Update to EVLA SSS Test Programs

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There is a new program on the SSS Test Programs page (http://www.aoc.nrao.edu/asg-internal/software/sss/sssTestPgm.shtml): evlaAutoTune.jnlp. Use the link on the above page labeled "EVLA Antenna Electronics - Automatic Configuration" to run this program.

The new program builds on the one released a year ago. You may recall that that program asked the user to flip the switches and tune the local oscillators of the EVLA antenna electronics and calculated the resulting output signals. The new version still allows users to do this, but also lets them pick desired output frequencies and then "auto tune" the electronics to produce signals centered on those frequencies.

Purpose of The Test Program

We would like to discover as many of the current flaws in the model of the antenna electronics as possible before it is exposed publicly via the observation preparation tool (OPT). The OPT is currently using this logic only when the WIDAR correlator is being used; the logic is bypassed when the VLA correlator is selected, so it is not an issue for the upcoming Ka call.

Using the Program for the First Time

Use the *Help* menu (upper right corner) and look at least at the *About*, *Output*, and maybe the *Switches / How To Use* menu items.

Separation of Tuners from Electronics

If you decide to help test this code, you should know that there is a split between the model of the electronics and a collection of objects call "tuners". Think of the model as a representation of the block diagram. It has switches, filters, mixers, multipliers, local oscillators, and wiring to connect them all. Its job is to take input from the receivers and produce outputs based on the setting of its switches and LOs.

The tuners take a set of desired outputs and attempt to configure the model of the electronics to produce those signals. A flaw in the model manifests itself by producing unexpected output signals for a set of input signals, switch settings, and LO tunings. A flaw in a tuner may manifest itself by not producing the desired signals. On the other hand the production of the desired signals by a tuner cannot be taken as proof of a working model; a problem in the model may be masked. That is, the model produces the signals desired by the tuner, but the real electronics would produce different outputs for the settings chosen by the tuner.

The model of the electronics has no idea that the tuners exist; the opposite is, naturally, not true. This generation of tuners has some a priori knowledge of the electronics on which they operate. They might know, for instance, that the UX converter uses the L301-1 and the L301-2. They do not generally know, however, the numerical values of individual electronic components. For example, the tuners do not know the tuning ranges of the aforementioned LOs, but they can determine these quantities via queries. This means that if the numerical values of filters, multipliers, or LOs change, they need be updated only in the model; the tuners should react to these changes automatically. The tuners, though, are not equipped to automatically handle the introduction of new components into the electronics. In some of these situations they would need to be updated by hand.

Tuning Philosophy

It helps to first understand the context in which we plan to employ the model of the antenna electronics. In the OPT we will have regions for novice users and regions for expert users. We expect to have a user interface that shields novices from the IFs altogether. They will select regions of frequency space to study and specify properties about their spectral windows, such as resolution and quantization. The software will then attempt to tune the electronics to cover their request and organize the regions into basebands and subbands for WIDAR. In order to know if a request can be met, we must know at OPT-time what is possible and what is not, with respect to tuning the electronics. Even in the expert user interface, which is partially implemented now, users will be able to slide basebands around in frequency space, potentially putting them in places that cannot be simultaneously tuned.

The philosophy of the tuners is to deal with impossible requests by satisfying as much of the request as possible. For example, in the high frequency bands there are restrictions on where IFs can be placed, relative to one another. If a request runs up against these restrictions, we do not reject the request, but instead configure the electronics to match as much of the request (in terms of frequency overlap) as possible. In the future we may ask the tuners to respond with multiple configurations so that users can choose their own least-of-all-evils. While the current tuners try for a best match, they do not try all that hard, so they might not arrive at global maximums. Some testing should show how good a job they do.

Caveats and Assumptions

- There is an assumption that anything that can be manipulated in the test program can be manipulated programmatically in the real system, and that there is or will be a way for the information gathered in the OPT to be pushed downstream.

- The tuners, and the quantization quick-set buttons, assume that the 4 GHz LO in the T304s will be used for 8-bit signals and bypassed for 3-bit. It would be simple to reverse this assumption, or to implement rules on when to mix vs. when to bypass. The tuners, though, do not currently try mix vs. bypass when trying to decide on optimum configurations.

- The wiring in the model between the T304s and the DTS modules is based on the May 2007 version of the block diagram. That version had DTS A hooked to A(0) and A1/C1, DTS B to B(0) and B1/D1, and so on, allowing for a pair of 8-bit IFs and two pairs of 3-bit IFs simultaneously. The change shown in the December 2007 version regarding this wiring has not been made in the model – initially because i missed it, but now because there is apparently some discussion about returning to the original plan.

- Filters are deemed to have sharp cutoffs. If the block diagram shows a filter as having a range of 7.5-12.5 GHz, the model will not let a frequency of 7.49999 pass through that filter.

- No attention has been paid yet to tuning the 4 and P bands.

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