NASA TECH BRIEF

Conceptual Servo Technique for Controlling Tape Drivers

The problem:

Quality performance in a magnetic tape system requires that the tape be driven in quite close synchronism at the airborne and ground stationed devices. Long term speed variation or instantaneous speed perturbations must be avoided in the airborne system lest frequency distortion and flutter exceed ground-based system tolerance.

The solution:

An electronic speed control designed to maintain long term speed accuracy in tape transport systems within ±5 microseconds at a tape speed of 30 inches per second and to control flutter to within 0.8% rms from dc to 5 kHz.

A tachometer, which is an integral part of the motor assembly, provides an output signal that is fed to a tachometer amplifier and then to a frequency discriminator. The output of the frequency discriminator is a voltage level that is inversely proportional to the input frequency. The output of the frequency discriminator drives an operational amplifier that provides the proper loop gain and compensation required for loop stability. The output of the operational amplifier is then fed to the motor driver which raises the loop power level to a point high enough to provide the required motor torque.

The phase detector loop is used to compare the phase of a reference frequency recorded on the tape to the same phase and frequency of a precise reference oscillator. The output of the phase detector is a voltage proportional to the phase difference between the signal recorded on the tape and the output from the precision reference oscillator. This phase error voltage is applied to the loop amplifier to further correct the tape speed.

The recorder/reproducer system is provided with a tape which has a precision 30 kHz reference signal recorded on the reference track. During the record mode the recorder is phase locked to this previously recorded signal. The tachometer loop is used as a back-up system during periods when loss of signal due to tape dropouts occurs. At the same time a precision 30 kHz signal is being recorded on a second reference track to ensure that the servo system will correct flutter introduced during the record mode when the unit is in the reproduce mode. During the reproduce mode the recorder is phase locked to the second reference track with the tachometer loop again being used as a back-up system during periods of loss of signal due to dropouts.

Use of the servo system during the record and reproduce modes results in the minimum amount of frequency distortion and flutter. The time displacement error will then be held to less than one period of the reference oscillator frequency.

Notes:

1. The approach described would permit the design of a multispeed high-performance recorder/reproducer system, where the tape speed would be electronically selected. This system would do away with belts, gears and clutches or other mechanical speed changing devices. Speed selection could then be accomplished by changing circuit constants in the servo system electronics.
2. This development is in conceptual stage only, and, as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.

Patent status:

No patent action is contemplated by NASA.

Source: R. Couchman and R. Bentley
of Kinelogic Corporation
under contract to
Marshall Space Flight Center
(MFS-12955)

Category 01

SF
RM. 1423 KSC HQS.
ATTN. ATKINS
-1-