MEMORANDUM

To : Scott Mitchell, John Cowley, Brian Pieper, Bill Frazier
From : Doug Wiemer
Date : 23 April 1996
Subject : Yaw Deviation From Ideal In GFO Low β Orbits

Below orbit β angles of about 15 degrees yaw will lag behind desired yaw by an amount which is predictable and based upon table determined acceleration limits and the control system dynamic rate limit. Also, desired yaw at β angles less than 0.05 radians or 2.86° is the same as desired yaw at β angles equal to 0.05 radians given that software modifies the sun vector, used in attitude calculations, to prevent it from being closer than 0.05 radians from the orbit plane. This sun vector modification provides more desirable yaw motion of the satellite. Verification of which direction a yaw turn goes is required at β angles less than 0.005 radians since there is this much hysteresis included in the sun vector modification algorithm.

Point State Desired Attitude:

1. Altimeter boresight aligned with geodetic nadir.
2. Cross product of solar panel normal and altimeter boresight aligned with cross product of sun vector and geodetic nadir.

Point State Control System Limits Set By Table Values:

1. Maximum acceleration (a_m) 2e-4 r/s^2
2. Maximum rate 2e-2 r/s
3. Maximum dynamic rate $\sqrt{1.5 a_m \theta_e}$ r/s where θ_e is attitude error in radians
4. Minimum dynamic rate 1e-3 r/s

Figures on the following pages show desired and actual yaw angles for various β angles; the yaw lag from desired for the given β angle; and a two piece curve fit of the lag.

