VSRT MEMO #022

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To: VSRT Group
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Subject: Correction for feed and axis offsets

1] Pointing corrections

The satellite TV dish has an offset parabola. In addition the default feed (the one on the right looking at the feeds from the dish) is offset by about 11˚. This feed offset results in pointing offsets which need to be corrected. The feed offset results in an azimuth offset of $\mathrm{atan}\,2\left(\sin(f),\cos(f)\cos(el)\right)$ and an elevation offset of $\left[els - a\sin\left(\sin(el)\cos(f)\right)\right]$

Where f = feed offset

el = antenna elevation

els = source elevation

In many Radio Astronomy application the azimuth correction is approximated by $f/\cos(el)$ and the elevation correction is ignored. For a large feed offset this approximation is poor. Further the azimuth offset needs to be calculated using the antenna elevation rather than the source elevation so that the elevation correction needs to be computed first. In addition, for very high accuracy the elevation correction needs to be computed interactively.

2] Baseline corrections

If an interferometer uses identical antennas on identical mounts the vector baseline can be measured between any two identical points on the antennas when the antennas are pointed in the same directions. If the antennas are not identical but are on mounts with intersecting axes and there are no feed offsets the baseline is the vector between the intersections of axes.

If the antennas and mounts are not identical then the axis offsets and feed offsets need to be considered.

If we define "fixed" baseline vector $\vec{b}_0$ *as* the intersection of a horizontal plane through the elevation axis with the azimuth axis then the baseline can be written as the sum of a fixed vector plus changing vectors due to the axis and dish offsets.

$$\vec{b} = \vec{b}_0 + \vec{b}_1 + \vec{b}_2$$

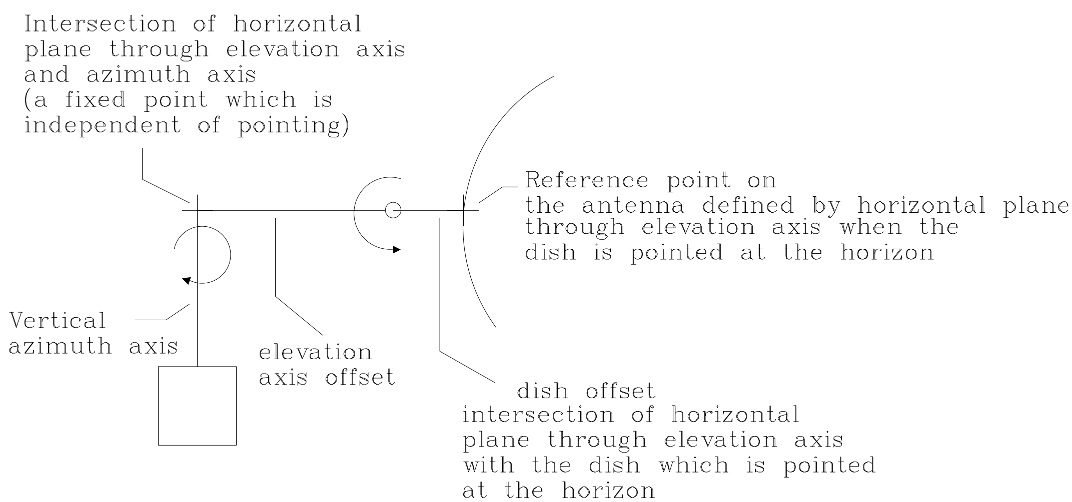
where $\vec{b}_1$ is given by

$$\vec{b}_1 = a_1\left(\cos(az)\hat{i}_y + \sin(az)\hat{i}_x\right)$$

where a_1 is the difference in elevation axis offset between the 2 antennas. $\hat{i}_x$ and $\hat{i}_y$ are unit vectors pointing east and north respectively.

$$\vec{b}_2 = a_2\cos(el)\left(\cos(az)\hat{i}_y + \sin(az)\hat{i}_x\right) + a_2\sin(el)\hat{i}_z$$

where a_2 is the difference in dish offset from the elevation axis and $\hat{i}_z$ points to the zenith. The azimuth and elevation are the antenna pointing angles after correction for feed offsets. See figure 1 for the geometry.



Elevation and dish offsets needed to account for changes in interferometer baseline with antenna pointing

Figure 1