VLBA ACQUISITION MEMO #132

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To: VLBA Recording Group

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Subject: Various Operating Modes of the Model 96 and their sensitivity to machine alignment and tape defects

Operating Modes - History

The Honeywell Model 96 uses both a capstan and an idler roller with flywheel. Sometimes the idler roller would slip under acceleration (MKIII tape acceleration can be much higher than the VLBA which is well controlled) and Hans decided to remove the flywheel (also known as a damper - the flywheel contains some material for dynamic damping) and for many years we operated MKIII without the flywheel. During tests of the MKIIIA high density system, John Webber noted some problems with the tracking and it was decided to remove the idler roller altogether and replace it with a fixed post. [It is not clear whether the effects of capstan and idler eccentricity are aggravated by removing the damper.]

Operating Modes - Tests

Having performed all the sensitivity tests with the present configuration (with fixed post in place of an idler) I decided to repeat some tests with the following operating modes:

1] Fixed post and tape angle ≈100 arcsecs (present MKIIIA configuration).

2] Fixed post and tape angle ≈0 arcsecs.

3] Idler roller plus flywheel/damper (i.e., Honeywell configuration).

The second of these modes was discussed in Memo #126 and required a deliberate tilt of the capstan away from the vacuum columns. Compared with the first operating mode the sensitivity of the tape position to tilts of the capstan and headstacks are reduced by a factor of three with the idler roller and a factor of two with zero tape angle. The latter result was already presented in Memo #126.

Tests of the sensitivity to tape imperfections for these three modes were evaluated by measuring the variation of head position with tape footage needed to peak up the playback of a tape in the reverse direction of a recording made in the forward direction. Or in the jargon of the narrow track longitudinal recording business - the variation of the forward-reverse offset. Now it has already been noted (see Memo #123) that there are machine dependencies to the forward-reverse offset - but these are much smaller than the tape dependencies seen on any tapes. For example, the machine dependent contribution (in operating Mode #1) to the forward-reverse offset is only

4 microns peak to peak from supply reel full to empty whereas the forward-reverse offset variation on some tapes can be as large as 100 microns peak to peak. The main reason for the large tape forward-reverse signature is thought to be the anisotropy of Young's modulus combined with a misalignment of the direction of maximum modulus with the tape direction. This is being studied theoretically and the theory will appear in Memo #129.

