Sai Wang

Supervisors

Professor: Jianjun Hao (2016 - 2019)
Professor: Yoan Shin (2017 - 2019)
Professor: Yi Gong (2019 - so far)

Other professors

Professor: Wencai Zhao (2012 - 2016)
Professor: Bingsheng He (2020 - 2023)

Coding skill

Matlab

Python

R

Scale: 0 (basic skills) - 6 (expert).

Research Experiences

2024 — **Large Language Model** — Efficient AI
Technologies: pruning, knowledge distillation, quantization, and more for optimizing model size, inference speed, and resource utilization in AI systems.

2022 — **Nonlinear convex optimization** — Variational analysis
Solving real-variable and complex-variable convex problems by using the proximal point algorithm, primal-dual method, and ADMM. These methods can achieve an O(1/t) convergence rate.

2019 — **Edge-cloud network and federated learning** — Task offloading and resource allocation
Aiming to reduce latency, energy consumption, and training error by optimizing task offloading, transmit power, number of epochs, and data allocation.

2017 — **Underwater Wireless sensor network** — Clustering algorithm
In underwater wireless sensor networks, an energy-efficient clustering algorithm based on the Voronoi diagram is proposed for magnetic induction communications.

2016 — **Wireless sensor network** — Path planning
Reducing latency and energy consumption by designing the optimal path for UAVs.

Summary of nonlinear optimization

1. The convex optimization problem with nonlinear inequality constraints:

$$\min\left\{f(\mathbf{x}) \mid \phi_i(\mathbf{x}) \le 0,\ \mathbf{x}\in\mathcal{X},\ i=1,\cdots,m\right\}, \tag{1}$$

   where $\mathcal{X}\in\mathbb{R}^n$ is a nonempty closed convex set, $f:\mathbb{R}^n\to\mathbb{R}$ and $\phi_i:\mathbb{R}^n\to\mathbb{R}$ $(i=1,\dots,m)$ are proper and closed convex functions, and ϕ_i $(i=1,\dots,m)$ are continuously differentiable.
2. The saddle-point problem with a nonlinear coupling operator:

$$\min_{\mathbf{x}\in\mathcal{X}}\max_{\mathbf{y}\in\mathcal{Y}}\mathcal{L}(\mathbf{x},\mathbf{y}) := f(\mathbf{x}) + \langle \mathbf{y}, \mathbf{\Phi}(\mathbf{x})\rangle - g(\mathbf{y}), \tag{2}$$

   where $\mathcal{X}\subseteq\mathbb{R}^n$ and $\mathcal{Y}\subseteq\mathbb{R}^m$ are two closed convex sets. $f:\mathcal{X}\to\mathbb{R}$ and $g:\mathcal{Y}\to\mathbb{R}$ are two proper convex but not necessarily smooth functions. The nonlinear function $\mathbf{\Phi}:\mathbb{R}^n\to\mathbb{R}^m$ is both convex and continuously differentiable over $\mathcal{X}$.
3. The convex complex-variable matrix optimization problem:

$$\min\{f(\mathbf{X}) \mid \phi_i(\mathbf{X}) \le 0,\ \mathbf{X}\in\mathcal{X},\ i=1,\cdots,p\}, \tag{3}$$

   where $\mathcal{X}\subseteq\mathbb{C}^{m\times n}$ is a convex set and objective $f:\mathbb{C}^{m\times n}\to\mathbb{R}$ is convex. Constraint functions $\phi_i:\mathbb{C}^{m\times n}\to\mathbb{R}$ $(i=1,\cdots,p)$ are convex and differentiable over $\mathcal{X}$.
4. The separable convex optimization problem with nonlinear inequality constraints:

$$\min\left\{f(\mathbf{x})+g(\mathbf{y}) \mid \phi_i(\mathbf{x})+\psi_i(\mathbf{y}) \le 0,\ \mathbf{x}\in\mathcal{X},\mathbf{y}\in\mathcal{Y},\ i=1,\cdots,p\right\}, \tag{4}$$

   where $\mathcal{X}\in\mathbb{R}^n$ and $\mathcal{Y}\in\mathbb{R}^m$ are two nonempty closed convex set, $f:\mathbb{R}^n\to\mathbb{R}$, $\phi_i:\mathbb{R}^n\to\mathbb{R}$ $(i=1,\dots,p)$, $g:\mathbb{R}^m\to\mathbb{R}$ and $\psi_i:\mathbb{R}^m\to\mathbb{R}$ $(i=1,\dots,p)$ are proper and closed convex functions, and ϕ_i,ψ_i $(i=1,\dots,p)$ are continuously differentiable.

.