

MEMSENSE

**nIMU
Nano Inertial Measurement Unit
Antenna Stabilization Application**

Technical Note TN0002
Revision 1

www.memsense.com

888.668.8743



Antenna Array Stabilization

Initial Considerations

The noise resolution of some of our products:

nIMU < gyros 1.0 deg/s

AccelRate < gyros 1.0 deg/s

50 Hz Bandwidth. Higher custom bandwidth available.

The antenna array and its environment may be assumed to be:

An antenna that points towards the horizon, that is, an antenna that rotates about a vertical axis, "Z". Wind affects the motion of the array in the "X" and "Y" axes (horizontal plane). The array's motion may be corrected via a servo motor or other mechanism.

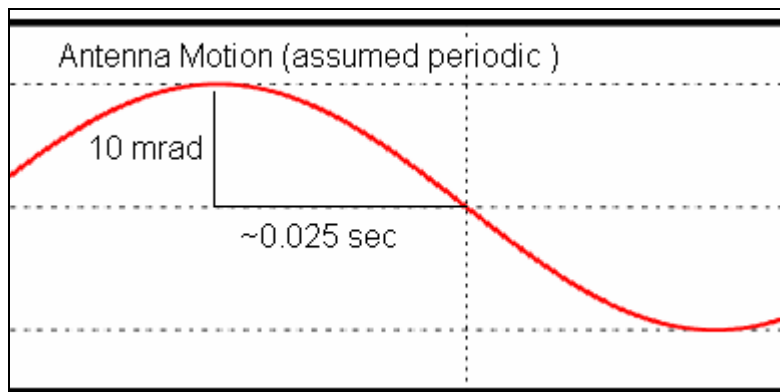
The Character of the Inertial Data

The maximum deflection has been assumed to be ~10mrad.

The process under which the array deflects is on the order of 10 – 20 Hz.

Assuming a sine wave character for the position of the array's target axis with time we can make some observations.

A plot of the motion in the horizontal plane may look something like this ideally.



At 10 mrad of deflection per 0.0125 sec (20 Hz)

We have $10e-3 * 57.3 / 0.0125 \approx 45.8$ deg/s

For a the 10Hz process we have $10e-3 * 57.3 / 0.025 \approx 22.9$ deg/s

The resolution of a typical gyro is 0.6 deg/s (maximum 0.95 deg/s)

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If the resolution was 1deg/s we would be able to resolve deflections on the order of

$$x_u = \frac{1\%/sec}{45.8\%/sec} (10mrad) \approx 0.2mrad$$

Latency

Another aspect of the antenna stabilization application is latency between when the dynamic occurs and the control system produces a counteracting force. The nIMU, for instance, has a latency of approximately 8ms. As seen in the figure above, the rise time of a 20Hz sine wave is 25ms this should allow ample time for the nIMU to sense and communicate the dynamic to the control system so that the control system can counteract the force of the perturbing dynamic.

Summary

Despite the very preliminary and general parameters for this application, it is within reason that our sensors may be a solution. Attitude data from a number of products offered by MEMSense may be utilized in a feedback stabilization system of this kind.

Accelerometer and magnetic compass data is available in the same packages and may also be utilized to enhance the performance of a feedback system. Further details on MEMSense IMUs and sensors can be found at memsense.com.