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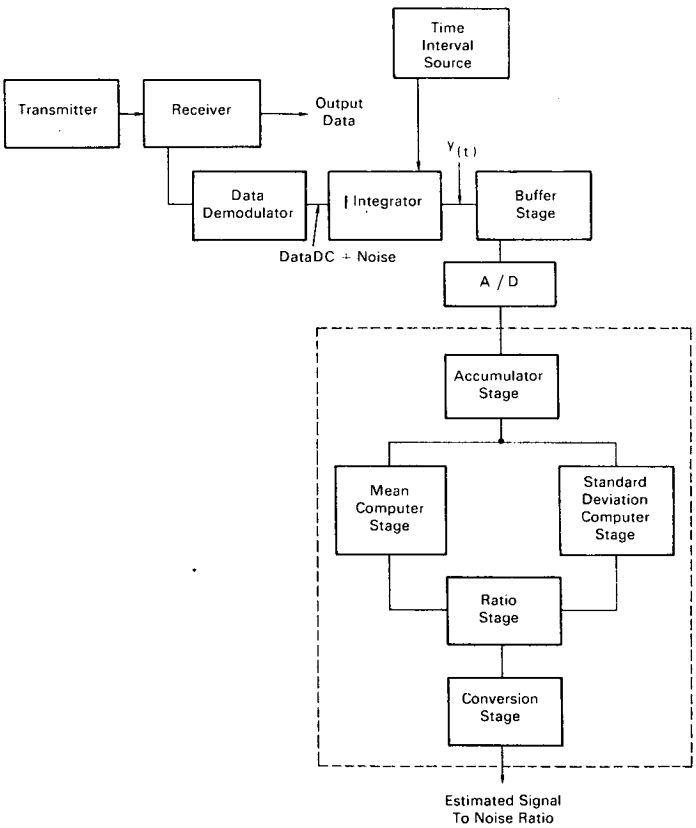
NASA TECH BRIEF

Estimation of Signal-to-Noise Ratios



System for Estimation of SN Ratios

The problem:

Determination of signal-to-noise (SN) ratios and modulation indices in long-range communications systems.

The solution:

A statistical method that estimates the SN ratio in an observed random voltage such as the output of a telemetry receiver, and enables continual monitoring of it.

How it's done:

Signals from a distant transmitting source, overlaid by noise signals, are monitored continuously. During each of a series of successive time periods the signals plus noise are integrated to produce an output at the

(continued overleaf)

end of each period. These outputs are then accumulated for estimation of the mean and the standard deviation of the outputs, which are related to the SN ratio.

Estimators for the mean and for the standard deviation are so chosen that the two statistical terms can be derived from a minimum of computations that are all performed automatically by either a special-purpose computer or a properly programmed general-purpose computer. The mean and standard deviation are derived by accumulation of a minimum number of outputs sufficient for estimation of the SN ratio with a predetermined degree of accuracy.

By use of the mean and standard deviation for this estimation, and by selection of the particular estimators to fulfill certain requirements, the desired ratio is conveniently derived with a minimum of additional equipment and the least possible delay. This method may be used for detection of the ratios of different signals, emitted simultaneously by the communications system at different frequencies, so that more than one SN ratio may be derived simultaneously. This capability is specially significant for a space communications system wherein different signals are transmitted in different channels: for example, carrier signals of a first frequency transmitted in a subcarrier channel.

The power ratio of data signals to carrier signals is a function of the transmitter's modulation index which is generally kept constant. Normally the power of the carrier signals and noise at the receiver is predicted closely. Such information, together with the estimated carrier and data ratios, can then be used for verification of the operation of the communications system, and to sense and locate any malfunction therein: for example, by automatic estimation of the carrier and data SN ratios, the ratio of data signals to carrier signals can be derived--thus a signal is provided that is related to the modulation index. Thus the noise in the system is used as a reference with which the modulation index may be monitored.

The invention is useful for communications systems of which the SN ratio is relatively constant over the estimating period; it may show limitations when time-variable multipath channels are used, when the signal fluctuates rapidly.

Notes:

1. Users of long-range communications equipment may be interested.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP69-10557

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3350643), and royalty-free license rights will be granted for its commercial development. Inquiries about obtaining a license should be addressed to NASA, Code GP, Washington, D.C. 20546.

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