β=0°

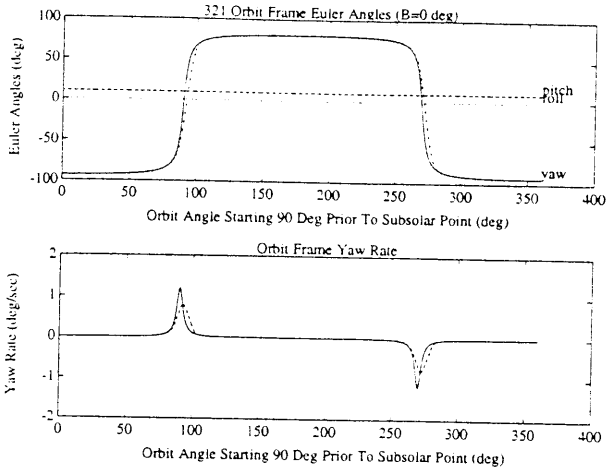


Figure 1

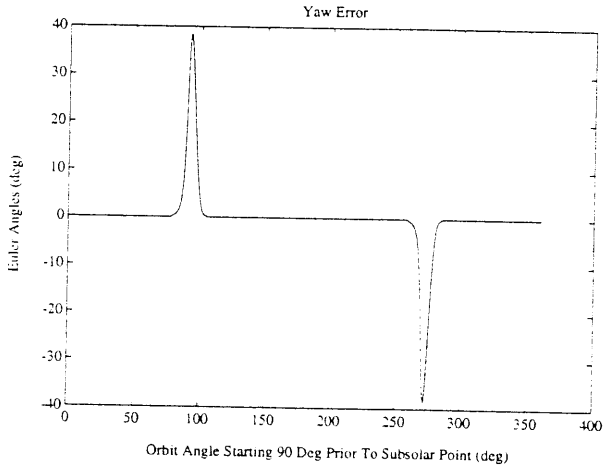


Figure 2

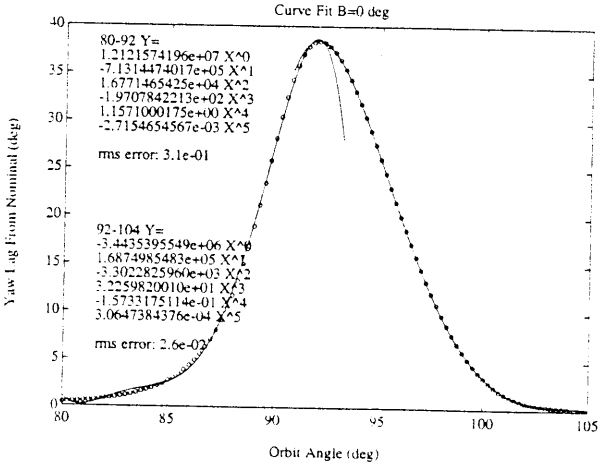
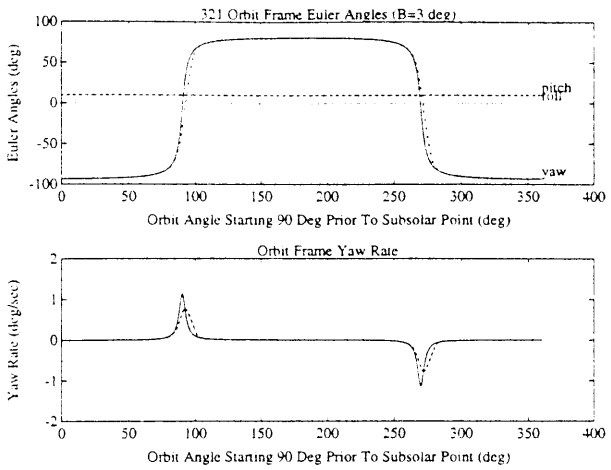


Figure 3

β=3°



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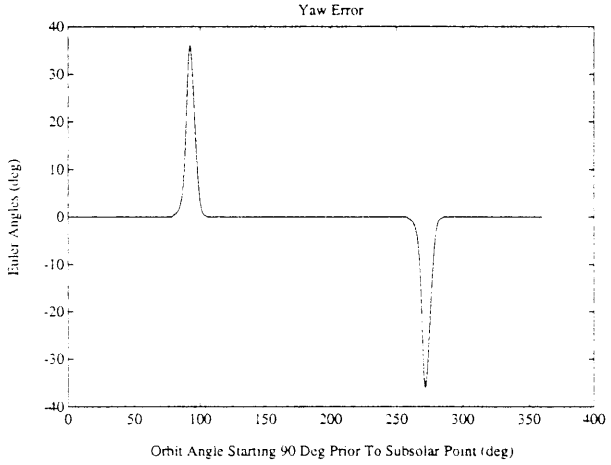


