VLA Test Memo. No. 233

Encoder upgrade at the VLA: Mid-term update

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Normal reference pointing at the VLA entails deriving corrections to the pointing model every hour or so by observing a celestial calibrator within 10^o of the target source. Residual pointing errors after application of these corrections are typically $\leq 10''$ for most antennas, and $\leq 6''$ for the best antennas (Broilo et al. 1999). However, there are a few antennas for which short time-scale pointing errors after reference pointing are significantly greater than $10''$, up to $30''$ in the worst case. These short time-scale errors are dominated by errors in the encoder electronic read-out of antenna positions, arising from gain variations between the sinusoidal signals from the sin and cos channels of the Inductosyn transducer (Barlow et al. 1986, Poyner et al. 1986, Clark 1997). The resulting errors are clearly sinusoidal in character, and can be mitigated through fine-tuning of the gains of two encoder channels. However, such fine-tuning is time consuming, and can change over time, thereby requiring frequent monitoring. Broilo et al. (1999) have redesigned the encoder electronics with the goal of reducing this error to $\leq 6''$ in all cases. The new electronics were tested successfully on antenna 24 in 1999, and the rest of the antennas are being out-fitted with the new electronics. At the same time the encoder hardware is being over-hauled and re-aligned, and a new mount installed.

As of September 2002 about half the VLA antennas have the new encoder electronics. This memo is an interim report on the performance of the new systems.

We present data from PN3DB test observations run on Dec. 6, 2000 and Sept. 25, 2002. The

PN3DB test entails tracking a bright celestial calibrator at the (commanded) half-power point of the primary beam at 8 GHz in two orientations (Az and El). Short timescale pointing variations manifest themselves as flux density variations as the source moves up and down the steep part of the primary beam response due to tracking errors. Standard reduction of the data involves fitting sinusoids to the temporal variations in the antenna-based gains produced by the AIPS task CALIB.

Figure 1 shows the PN3DB sinusoidal amplitudes from the two test observations. In Dec. 2000 the only antenna with the new encoder electronics was antenna 24. In Sept. 2002 the following antennas had up-graded encoders:

1 2 4 6 8 11 15 16 21 22 23 24 27 28

From Figure 1 it is clear that the short timescale pointing performance of the VLA is improved by the encoder upgrade. A good example is antenna 21, which was consistently the worst performer in terms of PN3DB errors prior to the upgrade, but is now among the better antennas.

A second important point is that the performance of antenna 24 on PN3DB tests has remained consistently good since it was upgraded in 1999. In general, antennas with upgraded encoders typically perform well over the timescales on which they have been monitored (up to 3 years).[1]

A final point is the very bad performance of antenna 6 in September 2002. This antenna has a new encoder, and had been performing very well from April to July 2002. Then between July and September the performance degraded dramatically. Inspection of the encoder revealed a bad connector. In general, the new encoder electronics is much easier to maintain than the old electronics.

Overall, through the encoder upgrade the VLA is taking its most important step toward $< 6''$ short timescale pointing errors. The upgrade is proceeding at the rate of about one to two

[1]Note that some initial adjustments may be required both to the pointing model and the encoder electronics after an encoder is upgraded (Sowinski 2002).

antennas per month, and should be complete toward the end of 2003. However, the behavior of antenna 6 demonstrates that the system is not fail-safe, ie. even after the encoder upgrade is complete Operations should run regular PN3DB tests to monitor the state of the system.

References

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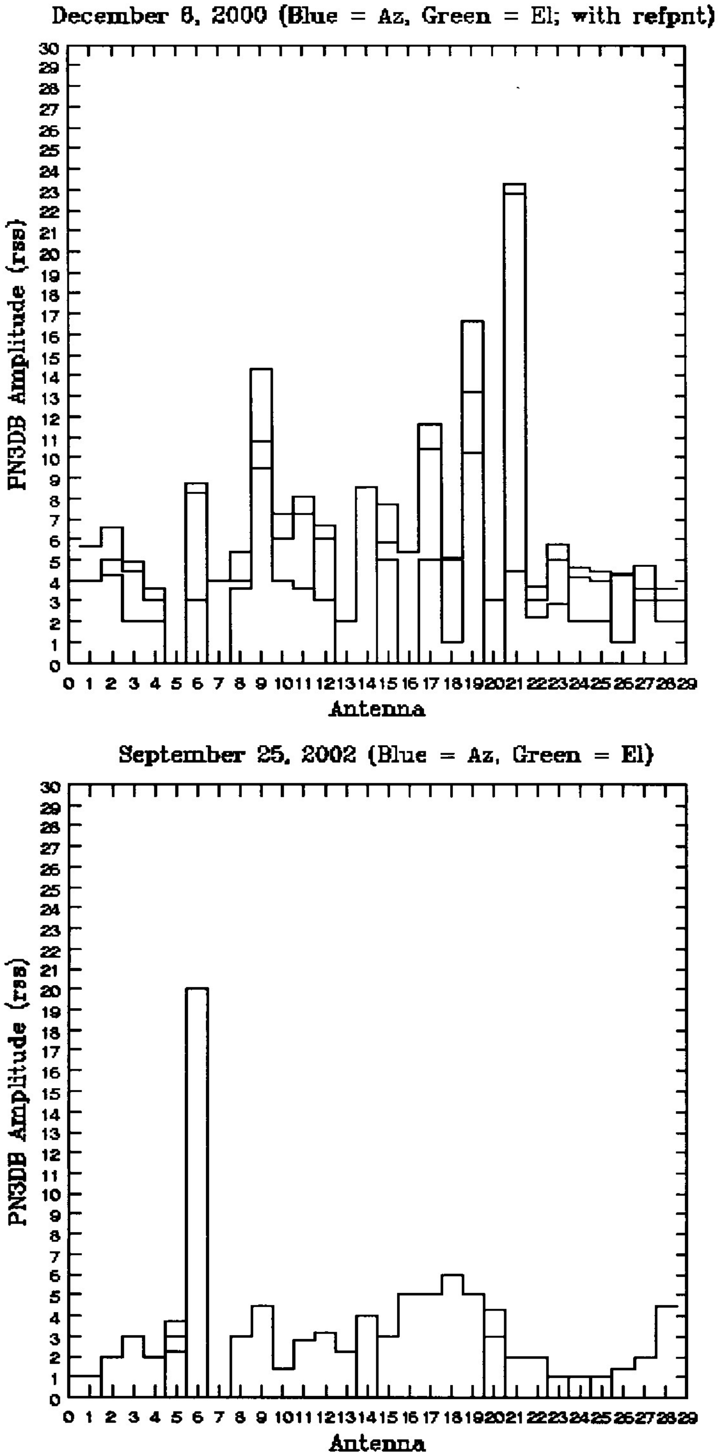

Fig. 1.— The upper figure shows the PN3DB amplitudes from data taken on December 6, 2000. The lower figure shows the PN3DB amplitudes from data taken on September 25, 2002.