ty.lb; 0_n; -Inf_{2n}]; \tag{28}$$

$$ub = [Tx.ub; Ty.ub; 1_n; Inf_{2n}]; \tag{29}$$

2 todoplot