Foreword about Sung Won Kim, Professor of the School of Computer Science and Engineering, Yeungnam University, Republic of Korea.

Sung Won Kim

Sung Won Kim received his B.S. and M.S. degrees from the Department of Control and Instrumentation Engineering, Seoul National University, Korea, in 1990 and 1992, respectively, and his Ph.D. degree from the School of Electrical Engineering and Computer Sciences, Seoul National University, Korea, in August 2002. From January 1992 to August 2001, he was a Researcher at the Research and Development Center of LG Electronics, Korea. From August 2003 to February 2005, he was a Postdoctoral Researcher in the Department of Electrical and Computer Engineering, University of Florida, Gainesville, USA. In March 2005, he joined the School of Computer Science and Engineering, Yeungnam University, Gyeongsangbuk-do, Korea, where he is currently a Professor. His research interests include resource management, wireless networks, mobile computing, performance evaluation, and machine learning.

Intelligent Reflecting Surfaces (IRS) is innovative technologies poised to revolutionize wireless communications. These surfaces manipulate electromagnetic waves, enhancing signal propagation and reception, which results in improved communication efficiency and reliability. IRS technology is primarily in the experimental stage, with focus areas including material design, signal processing algorithms, and integration with existing network infrastructures. Efforts are concentrated on small-scale prototypes and controlled laboratory settings. IRS technology is expected to find extensive applications in smart cities, enhancing wireless connectivity in densely populated urban areas. This could significantly improve network access in places like stadiums, shopping centers, and during large public events. The integration of IRS with IoT devices and edge computing could dramatically enhance connectivity and reduce latency, which is vital for processing large volumes of data locally and in real-time. Future developments are likely to leverage AI and machine learning to optimize IRS performance dynamically. These technologies can help IRS adapt to changing conditions and user demands by automatically adjusting the surface properties. IRS can help extend the reach of base stations, improving mobile connectivity in rural and underserved areas. This application could bridge the digital divide by providing high-quality wireless communication options across diverse geographical locations. By improving signal efficiency, IRS can decrease the energy requirements of wireless networks. This advancement supports the development of sustainable communication technologies that reduce the carbon footprint of network operations. IRS offers potential improvements in network security and privacy. By controlling the direction and reach of signals, IRS can minimize the risk of interception and unauthorized access, enhancing overall network security. As IRS technology matures, its integration into global communication infrastructures could transform how data is transmitted and received across various environments.

The potential for IRS to support an array of applications—from enhancing urban infrastructure to supporting remote operations—highlights its versatility and broad impact. Continued research and collaboration across academia, industry, and regulatory bodies will be essential to address the current challenges and to harness the full potential of IRS technology. Innovations in materials science, signal processing, and network integration will play critical roles in advancing IRS capabilities. Moreover, as we lean towards more data-driven and connected societies, the importance of sustainable and secure communication systems becomes paramount. IRS technology could be at the forefront of this transformation, promoting more efficient and environmentally friendly communication solutions.

The trajectory of IRS technology suggests a promising future with substantial benefits for wireless communication networks. By overcoming current challenges and leveraging future technological advancements, IRS can significantly enhance the quality and security of wireless communications. Its role in future networks will likely be integral, particularly as the world moves towards more interconnected and smart environments. The ongoing evolution of IRS will require a concerted effort from multiple stakeholders to fully realize its potential and deliver on its promise of reshaping wireless communication landscapes.