Designing Massive Phased Antenna Arrays for Future Wireless Communication Systems

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Description: Artificial intelligence continues to shape our world, and one of its major impacts lies in altering traditional engineering approaches. Industries have been investing colossal resources in artificial intelligence due to its potential to improve the ability and function of nearly all systems and operations that drive our economic and national security activities daily, such as medicine, geoscience, mining and wireless communications. At the same time, the demands of the modern interconnected world call for complex wireless systems with arrays consisting of increasing numbers of antennas. One of the most important features of 5G is the use of massive antenna arrays, with array sizes of 64, 128 or 256 elements. Such a large number of antenna elements provide an unprecedented variety of possibilities in their functions. In 5G systems, massive antenna arrays can significantly increase network capacity, communication range and data rates and reduce interference from unwanted sources. 5G covers only users on the ground, but the ambitious aim of 6G is to extend mobile coverage to air, connecting airborne vehicles with terrestrial networks. It is envisaged that 6G systems will eventually integrate space networks (geostationary, medium and low Earth orbit satellites), airborne networks (incl. aircrafts and unmanned aerial vehicles) and terrestrial networks (incl. mobile base stations and Earth stations). Innovations in antenna engineering are vital to achieving the challenging vision of 6G, and the most promising solutions to integrated networks are based on beamforming and beam steering of antenna arrays. The aim of the project is to explore the potential of deep neural networks for accelerating the computational simulation of complex antenna systems and massive antenna arrays. This project will apply recent advances in deep neural network research to electromagnetic modelling of massive antenna arrays for use in future wireless communication systems.

A 20-second exposure showing the Milky Way overhead the SKA-Low verification array. Credit: ICRAR/Curtin