INTERFEROMETER BASELINE SURVEY

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During the summer of 1964 a survey of the NRAO Interferometer baseline was conducted by M. Fagerlin, S. Smith, and G. Bream under the direction of C. M. Wade. The baseline distances were measured using a Model 4D Geodimeter rented from the AGA Corporation of America. A Wild T-2 Theodolite was used to measure the azimuth and elevation angles. The object of the survey was to establish the baseline parameters (length, azimuth, and elevation) with a very high degree of accuracy.

The measurements were made from two locations. The first measurements were made with the Geodimeter and Theodolite plumbed above the center of the base plate on the south pier of station 6. The target reflectors were set at the same height above the equivalent points at Stations 1 through 5. The measurements made were the distance from Geodimeter to reflector, the horizontal angle between a fixed reference and the center of the reflector, and the elevation of the target with respect to the Theodolite. At a later time the fixed reference was related to Polaris and thus the azimuth of each baseline segment with respect to Station 6 was known.

The second measuring location was a point (ϕ = 38° 26' 05".4, λ = 79° 50' 09".3) between the two telescopes 85-1 and 85-2 at Station 1 but off the baseline so that the three locations determined a triangle. The target reflectors were fastened to the feed horns so that the centers of the reflectors were aligned with the axes of symmetry of the feeds and both reflectors were equidistant from the feeds. During the measurements the telescopes were pointed at the same point in the sky with coordinates 0 hour angle and declination 38° 26' 09", the zenith of 85-1. The measurements made were the distance from the Geodimeter to each reflector, the elevation of each reflector with respect to the measuring station and the horizontal angle of which the Theodolite was the vertex. The distance between targets was then computed using the Law of Cosines,

$$D^2 = D_1^2 + D_2^2 - 2D_1D_2 \cos A$$

In this equation D is the desired distance between 85-1 and 85-2, D_1 is the measured distance from the field station to 85-1 and D_2 is the measured distance to 85-2. The angle, A, was not the measured angle but was given by

$$\cos A = \text{coz}\ z_1 \cos z_2 + \sin z_1 \sin z_2 \cos A'.$$

The measured angles were z_1, z_2 and A'.

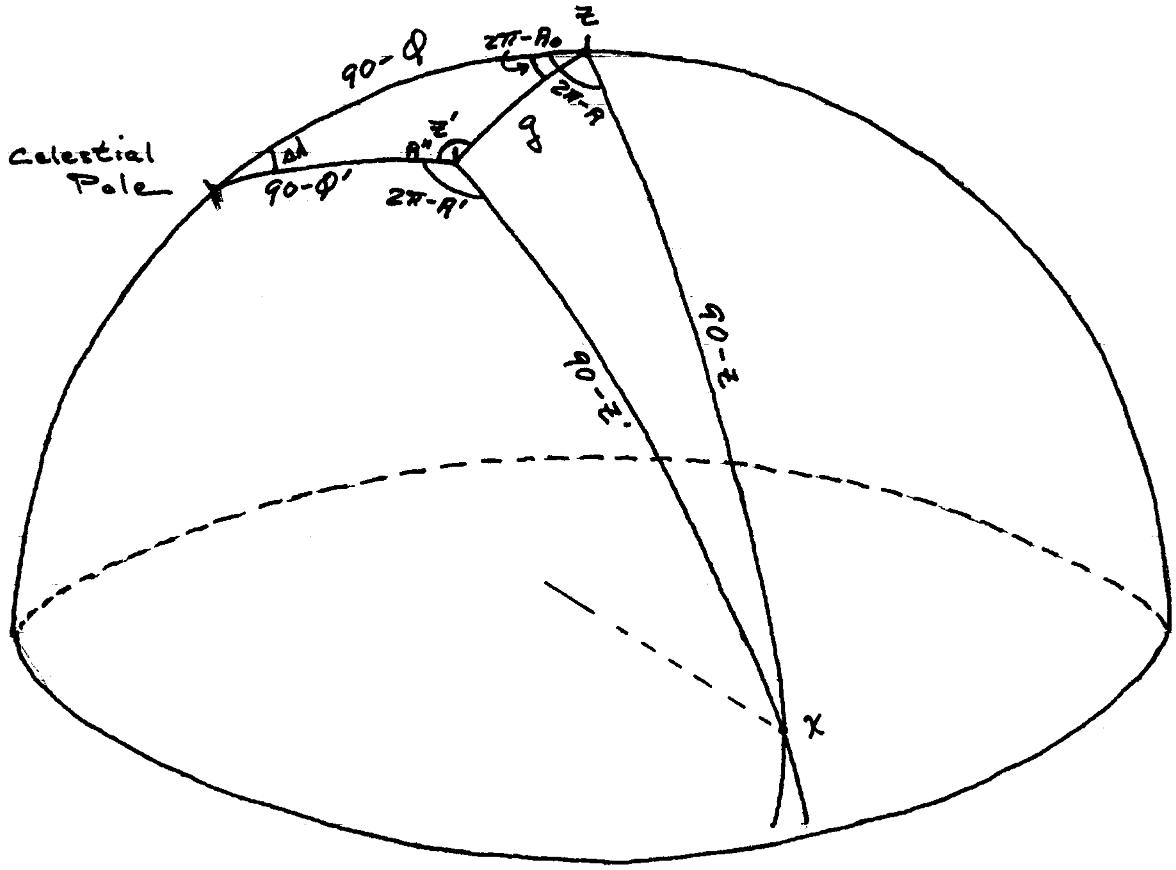
In order to reference all measurements to the common location of 85-1 a computer program was written which converted the measured angles to a common reference frame with its vertical pointing parallel to the zenith at 85-1. This permitted the use of plane trigonometry through-out the rest of the reduction, and made it a simple matter to refer all the results to 85-1.

