Interoffice

NATIONAL RADIO ASTRONOMY OBSERVATORY

TUCSON, ARIZONA

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To: M.A. Gordon

From: J.M. Hollis

Subject: Present Telescope Tracking Constraints

On a 100 msec interrupt basis the drive error signals are presently computed via software and sent to the omniverter D/A's for subsequent use by the servo system. The software computes the drive error signals in 1 bit increments of 2^{22} bits which is equal to

$$\frac{1}{2^{22}} \cdot 360^{o} \cdot \frac{60'}{1^{o}} \cdot \frac{60''}{1'} = 0.309''$$

However, since each D/A is 9 bits ($2^{9} = 512$), the drive error signals are quantized in increments of

$$\frac{1}{512} \cdot \frac{1500}{2^{22}} \cdot 360^{o} \cdot \frac{60'}{1^{o}} \cdot \frac{60''}{1'} = 0.905''$$

where 1500 represents the inner tracking window which is equal to 7.725'. For our system this quantization is acceptable since we have 20 bit encoders whose quantization is

$$\frac{1}{2^{20}} \cdot 360^{o} \cdot \frac{60'}{1^{o}} \cdot \frac{60''}{1'} = 1.236''$$

The acceleration of the servo system is $265'/sec^{2}$ and the maximum azimuth slew speed of the telescope is 70'/sec. Thus, in approximately one quarter of a second, the servo system can accelerate the telescope from 0 to 70'/sec. Moreover, when the telescope is moving at full speed, it can move 7' from one interrupt to the next. Therefore, the inner drive error window (7.725') can almost be missed when the telescope is moving at full speed. The two-window software only partially aids this problem as is

evident from empirical tests.

For improved tracking we could (1) Add more sensitive (more bits) encoders to our system (2) Add a dedicated new interrupt (which is more frequent than 100 msec) to the existing system to be used for drive error computation (3) Instead of (2), take the drive error signals computation out of the computer and do it entirely in peripheral hardware. This peripheral unit would read the encoders on its own, obtain the wanted positions from the computer, and generate the drive error signals as fast as is necessary for our sensitive servo system. It would be necessary to feed the drive error signals back into the computer for integrations tracking disable testing. The computer would thus be free of reading the encoders 10 times a second, making drive error computations 10 times a second and commanding the omniverter 10 times a second.

Obviously I prefer (3) above. Adding yet another interrupt as in (2) would not be in the best interests of computer timing. I would like to see (3) implimented before or during summer shutdown 1978.

JMH/tf

cc: J.M. Payne
B.L. Ulich