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Commissioning of the Dominion Radio Astrophysical Observatory Radio Frequency Interference Monitor

Nicholas Bruce*(1), Charl Baard(1), Rob Messing(1), and Stephen Harrison(1)
(1) Herzberg Astronomy and Astrophysics Research Centre, National Research Council Canada, Penticton, BC, Canada

1 Extended Abstract

The Dominion Radio Astrophysical Observatory (DRAO) prototyped a radio frequency interference (RFI) monitor designed to deliver a calibrated full sensitivity and full bandwidth product that covers 350 MHz to 1800 MHz [1]. During four years of operation, it helped identify numerous sources of RFI and enabled research toward RFI science [2, 3]. To detect low-power emitters the monitor has a target sensitivity requirement derived from that of the Square Kilometer Array [4], and to detect transients has a monitoring duty-cycle requirement of 95%.

Telemetry data showed that key components of the RF signal chain, including the matched load used for Y-factor gain calibrations, were tracking ambient temperatures and that the thermal control system was undersized. The noise floor of an Allan deviation gain analysis was found to occur earlier than the calibration rate (fig. 1). Calibration must occur before the minima to neutralize the effect of gain drift and enable improved sensitivity through continued integration. Calibrating frequently using the existing method would result in a duty-cycle of 80%, thus depending on the chosen configuration, one requirement or the other was not met.

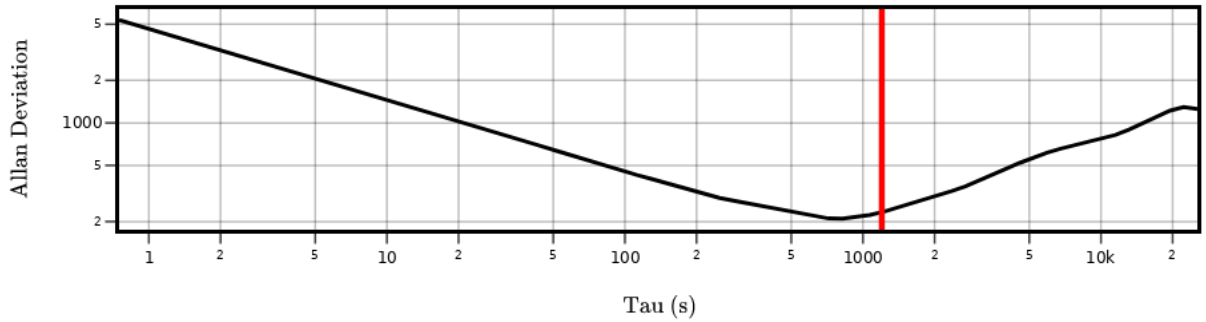

Figure 1. Allan deviation (black) of the prototype RFI monitor at 1.25 GHz showing the minima under 1000 s along with the calibration time (red) at 1200 s. This shows that the monitor was not stable before the commissioning effort.

A redesign of the RF signal chain and calibration system was initiated to meet both key requirements. In this work, we describe the process of redesigning and commissioning the DRAO RFI monitor; from a prototype to a production instrument. We show the requirement-driven design, iterative evaluation process to validate requirements, and showcase the quality of the final data product.

References

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