

Space Shuttle Ultra KU Antenna Gimballing

All vectors are in the local vessel frame. Consistent with the normal Orbiter conventions, left hand coordinates are used and rotations are positive in the right hand sense.

Some definitions:

alpha – rotation angle about the alpha axis.

beta – rotation angle about the beta axis. I have assumed *beta* = 0° means the antenna (ie, the normal to the dish) is pointing in the same direction as *a* and *beta* = 180° as pointing back towards the KU mount. As I understand it beta only has a range of 2° to 164°.

a – normalised vector of the alpha rotation axis (direction fixed relative to spacecraft axes once deployed).

b – normalised vector of the beta rotation axis for *alpha* = 0° (direction fixed relative to spacecraft axes once deployed).

t – normalised vector pointing toward the target.

The maths:

$$\beta = \cos^{-1}(a \cdot t)$$

$$\alpha = ((-((a \times t) \times a) \times b) \cdot a) \cdot \cos^{-1}(b \cdot -((a \times t) \times a))$$