Figure 5

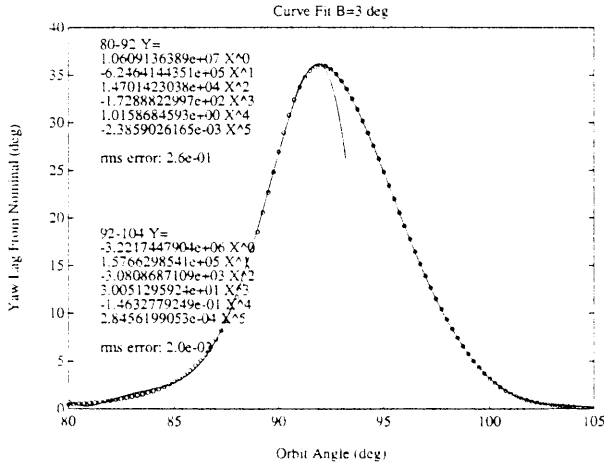


Figure 6

β=4°

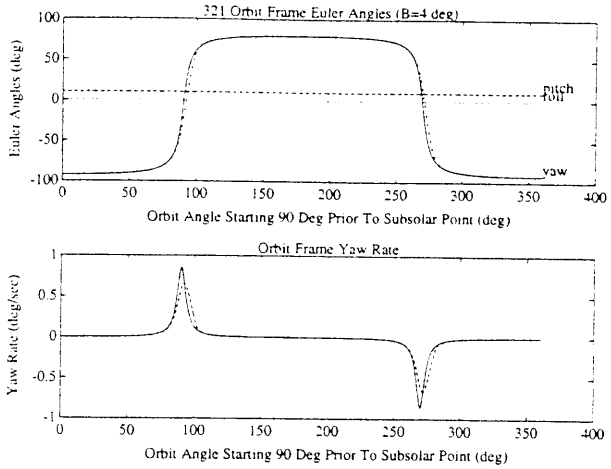


Figure 7

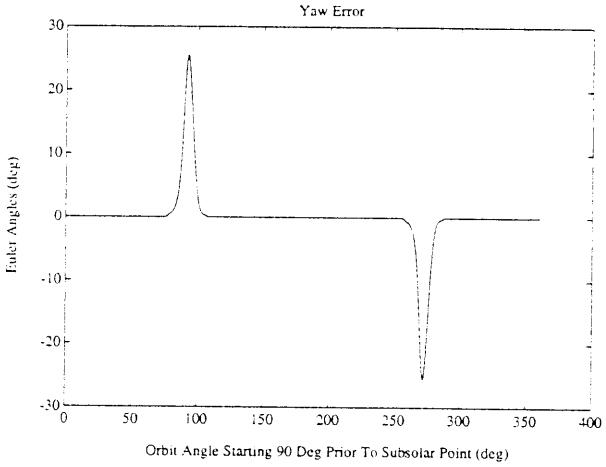


Figure 8

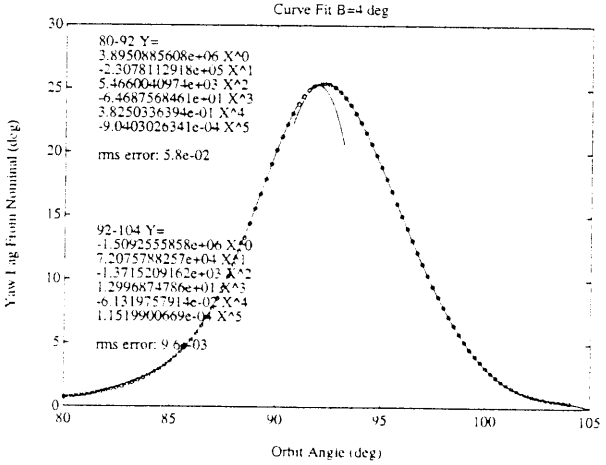


Figure 9

β=5°

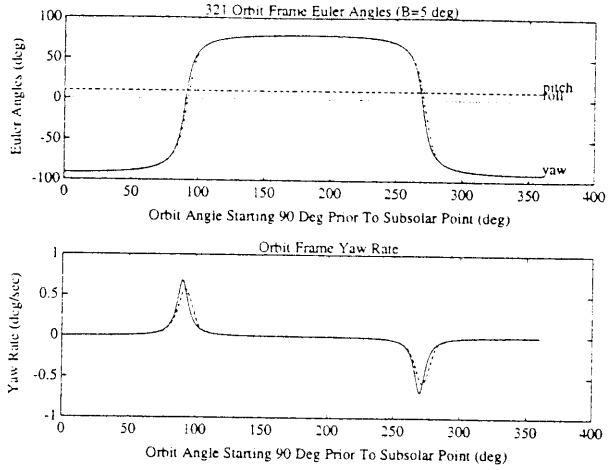


Figure 10

