December 1967 Brief 67-10643

NASA TECH BRIEF

Concept for Automatic Doppler Compensation in Two-Way Communication Systems

In two-way communication systems where the relative velocity between the two ends of the communication link is not zero, there will be a frequency shift proportional to the relative velocity and to the frequency used for the communication link (Doppler). In many cases, this frequency shift may be large compared to the bandwidth of the data to be transmitted over the links. In conventional communication, either the receiver bandwidth is widened to accommodate this shift plus the data bandwidth, or a technique is used to tune out this frequency shift. This last might be done manually by a receiver operator, or it may be accomplished automatically, called Automatic Frequency Control (AFC).

The AFC technique is very useful for automatic communication systems, but it requires that both ends of the communication system "lockup" before any data may be transferred. The time required for this lockup varies with system design. For many systems this is of no significance, but for the case where one station (master) rapidly interrogates many other stations (remote stations), the lockup time is usually intolerable on the return link from the remote to the master station. This results from the fact that the master station usually is always transmitting and all remote stations within range will have time to acquire and lockup before they are interrogated by the master station. However in the general case, each remote station may be moving at a different relative velocity to the master and thus the master must either search for each reply or else it must have a wide enough bandwidth to accommodate each reply plus the maximum Doppler.

The operation of the two-way system is as follows. The master station radiates a carrier which is slowly swept in frequency over a suitable range. The remote stations are tuned to a nominal frequency and when the swept transmitted frequency plus the Doppler shift equals this nominal frequency, the remote station activates an Automatic Frequency Control (AFC) circuit. This circuit then follows the frequency sweep of the master plus the Doppler due to the relative motion between the master and remote station. AFC is achieved by varying a local oscillator in the remote receiver such that the received signal falls at the center of a frequency discriminator.

An automatic Doppler correction is derived from the AFC system and applied to the reply link such that the master receiver may be fixed tuned and requires neither a time consuming frequency search for the reply nor an excessive bandwidth to accommodate the Doppler.

The master station might be an airplane control tower communicating to automatic readout devices located on airplanes flying in the area. It could also be located in a satellite and be interrogating remote stations located on the ground, floating in the sea, suspended from balloons, flying in airplanes or in another satellite. The automatic Doppler compensation is applicable to any other system where one or both stations are moving, which gives rise to a Doppler frequency shift.

Notes:

1. 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.

(continued overleaf)

2. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
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Reference: B67-10643

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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