Experimental Evaluation Using VLA Datasets of RFI Mitigation Performance over Long ngVLA Baselines

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A 2017 BYU ngVLA community study resulted in a simulation-based proof of concept for a new RFI canceling algorithm which is suitable for proposed ngVLA array geometries [M.C. Burnett, Astronomical J., Mar. 2018]. That algorithm, dubbed "Sub-array Proscessing" (SAP) is a subspace projection approach which can successfully null RFI even when there is decorrelation of the RFI signals over the longer ngVLA baselines. Cancelation success depends on having high correlation of the RFI signal between antennas. Since samples are delayed to align the array to the phase center, RFI is decorrelated, but is still extant. This decorrelation is greater for longer array baselines, wider correlator channel bandwidths, and larger sky separation between the RFI source and the imaging phase center. To enhance subspace projection on large arrays, SAP instead does processing on sub-array partitions which have low RFI decorrelation across antennas.

Also, our 2017 VLA summer project resulted in the first successful demonstration on real VLA high-time resolution data of a simpler full-array subspace projection approach (see figures below). RFI canceling succeeded on VLA data from D-configuration where there was little decorrelation of the RFI because baselines were shorter and source geometry was more favorable than will often be the case for ngVLA observations.

We will present results for applying the new SAP RFI canceling algorithm to high time resolution VLA datasets. By using wider correlator channel bandwidths for the VLA, we can simulate the longer ngVLA baseline RFI decorrelation effect at narrower bandwidths. The goal is to verify that SAP will work in ngVLA-like environments.

The figures below compare real VLA images formed from the same data set without (left) and with (right) sub-space projection RFI canceling. A single 62.5 kHz correlator frequency channel is used to observe at 2341.875 MHz, with a 20 ms integration dump rate. The FOV spans 16°32' to 16°44' DEC and 05:21:30 to 05:20:48 RA. The RFI source is the SIRIUS-FM-6 satellite, the SOI (visible on the right after RFI canceling) is 3C138, and the VLA was in D configuration.