

Manual of LSOCCP_ReSNA

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

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1 Problem

LSOCCP_ReSNA.m solves (tries to solve) the Linear Second-Order Cone Complementarity Problem (LSOCCP) expressed as follows:

$$\begin{aligned} \text{Find } & (x, y) \in \mathbb{R}^n \times \mathbb{R}^n \\ \text{such that } & x \in \mathcal{K}, y \in \mathcal{K}, x^\top y = 0, \\ & y = Mx + q, \end{aligned} \tag{1.1}$$

where $M \in \mathbb{R}^{n \times n}$ and $q \in \mathbb{R}^n$ are given matrix and vector, respectively, and \mathcal{K} is a Cartesian product of several second-order cones (SOCs), i.e.,

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

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

$$\mathcal{K}^{n_i} := \begin{cases} \{z \in \mathbb{R} \mid z \geq 0\} & (n_i = 1) \\ \{z \in \mathbb{R}^{n_i} \mid z_1 \geq \sqrt{z_2^2 + \dots + z_{n_i}^2}\} & (n_i \geq 2). \end{cases}$$

2 How to use the plugin

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

Usage 1: `[x,y] = LSOCCP_ReSNA(M,q,K)`

Usage 2: `[x,y] = LSOCCP_ReSNA(M,q,K,x0,y0)`

- **M** — implies the matrix $M \in \mathbb{R}^{n \times n}$ in problem (1.1).
- **q** — implies the vector $q \in \mathbb{R}^n$ in problem (1.1).
- **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)`.
- **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**.

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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 $\|H_{\text{NR}}(w^{(k)})\| \leq \text{tole}$, 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.