DECOPT - DEcomposition Convex OPTimization

DECOPT is a MATLAB software package for solving the following generic constrained convex optimization problem:

$$\min_{\mathbf{x}\in\mathbb{R}^p,\mathbf{r}\in\mathbb{R}^n} \Big\{ f(\mathbf{x}) + g(\mathbf{r}) : \mathbf{A}\mathbf{x} - \mathbf{r} = \mathbf{b},\ \mathbf{l} \le \mathbf{x} \le \mathbf{u} \Big\}, \quad \text{(CP)}$$

where f and g are two proper, closed and convex functions, $\mathbf{A} \in \mathbb{R}^{n\times p}$, $\mathbf{b} \in \mathbb{R}^n$ and $\mathbf{l}, \mathbf{u} \in \mathbb{R}^p$ are the lower and upper bounds of $\mathbf{x}$. Here, we assume that f and g are proximally tractable. By proximal tractability, we mean that the proximal operator prox_{φ} of a given proper, closed and convex function φ:

$$\mathrm{prox}_{\varphi}(\mathbf{x}) := \arg\min_{\mathbf{y}\in\mathbb{R}^p} \{\varphi(\mathbf{y}) + (1/2)\|\mathbf{y} - \mathbf{x}\|_2^2\}$$

is efficient to compute (e.g., by a closed form solution or by polynomial time algorithms).

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DECOPT aims at solving (CP) for any convex functions f and g, where their proximal operator is provided. The following special cases have been customized in DECOPT:

Basis pursuit:

$$\min_{\mathbf{x}} \big\{ \|\mathbf{x}\|_1 : \mathbf{A}\mathbf{x} = \mathbf{b}, \mathbf{l} \le \mathbf{x} \le \mathbf{u} \big\}.$$

ℓ_1/ℓ_2-unconstrained LASSO problem:

$$\min_{\mathbf{x}} \frac{1}{2}\|\mathbf{A}\mathbf{x} - \mathbf{b}\|_2^2 + \lambda\|\mathbf{x}\|_1$$

ℓ_1/ℓ_1-convex problem:

$$\min_{\mathbf{x}} \|\mathbf{A}\mathbf{x} - \mathbf{b}\|_1 + \lambda\|\mathbf{x}\|_1.$$

Square-root ℓ_1/ℓ_2 LASSO problem:

$$\min_{\mathbf{x}} \|\mathbf{A}\mathbf{x} - \mathbf{b}\|_2 + \lambda\|\mathbf{x}\|_1.$$

$\ell_1/\ell 2$ - the basis denosing (BPDN) problem:

$$\min_{\mathbf{x}} \big\{ \|\mathbf{x}\|_1 : \|\mathbf{A}\mathbf{x} - \mathbf{b}\|_2 \le \delta \big\}.$$

ℓ_2/ℓ_1 - the ℓ_1-constrained LASSO problem:

$$\min_{\mathbf{x}} \big\{ (1/2)\|\mathbf{A}\mathbf{x} - \mathbf{b}\|_2^2 : \|\mathbf{x}\|_1 \le \delta \big\}.$$

Here, $\lambda > 0$ is a penalty parameter, $\delta > 0$ is a given level parameter.