In-flight test of basic angle stability at the 6th harmonic of the spin

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Periodic variations of the basic angle at six times the spin rate could be detected by comparing scans of the same great circle obtained with an interval of 10 to 20 days. The amplitudes of the sine and cosine components can probably be determined to better than 0.1 mas.

In the note "Abscissa errors caused by periodic variations of the basic angle" (Lindegeren, 1981 Aug 5) it was shown that variations of the form

$$\Delta \gamma = a_k \cos(k\Omega) + b_k \sin(k\Omega)$$  \hspace{1cm} (1)

where $\Omega$ is the heliotropic spin phase (from the subsolar point on the scan to the x axis), will cause abscissa errors approximately as

$$\Delta v = \frac{1}{2 \sin(k\gamma/2)} [b_k \cos(kv_k - kv_s) - a_k \sin(kv - kv_s)]$$  \hspace{1cm} (2)

where $v$ is the abscissa of the star and $v_s$ that of the sun.

If the same great circle is scanned some time later, when the sun's abscissa has increased by $\Delta v_s$, we find another set of abscissa errors, $\Delta v'$. The difference between the two great-circle solutions is therefore

$$\Delta v - \Delta v' = \frac{\sin(k(\Delta v_s/2))}{\sin(k\gamma/2)} [a_k \cos(kv - kv_s) + b_k \sin(kv - kv_s)]$$ \hspace{1cm} (3)

where $\Delta v_s = \frac{1}{2}(v_s + v_s') = v_s + \frac{1}{2}\Delta v_s$ is the mean solar abscissa. For $k = 6$, $\gamma = 58^\circ 08'$, we have

$$\frac{\sin(k(\Delta v_s/2))}{\sin(k\gamma/2)} = \pm 9.57$$ \hspace{1cm} (4)

for $\Delta v = 30^\circ, 90^\circ, 120^\circ, \ldots$ Thus if the Fourier coefficients of $\Delta v - \Delta v'$ can be determined to 1 mas, we obtain from (3) the basic angle variations to about 0.1 mas.

The abscissa difference $\Delta v_s = 30^\circ$ for the sun can be realized with a time interval of about 20 days, since

$$\sin(\Delta v_s/2) = \sin(\xi) \sin(\Delta v_s/2)$$ \hspace{1cm} (5a)

for the two instants when the revolving phase is

$$\cos \nu = \pm \cot \xi \tan(\Delta v_s/2)$$ \hspace{1cm} (5b)

But even a smaller time interval of (say) 10 days only gives a factor $\sqrt{2}$ larger mean errors.

With some 800 programme stars in a great circle scan, the desired precision would require that the abscissa mean error per star is below 14 mas.