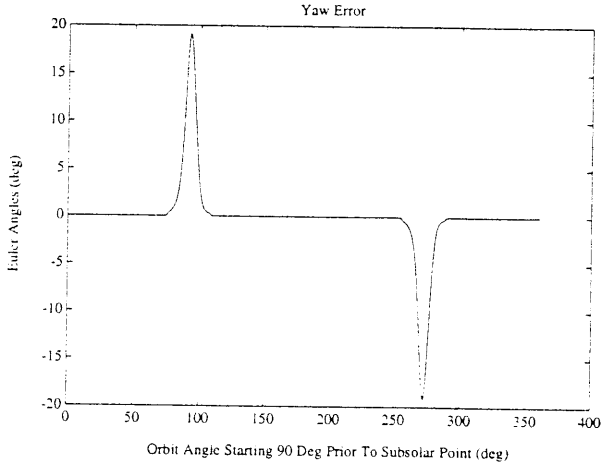


Figure 11

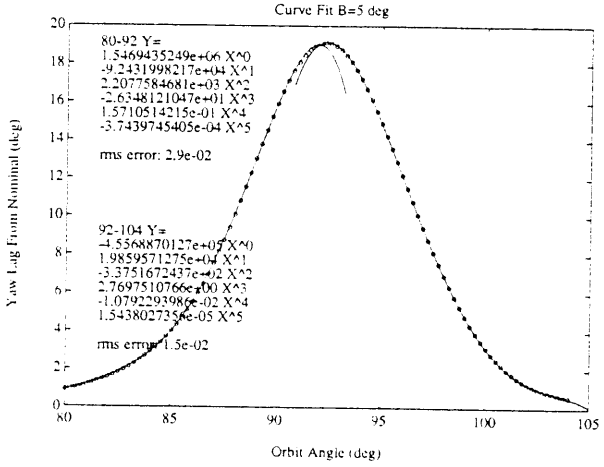


Figure 12

β=6°

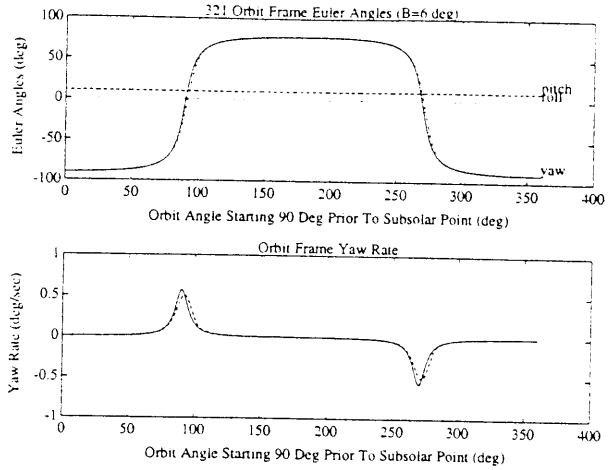


Figure 13

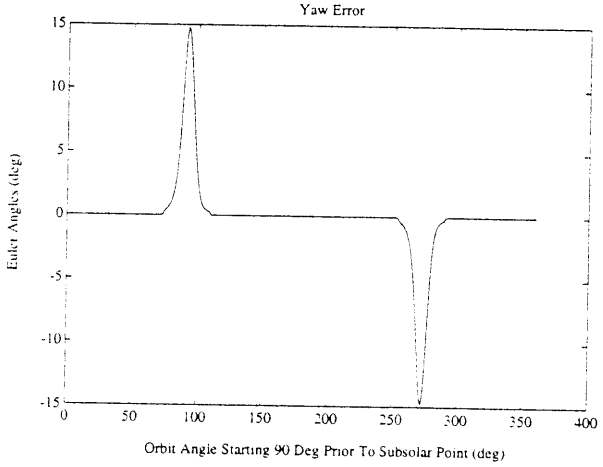


Figure 14

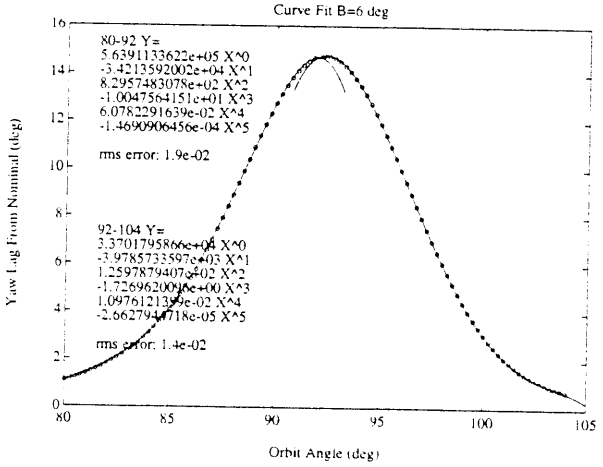


Figure 15

β=7°

