Sai Wang

Phd student

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Southern University of Science and Technology, Shenzhen, Guangdong Province, China (518055)

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Main Research Interests

Wireless Communication

-MIMO beamforming design,
-Edge-cloud computing,
-Integrated sensing and communication,
-Wireless sensor network.

Nonlinear Optimization

-Nonlinear programming,
-Nonlinear convex optimization,
-Complex-variable optimization,
-Saddle-point problem.

Machine Learning

-Federated learning,
-Distributed learning,
-Game theory.

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Bibliography

Sai Wang received a B.S. degree in communication engineering from the Shandong University of Science and Technology, Qingdao, China, in 2016 and an M.S. degree in information and telecommunication engineering from Soongsil University, Seoul, South Korea, in 2019. He received a Ph.D. degree in Applied Mathematics at the Southern University of Science and Technology, Shenzhen, China. His research interests include cloud/edge computing, machine learning, and numerical optimization.

Education

2019 - 2023 Ph.D. — Southern University of Science and Technology, Shenzhen, China
Majoring in Applied Mathematics.

2017 - 2019 M.S. — Soongsil University, Seoul, Korea
Majoring in Information and Telecommunication Engineering.

2016 - 2019 M.S. — Shandong University of Science and Technology, Qingdao, China
Majoring in Information and Telecommunication Engineering.

2012 - 2016 B.S. — Shandong University of Science and Technology, Qingdao, China
Majoring in Communication engineering.

Publications

12/ 2023 — S. Wang and Y. Gong, “Resource Allocation and Convergence Analysis for Personalized Federated Learning in Edge-Cloud Computing Networks,” IEEE Transactions on Wireless Communications, under review, 2023.

12/ 2023 — S. Wang and Y. Gong, “First-Order Complex-Variable Methods for Nonlinear Convex Optimization with Applications to Beamforming Design,” IEEE Transactions on Signal Processing, under review, 2023.

10/ 2023 — S. Wang and Y. Gong, “A Generalized Primal-Dual Correction Method for Saddle-Point Problems with the Nonlinear Coupling Operator,” IEEE Signal Processing Letters, under review, 2023.

10/ 2023 — S. Wang and Y. Gong, “Nonlinear convex optimization: From relaxed proximal point algorithm to prediction correction method,” Journal of Computational Mathematics, under review, 2023.

10/ 2023 — S. Wang, Y. Gong, X. Li and Q. Li, “Integrated Sensing, Communication and Computation Over-the-Air: Beampattern Design for Wireless Sensor Networks,” IEEE Internet of Things Journal, early access, 2023, doi: 10.1109/JIOT.2023.3327117.

09/ 2023 — S. Wang, X. Li and Y. Gong, “Energy-Efficient Task Offloading and Resource Allocation for Delay-Constrained Edge-Cloud Computing Networks,” IEEE Transactions on Green Communications and Networking, early access, 2023, doi: 10.1109/TGCN.2023.3306002.

09/ 2023 — S. Wang and Y. Gong, “Joint Power Control and Task Offloading in Collaborative Edge–Cloud Computing Networks,” IEEE Internet of Things Journal, vol. 10, no. 17, pp. 15197-15208, Sept., 2023.

07/ 2022 — S. Wang and Y. Gong, “Convergence Analysis of Cloud-Aided Federated Edge Learning on Non-IID Data”, 2022 IEEE 23rd International Workshop on Signal Processing Advances in Wireless Communication (SPAWC), Oulu, Finland, pp. 1-5, 2022.

Sai Wang

Phd student

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).

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Research Experiences

since 2020 — Nonlinear convex optimization — *Variational analysis*
Solving real-variable and complex-variable convex problems by using 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 communicatio.

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

Summary of optimization work

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 $\phi_i:\mathbb{R}^n\to\mathbb{R}$ $(i=1,\ldots,m)$ are proper and closed convex functions, and ϕ_i $(i=1,\ldots,m)$ 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, $f:\mathbb{R}^n\to\mathbb{R}$, $\phi_i:\mathbb{R}^n\to\mathbb{R}$ $(i=1,\ldots,p)$, $g:\mathbb{R}^m\to\mathbb{R}$ and $\psi_i:\mathbb{R}^m\to\mathbb{R}$ $(i=1,\ldots,p)$ are proper and closed convex functions, and ϕ_i,ψ_i $(i=1,\ldots,p)$ are continuously differentiable.