

The R2D2 deep neural network series paradigm for fast precision imaging in radio astronomy and MRI.

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Mapping the radio sky with the new modern radio-interferometric (RI) arrays requires solving challenging inverse problems for the formation of high-resolution high-dynamic range images from large volumes of visibility data. Current algorithms for image formation fall far short from delivering the joint precision, robustness, and scalability that this demands. This talk will discuss a recently introduced AI version of the traditional imaging algorithm CLEAN, dubbed “Residual-to-Residual DNN series for high-Dynamic range imaging”. R2D2’s reconstruction is formed as a series of residual images, iteratively estimated as outputs of DNNs taking the current image estimate and associated data residual as inputs. We will dive into its algorithmic structure and discuss its validation in simulation and on real RI data, showing that it opens the door to fast robust precision RI imaging. We will then discuss a transfer of technology to scalable non-Cartesian multi-coil MRI, where R2D2 has recently been extended to perform joint selfcalibration of coil sensitivity maps and image reconstruction, delivering a unique combination of precision, speed, and scalability in comparison to state-of-art approaches.