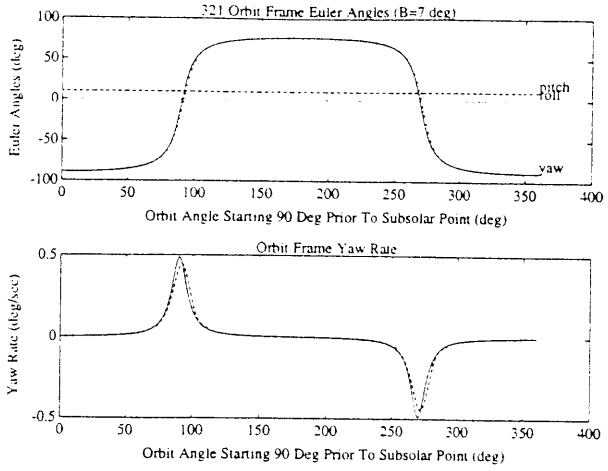


Figure 16

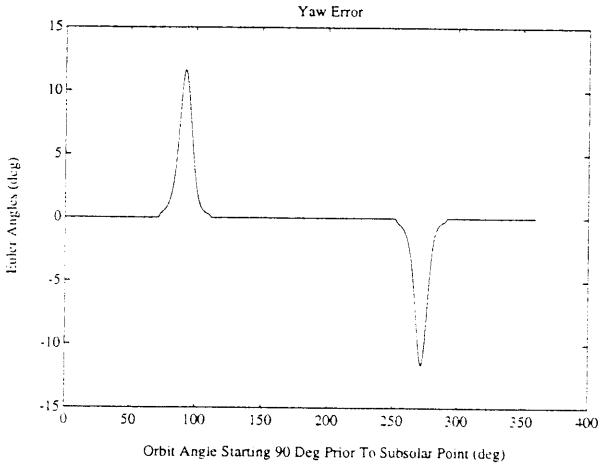


Figure 17

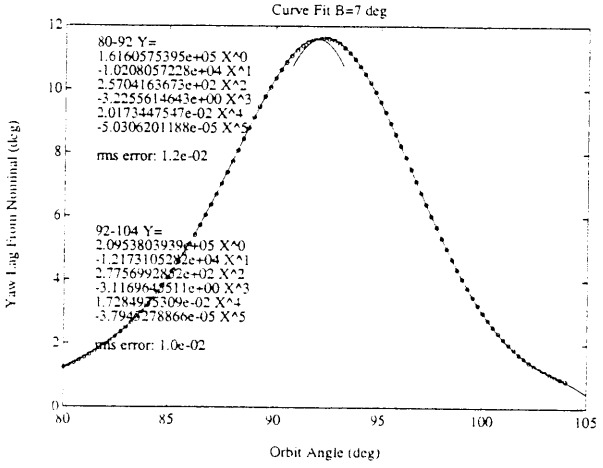


Figure 18

β=8°

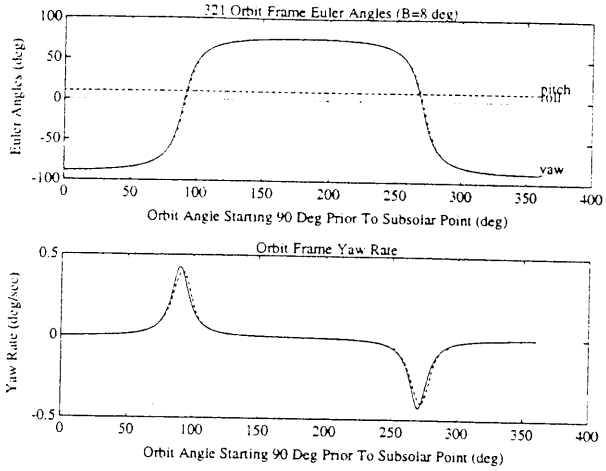


Figure 19

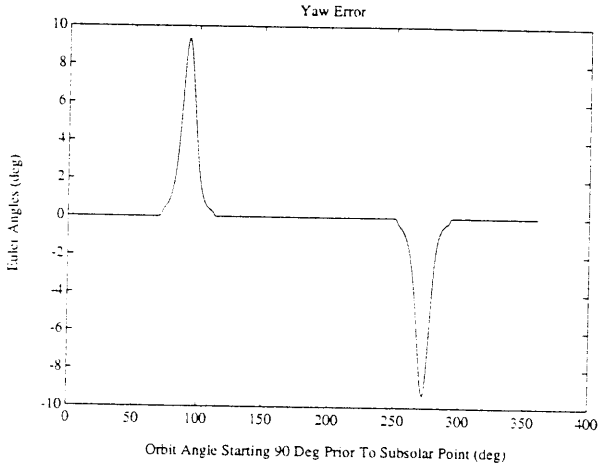


Figure 20

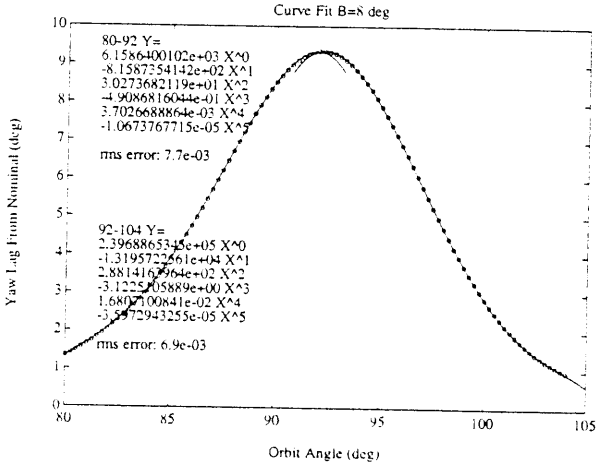


