Manual of MLSOCCP_ReSNA

— ReSNA Plugin for Mixed Linear Second-Order Cone Complementarity Problems —

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September 3, 2013

1 Problem

`MLSOCCP_ReSNA.m` solves (tries to solve) the Mixed Linear Second-Order Cone Complementarity Problem (MLSOCCP) expressed as follows:

$$\begin{array}{rl} \text{Find} & (x,y,p) \in \mathbb{R}^n \times \mathbb{R}^n \times \mathbb{R}^l \\ \text{such that} & x \in \mathcal{K},\ y \in \mathcal{K},\ x^\top y = 0, \\ & y = M_{11}x + M_{12}p + q_1,\ \ M_{21}x + M_{22}p + q_2 = 0, \end{array} \tag{1.1}$$

where $M_{11} \in \mathbb{R}^{n\times n}$, $M_{12} \in \mathbb{R}^{n\times l}$, $M_{21} \in \mathbb{R}^{l\times n}$, $M_{22} \in \mathbb{R}^{l\times l}$, $q_1 \in \mathbb{R}^n$ and $q_2 \in \mathbb{R}^l$ are given matrices and vectors, and $\mathcal{K}$ is a Cartesian product of several second-order cones (SOCs), i.e.,

$$\mathcal{K} := \mathcal{K}^{n_1} \times \mathcal{K}^{n_2} \times \cdots \times \mathcal{K}^{n_m}$$

with $n_1 + n_2 + \cdots + n_m = n$ and

$$\mathcal{K}^{n_i} := \begin{cases} \left\{ z \in \mathbb{R} \;\middle|\; z \geq 0 \right\} & (n_i = 1) \\ \left\{ z \in \mathbb{R}^{n_i} \;\middle|\; z_1 \geq \sqrt{z_2^2 + \cdots + z_{n_i}^2} \right\} & (n_i \geq 2). \end{cases}$$

2 How to use the plugin

Putting `ReSNA.m` in the same folder, you can use `MLSOCCP_ReSNA.m` as follows.

Usage 1: `[x,y,p] = MLSOCCP_ReSNA(M,q,K,el)`
Usage 2: `[x,y,p] = MLSOCCP_ReSNA(M,q,K,el,x0,y0,p0)`

- `M` — implies the matrix $M \in \mathbb{R}^{(n+l)\times(n+l)}$ such that

$$M = \begin{pmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{pmatrix}.$$

- `q` — implies the vector $q \in \mathbb{R}^{n+l}$ such that

$$q = \begin{pmatrix} q_1 \\ q_2 \end{pmatrix}$$

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- K — implies the Cartesian structure of $\mathcal{K}$ in problem (1.1). K should be given as the row or column vector whose component corresponds to the dimension of each second-order cones. For example, when $\mathcal{K} = \mathcal{K}^3 \times \mathcal{K}^1 \times \mathcal{K}^2$, let K = [3,1,2]. When $\mathcal{K} = \mathbb{R}^{10}_+$, let K = ones(1,10).

- el — implies the value of l, i.e., the dimension of p and q_2 in problem (1.1). el should be given as a nonnegative integer. If M_{12}, M_{21}, M_{22}, q_2 and p are absent (non-mixed case), let el = 0.

- x0 — implies the initial point $x^{(0)}$ for the regularized smoothing Newton algorithm (Algorithm 4.1 in manual_ReSNA.pdf). x0 should be given as a column vector whose length is equal to sum(K). If you omit x0 or let x0 = [], then ReSNA chooses a random vector from $[-1, 1]^n$ automatically.

- y0 — implies the initial point $y^{(0)}$, which can be omitted similarly to x0.

- p0 — implies the initial point $p^{(0)}$ for the regularized smoothing Newton algorithm. p0 should be given as a column vector whose length is equal to el. If you omit p0 or let p0 = [], then ReSNA chooses a random vector from $[-1, 1]^l$ automatically.

Parameters in ReSNA.m

- PROGRESS — decides whether or not ReSNA displays the detailed progress of the iteration. The default value is 'Y'.

- tole — is used for the termination criterion in Step 1 (Algorithm 4.1 in manual_ReSNA.pdf). When $\|H_{\text{NR}}(w^{(k)})\| \leq$ tole, the algorithm terminates normally and the obtained output is guaranteed to be the solution of problem (1.1). The default value is 1e-8.

- tole_diff — is used for approximating the Jacobian matrix by means of the finite difference method. The default value is 1e-8. (This parameter is not used for this plugin.)

- eta, eta_bar, rho, sigma, kappa, kappa_bar, kappa_hat — are the parameters indicated in Algorithm 4.1 in manual_ReSNA.pdf. Some default values are assigned automatically.