NASA TECH BRIEF

Marshall Space Flight Center

A Study of the Power Spectral Density of an FM Signal

The problem:

Several communications problems can be better dealt with when the power spectral density of an FM signal is known. This knowledge would help in the design of the corresponding band limiting network; it would help in assuring that the FM signal does not interfere with adjacent channels and that the bandwidth used is no larger than necessary. In addition, this knowledge would be useful in understanding how to stabilize video FM signals.

The solution:

In a published study, several useful mathematical descriptions of FM spectra have been derived.

How it's done:

In the study, the derived mathematical expressions describe an FM signal modulated by a composite video wave. Using three types of video information, three general spectrum equations for FM signals are obtained.

Of the three types of video information used, two are periodic patterns and one a random pattern. The two periodic patterns are the simple sinusoid and the bar pattern. These signals are commonly used as test patterns for testing video-frequency networks. Since their FM spectra are known, the band-limiting network necessary to make these signals into suitable test signals can be readily designed. The bar pattern is of particular interest in this application since, by varying the widths of the bars, the maximum changes in video brightness levels can be simulated. The information portion of the continually changing, or random pattern, is described using a Gaussian noise distribution. This method simulates the average properties obtained from a random picture.

A time-domain expression is derived. The expression describes the FM signal formed by a composite video signal and is very general. It applies to all video information. Using this equation and the method used to obtain the spectra from the three types of information considered, the equation for the spectra of any video information can be obtained.

Finally, the study presents specific calculated spectra and compares them with those obtained by experiment.

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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