Figure 21

β=9°

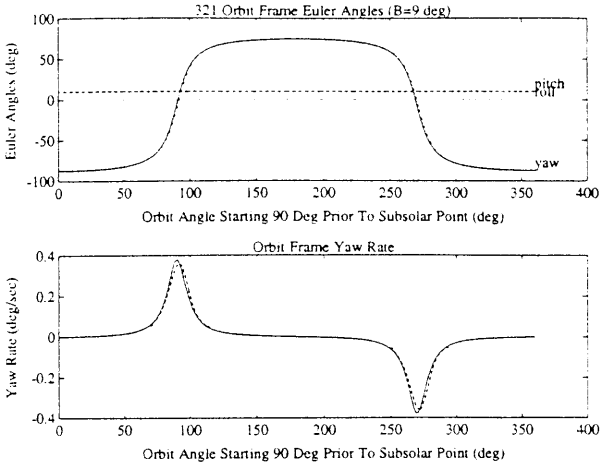


Figure 22

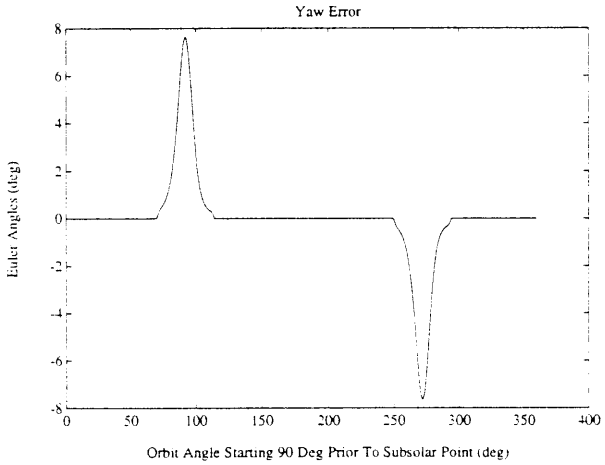


Figure 23

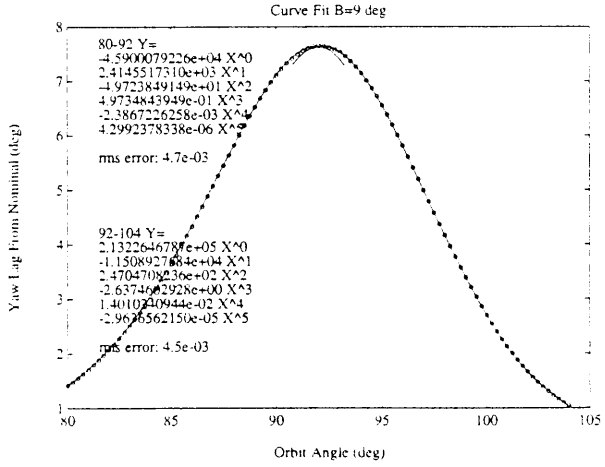


Figure 24

β=10°

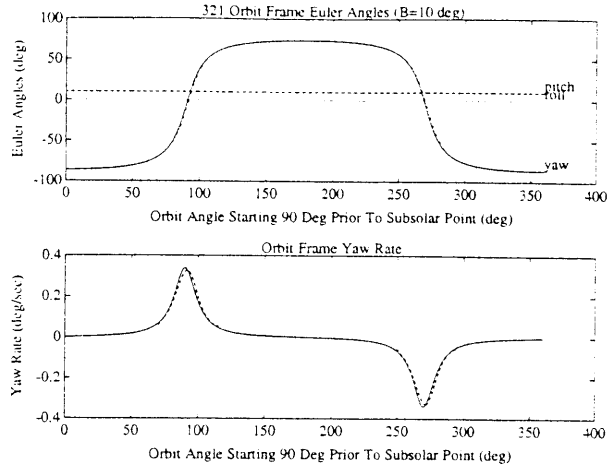
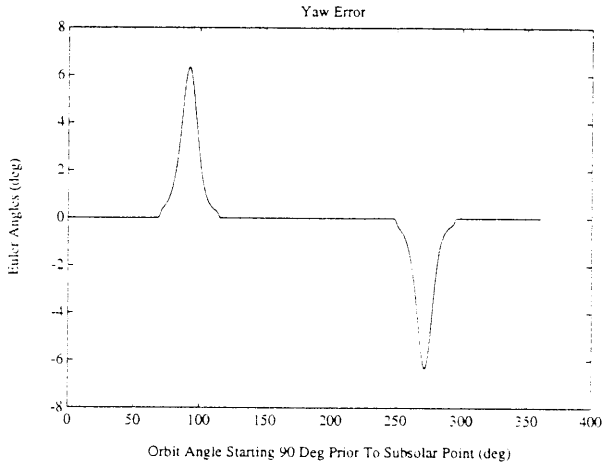