The final results of the survey are given in the following table:

85-2 at Station	Baseline Length	Baseline Azimuth	Baseline Elevation
1	1200.122 m.	242° 02' 16"	- 00° 57' 15"
2	1500.067	242° 02' 05"	- 00° 52' 09"
3	1800.097	242° 01' 57"	- 00° 50' 12"
4	2100.144	242° 01' 54"	- 00° 52' 30"
5	2400.043	242° 01' 56"	- 00° 48' 39"
6	2700.206	242° 01' 50"	- 00° 46' 58"

The maximum uncertainty in the Geodimeter measurements is claimed by the manufacturer as $\pm$ (1 + D x 10^{-6}) cm, where D is the distance measured. This is probably a high upper limit to the error. Each distance as measured independently by two observers (M.F. and G.B.) and the results differed in all cases by no more than a few millimeters. Thus the distance figures given above are probably accurate to at least $\pm$ 1 centimeters. The angles measured with the Theodolite have a reliability to at least 10 seconds of arc for the vertical angles and 4 seconds for azimuth when the instrument is used with care.

Outline of Program to Convert Measured Angles to a Common Reference Frame with 85-1.



z' = zenith of measuring location
z = " " 85-1
φ' = latitude of measuring station
φ = " " 85-1
Δλ = difference of longitude between 85-1 and measuring station

x is the intersection of the baseline pole with the celestial sphere.

A' and z' are the measured azimuth and elevation
A and z are the desired quantities.

$\angle PZ'Z = A''$

$\angle PZZ' = 2\pi - A_0$

$\widehat{Z'Z} = g$

$\angle Z'Zx = A_0 - A$

$\angle ZZ'x = A' - A''$

Base line Survey

Station	Latitude	Longitude	Feed Point Elev.
85-1	38° 26′ 08.″67	79° 49′ 42.″67	2824 ft.
S1	— 25′ 51.″10	— 50′ 25.″46	2760
S2	— 25′ 46.″52	— — 36.″16	2751
S3	— 25′ 41.″94	— — 46.″85	2739
S4	— 25′ 37.″35	— — 57.″55	2721
S5	— 25′ 32.″37	— 51′ 08.″24	2713
S6	— 25′ 28.″18	— — 18.″95	2703
Field Station	— 26′ 05.″4	79 50′ 09.″3	

Distance from:

	85-1 (D_{0i})	Station 6 (D_{6i})	Field Station	
to: S1	1200.122 m.	1500.084 m.	85-1	674.276
S2	1500.067 m.	1200.139 m.		
S3	1800.097 m.	900.109 m.	85-2	609.967
S4	2100.144 m.	600.062 m.		
S5	2400.043 m.	300.163 m.		
S6	2700.206 m.			

Azimuth (A'_{6i}) from S6 to:

S1	242° 02′ 46″
S2	— 02′ 49″
S3	— 02′ 57″
S4	— 02′ 58″
S5	— 02′ 52″

Vertical Angle (Z'_{6i}) from S6 to:

S1	00° 39′ 59″
S2	41′ 27″
S3	41′ 27″
S4	30′ 51″
S5	34′ 30″

from Theodolite in field to:

85-1	3° 53′ 55″
85-2	2° 31′ 33″

A_{01} =

Angle between TN, Theodolite, and 85-1 = 81° 37′ 41″ ~~81° 39′ 38″~~

Angle between 85-1, Theodolite, and 85-2 = 138° 42′ 38″

$$D^2 \cos^2 z = D_1^2 \cos^2 f_1 + D_2^2 \cos^2 f_2 + 2D_1 D_2 \cos f_1 \cos f_2 \sin(A - \pi/2)$$

$$D^2(1 - \sin^2 z)$$

$$D^2 \sin^2 z = D^2 -$$