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Exploring the Universe with Radio Astronomy and AI

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New radio telescopes, such as the SKA, will revolutionise our understanding of the Universe. They can detect the faintest distant galaxies and provide high-resolution observations of nearby galaxies. This allows for detailed statistical studies and insights into the formation and evolution of galaxies across cosmic time. These telescopes also play a crucial role in unravelling the physical processes of the early Universe before galaxies even formed. By tracing the hydrogen 21cm emission line in particular, we can see into the Dark Ages, an epoch of the Universe dominated by neutral hydrogen and depleted of light.
In this presentation, we explore the challenges posed by new radio surveys, particularly those arising from high-resolution images of millions of galaxies with increasingly complex radio structures. These galaxies often require visual inspection, but the sheer volume of data from these surveys exceeds the capacity for manual analysis. We are using machine learning algorithms and neural networks to more efficiently process data from the LoTSS survey conducted by the LOFAR telescope, a SKA pathfinder. We are also looking ahead and preparing for future challenges. In order to measure the large-scale distribution of neutral hydrogen in the universe, we are using simulated cosmological volumes of the 21cm line emission and exploring the novel line intensity mapping technique, which promises to be the next generation of cosmological and astrophysical probe. We are using diffusion networks to create samples of 21-cm maps. We will present our preliminary results and offer a glimpse into the potential of the synergy between these advanced techniques.

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