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Deep neural networks for source detection in radio astronomical maps

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Source finding is one of the most challenging tasks in upcoming radio continuum surveys with SKA precursors, such as the Evolutionary Map of the Universe (EMU) survey of the Australian SKA Pathfinder (ASKAP) telescope. The resolution, sensitivity, and sky coverage of such surveys is unprecedented, requiring new features and improvements to be made in existing source finders. Among them, reducing the false detection rate, particularly in the Galactic plane, and the ability to associate multiple detected islands into physical objects. To bridge this gap, we developed a new source finder, based on the deep learning Mask R-CNN framework, capable of both detecting, classifying, and segmenting/masking compact sources, radio galaxies, or imaging sidelobes in radio images. The model was trained using ASKAP data, taken during the Early Science phase, and previous radio survey data. The final model achieves Reliability (Precision) above 66% and Completeness (Recall) above 86% on sources and galaxies. This results in an F1 Score of 0.75 across all object classes.

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