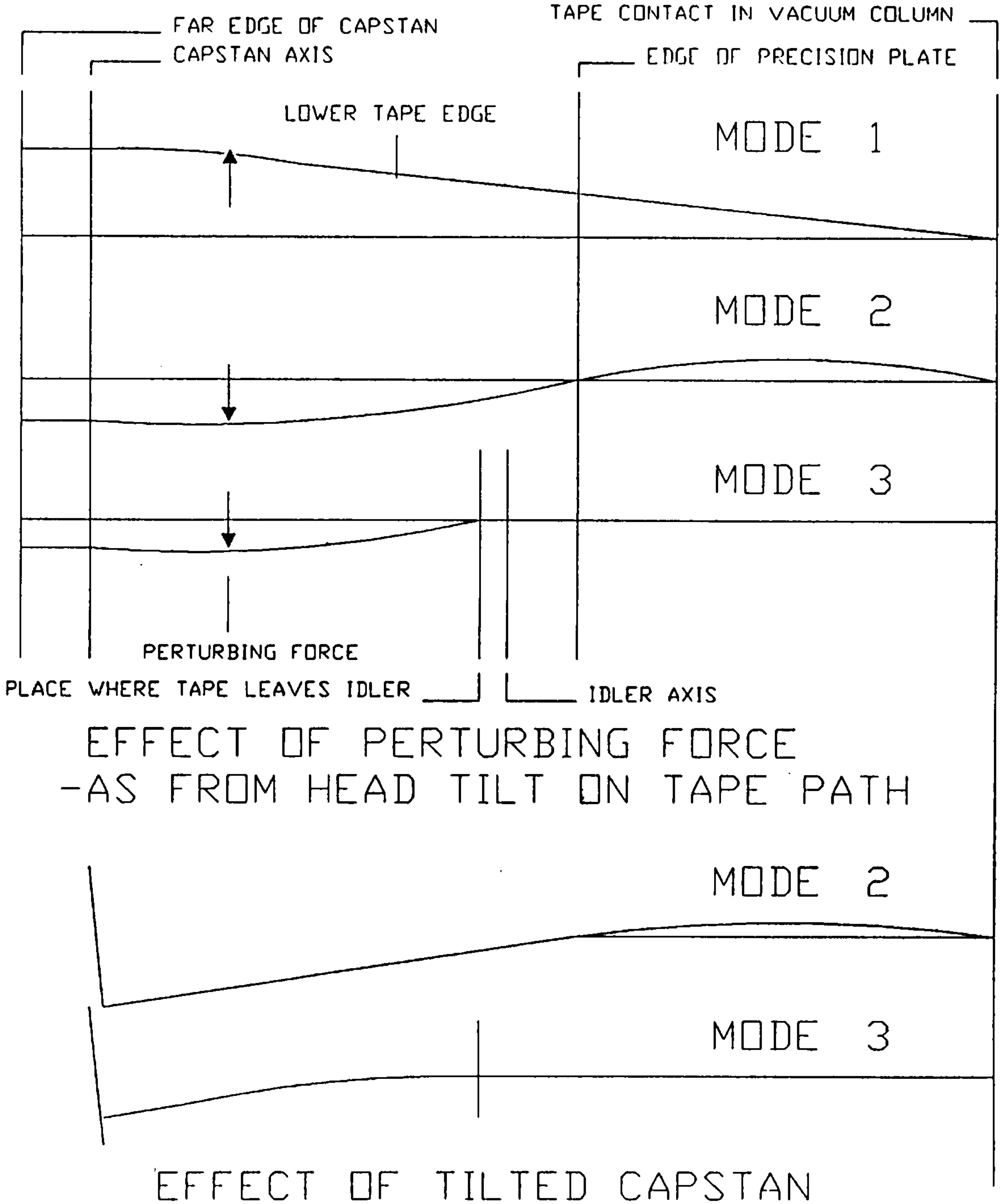
The following results have been obtained:

Operating Mode	Forward-Reverse D.C. Offset	Forward-Reverse Variation P-P
1	103 μm	22 μm
2	44 μm	7 μm
3	7 μm	5 μm

These results are based on only a single tape and more data is needed. However the forward-reverse variation is clearly substantially reduced in Modes 2 and 3, perhaps by factors even greater than the alignment sensitivity reduction factors of 2 and 3.

Theory

In Mode 1 the tape is free to ride up and down the capstan remaining normal to the axis while it pivots in the vacuum column. With a perfectly cylindrical capstan the only bending involved is a small amount due to the bias torque produced in the vacuum column. In Mode 2 the tape is constrained to remain parallel to the precision plate and must bend in order to remain normal to the capstan. In Mode 3 the idler acts as another capstan (provided the tape doesn't slip on the idler) and the tape path has to be analysed as a two-piece model. In the first path the tape path is similar to Mode 1 - [but the distance from the pivot point in the vacuum column to the idler is about half the distance from the capstan to the pivot point]. The second part of the path from the idler to the capstan is highly constrained as the tape must remain normal to both the idler and capstan axis. Figure 1 illustrates the bending beam models for Modes 1, 2, and 3 for the case of a tilted capstan.



PRINCIPLES:

1] TAPE REMAINS NORMAL TO ROTATING SURFACES

2] TAPE CAN PIVOT AT CONTACT POINT IN VACUUM COLUMN

3] PERTURBING FORCES ARE BALANCED BY COMPONENT OF TAPE TENSION

4] TAPE BENDS AS A UNIFORM BEAM IN RESPONSE TO IMPOSED TORQUES

CONCLUSIONS:

1] TAPE SHIFT AT HEADSTACK IS REDUCED BY ABOUT 2 IN MODE 2 AND BY ABOUT 3 IN MODE 3

FIG BENDING BEAM MODEL FOR TAPE PATH MODES