Figure 25



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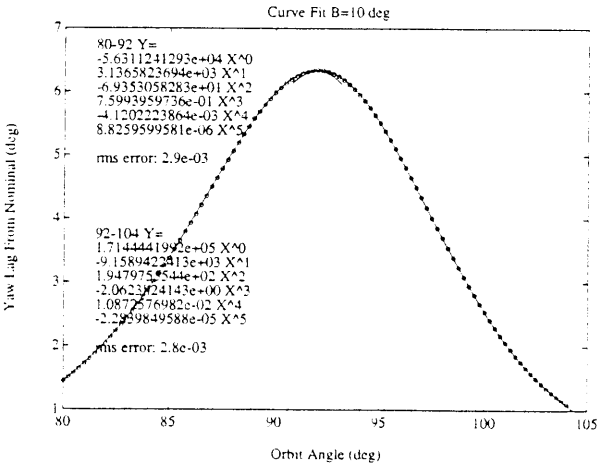


Figure 27

$\beta=15°$

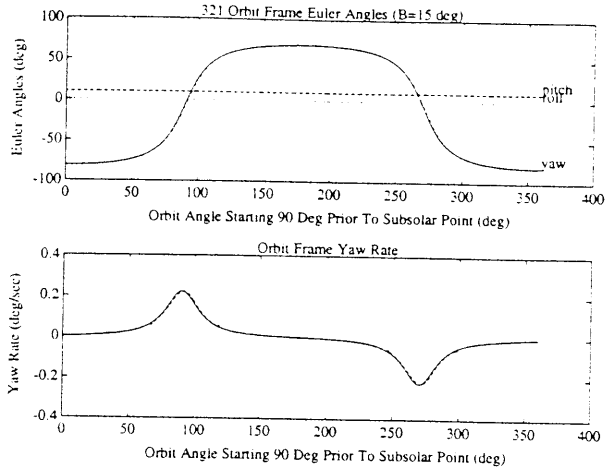
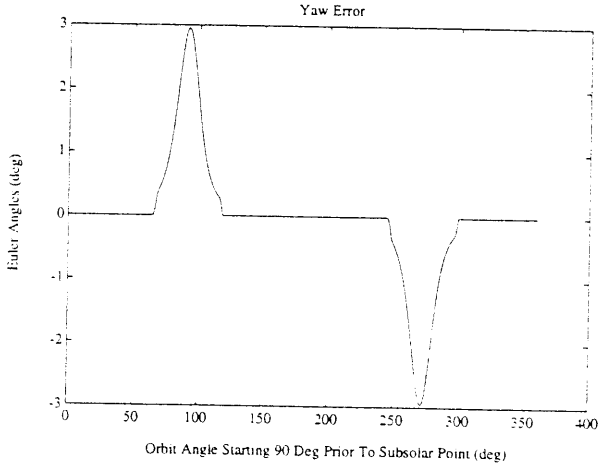


Figure 28



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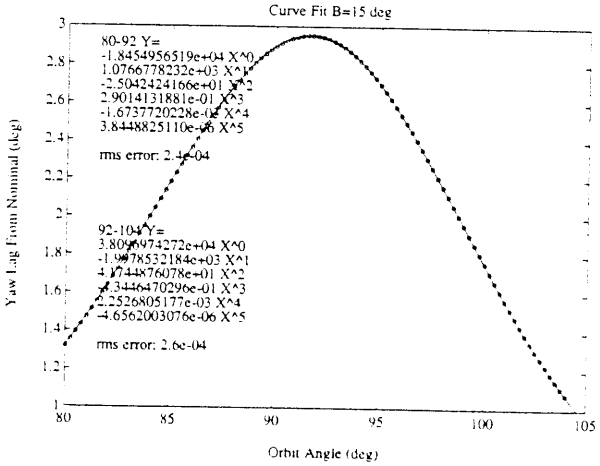

Figure 30