Contribution ID: **247** Type: **not specified**

Automatic Modelling and Object Identification in Radio Astronomy

Wednesday, 10 July 2024 11:50 (5 minutes)

Building appropriate models is crucial for imaging tasks in many fields, but often challenging due to the richness of the systems. In radio astronomy, for example, wide-field observations can contain various and superposed structures that require different descriptions, such as filaments, point sources or compact objects. This work presents an automatic pipeline that iteratively adapts models for such complex systems in order to improve the reconstructed images. It uses the Bayesian imaging algorithm resolve, which is formulated in the language of information field theory. Starting with a preliminary reconstruction using a simple and flexible model, the pipeline employs deep learning and clustering methods to identify and separate different objects. In a further step these objects are described by adding new building blocks to the model allowing for a component separation in the next reconstruction step. This procedure can be repeated several times for refinement to iteratively improve the overall reconstruction. In addition, the individual components can be modelled at different resolutions allowing to focus on important parts of the emission field without getting computationally too expensive.

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Session Classification: FlashTalks