

EXERCISE 2 - GLOBAL OPTIMIZATION

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March 2017

1 Reformulation in the canonical form of Linear Programming

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

$$s.t. \quad |x_i + T_x - x'_i| \leq \delta. \quad \forall i \in S_I \quad (2)$$

$$|y_i + T_y - y'_i| \leq \delta \quad \forall i \in S_I \quad (3)$$

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

$$Tx.lb \geq T_x \geq Tx.ub \quad (4)$$

$$Ty.lb \geq T_y \geq Ty.ub \quad (5)$$

$$z_i \in (0, 1) \quad (6)$$

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

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

$$(x_i - x'_i - \delta)z_i + w_{xi} \leq 0 \quad (8)$$

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

$$-(x_i - x'_i - \delta)z_i - w_{xi} \leq 0 \quad (10)$$

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

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

$$z_i Tx.lb - w_{xi} \leq 0 \quad (13)$$

$$-z_i Tx.ub + w_{xi} \leq 0 \quad (14)$$

$$T_x + z_i Tx.ub - w_{xi} \leq Tx.ub \quad (15)$$

$$-T_x - z_i Tx.lb + w_{xi} \leq -Tx.lb \quad (16)$$

$$T_y + z_i T_y.ub - w_{yi} \leq T_y.ub \quad (17)$$

$$-T_y - z_i T_y.lb + w_{yi} \leq -T_y.lb \quad (18)$$

$$1 \geq z_i \geq 0 \quad (19)$$

$$Tx.lb \geq Tx \geq Tx.ub \quad (20)$$

$$Ty.lb \geq Ty \geq Ty.ub \quad (21)$$

in matrix form:

$$\max_x < f, x > \quad (22)$$

with

$$x = [Tx.opt, Ty.opt, z, w_x, w_y] \quad (23)$$

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

s.t:

$$Ax \leq b \quad (25)$$

$$lb \leq x \leq ub \quad (26)$$

with

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

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

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

2 code

code mainbody: EX2_BNB_LP.m
add new subspace into list: addkids.m
split space into 2 subspace: split.m

3 implementation result

1.best translation model:Tx= -234.2592;Ty= -158.9087;
2.inliers:3,8,9,15,16,20,26,31,32,34,35,40,42,45,51;

4 figures of correspondences

5 figure of convergence of the cardinality bounds

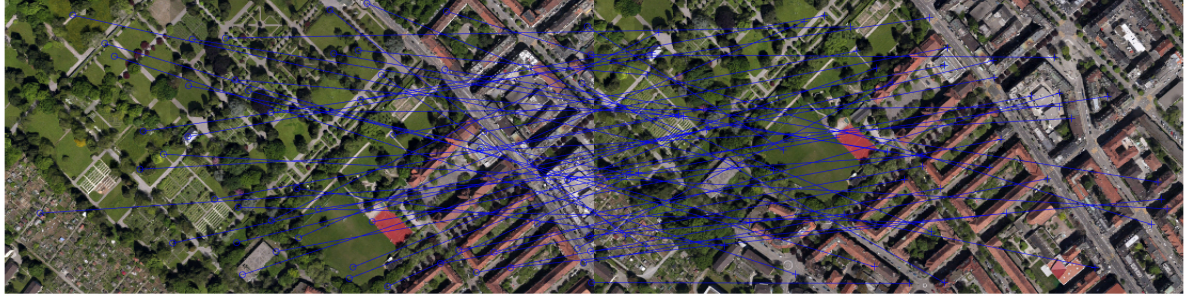


Figure 1: correspondences composed of inliers and outliers



Figure 2: correspondences of inliers

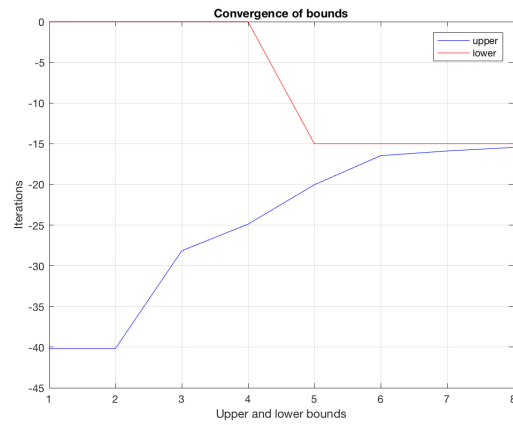


Figure 3: Evolution of the lower and upper bounds of the number of inliers along the branch and bound iterations