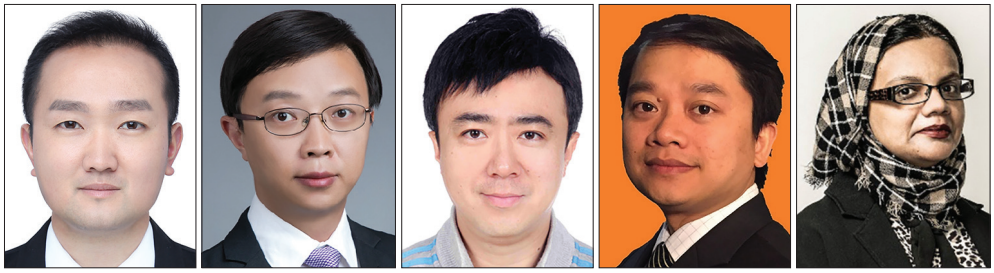
Mobile AI-Generated Content (AIGC) in 6G Era



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Mobile artificial intelligence-generated content (AIGC) is an emerging methodology for the generation, manipulation, and modification of mobile data, utilizing generative artificial intelligence (GAI) to accomplish a wide variety of computation and communication-oriented tasks for sixth-generation wireless networks (6G). Compared with traditional discriminative artificial intelligence (AI) technologies, AIGC leverages state-of-the-art GAI algorithms, e.g., generative adversarial network (GAN), variational autoencoder (VAE), Transformer, and diffusion model, to provide generation capability for 6G personalized services. The rapid development of mobile AIGC has received a lot of attention recently, aiming at building versatile content generation systems, ranging from inquiries and answers, such as ChatGPT, to creative tasks like realistic image and 3D object generation by DALL-E and Point-E.

However, mobile AIGC in 6G faces crucial challenges, particularly in how current mobile networks can be optimized to efficiently support AIGC services and how AIGC methodology can be harnessed to enhance overall network performance. Due to the extra large-scale mobile AIGC model parameters, the limited computation, communication, and storage resources of mobile devices and edge servers in wireless networks can hardly satisfy the requirements of resource-intensive AIGC services. Furthermore, mobile AIGC is envisioned to provide unprecedented capability in enhancing network throughput, security, and privacy for 6G. Nevertheless, the heterogeneity, high dynamics, and large-scale characteristics of 6G pose significant challenges to AIGC-aided network control and resource management.

The objective of this Special Issue (SI) is to bring together recent research results, technology advances, and future trends, including novel architecture, theory, evaluation, and applications towards mobile AIGC in 6G as well as 6G-supported emerging AIGC applications and services. With many high-quality submissions by experts around the world, the guest editors have selected the following papers which cover a wide variety of efficient and sustainable AIGC model frameworks and architecture for 6G services in autonomous driving, digital twin, mobile edge networks, and various physical layer communications.

The article, "Knowledge Base Enabled Semantic Communication: A Generative Perspective" by J. Ren *et al.*, uses semantic knowledge bases (KB) to improve communication efficiency by focusing on semantic representation. They introduce a generative AI method that employs source KB, task KB, and channel KB for semantic coding and transmission. This method is demonstrated to be superior to traditional techniques through a case study on image restoration, with key metrics such as efficacy, capacity, and scalability discussed to offer a framework for future research.

The article, "Wireless Network Digital Twin for 6G: Generative AI as A Key Enabler" by Z. Tao *et al.*, addresses the challenges of the complex architecture and scale of 6G networks by proposing the use of AI models like Transformers and diffusion models. A hierarchical generative AI-enabled digital twin is presented, validated through a case study, and further discussions highlight the potential and challenges of generative AI in 6G digital twins.

Further advancing the capabilities of GAI in wireless networks, H. Wang *et al.*, in "Collaborative Fine-tuning of Mobile AIGC Models with Wireless Channel Conditions," propose a method to collaboratively fine-tune mobile AIGC models by leveraging wireless channel conditions. This collaborative architecture enhances efficiency, data security, and load balance, as validated through simulation results.

Expanding on the applications of AI in autonomous systems, J. Zhang *et al.*, in "Cloud-Edge-Terminal Collaborative AIGC for Autonomous Driving" propose a cloud-edge-terminal collaborative architecture. This architecture uses AIGC to improve vehicle perception, decision-making, and motion planning. The study addresses challenges like computational complexity and latency, with simulation results validating the proposed architecture's effectiveness in enhancing autonomous driving performance and safety.

Focusing on the dual-functionality of deep generative models, J. Dai *et al.* explore their role in data compression and transmission resiliency in "Deep Generative Modeling Reshapes Compression and Transmission: From Efficiency to Resiliency." They discuss various compression paradigms and innovative approaches for joint source-channel coding, showcasing the advantages of generative models in achieving resilient data transmission.

Addressing the deployment of generative AI on mobile devices, Y. Zhang *et al.*, in "Mobile Generative AI: Opportunities and Challenges" highlight the benefits and challenges of mobile GenAI, including reduced costs, lower latency, enhanced privacy, and personalized applications. They propose a weight occupancy strategy for model compression to tackle challenges like high memory usage and prolonged inference latency.

Finally, B. Lai *et al.*, in "Resource-Efficient Generative Mobile Edge Networks in 6G Era: Fundamentals, Framework and Case Study" propose a resource-efficient generative incentive mechanism framework, which includes methods for reducing network overhead, formulating incentive mechanisms for resource allocation, and using generative diffusion models for optimal solutions.

The guest editors would like to extend their sincere apprecia-

tion to all the authors who submitted excellent research results to this SI, and to all the reviewers who spent precious time and efforts in the review process. Their technical expertise and constructive comments were integral in ensuring the overall high quality of this SI. We would also like to express our special thanks to the EiC Prof. Nirwan Ansari, and the Supervisor of this SI, Prof. Dusit Niyato for their advice and great support.

Biographies

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