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DSA-2000 : RFI assessment and mitigation

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The Deep Synoptic Array (DSA-2000) [1] is a planned innovative radio telescope made of 2000 5m-dish antennas located in the Nevada (USA) desert spread over a 15 x 19 km area (projected construction in 2024). The telescope will span 700 MHz to 2 GHz with an instantaneous field-of-view of 10.6 deg^2. Its design is centered around the concept of Radio Camera, involving a streamlined data processing pipeline – which includes data correlation, calibration, Radio Frequency Interference (RFI) flagging, and gridding - to achieve a real-time production of fully sampled radio images every 15 minutes at a sensitivity of 1 μJy per hour of integration, and at a spatial resolution of 3.5 arcsec. As any radio telescope, the DSA-2000 will also be sensitive to active spectrum users and will embed a multi-layer protection against RFI including real-time flaggers at the individual antenna and cross-correlation levels.

Assessing the future impact of RFI to the telescope data is crucial to estimate feasibility of the project and the resources needed to achieve the targeted sensitivity and goals of the instrument. This assessment firstly requires a comprehensive spectrum survey of the future telescope site. The survey consists of a directional and omnidirectional high sensitivity monitoring of radio transmissions in and beyond the telescope band over week-long campaigns in multiple locations, but also the precise inventory of fixed and mobile terrestrial transmitters located throughout the telescope site, as well as current and future air- and spaceborne transmitters. The latter is facilitated by on-site visual inspections, but also using government data bases such as the Federal Communication Commission licensing database or International Telecommunication Union filings. Secondly, simulations of radio transmissions based on the identified transmitters' locations, frequencies, emitted power, and propagation models, have been generated and added to forward modelling datasets to realistically evaluate the actual impact of RFI on the collected and intermediate telescope data and its end-products. This allows both the identification of the detrimental sources of RFI and the development of adapted mitigation schemes to overcome their effects. The proposed mitigation strategies involve the cooperation between local radio services and the future observatory, as well as a complete framework of finely tuned real-time RFI excision algorithms to be deployed at appropriate levels within the telescope signal chain and data processing pipeline.

After introducing the DSA-2000, we will present the methodology and results of the initial spectrum surveys conducted at the future telescope site. We will then detail the RFI simulation framework developed to evaluate the impact of known RFI on the telescope data. Finally, we will describe venues of coexistence with local radio services and the real-time algorithmic RFI mitigation strategy to be deployed on the telescope.

References

[1] Hallinan, Gregg, et al. "The DSA-2000--A Radio Survey Camera." *arXiv preprint arXiv:1907.07648* (2019).