Letters to the Editor

Comment on 'A Space-Dependent Reactor-Noise Formulation Utilizing Modal Expansions'

In a recent paper by Danofsky[1] "Sink frequencies" are exhibited for both auto- and cross-spectral-density functions. In the case of the auto-spectral-density function the sink frequency is apparently caused by the presence of a local stochastic absorber which dominates all other noise sources. The sink frequencies associated with cross-spectral densities are caused by space-dependent observation points when the noise sources are spatially distributed. The paper fails to distinguish, however, between important differences in the character of the auto and cross spectra in the vicinity of the sink frequency. The purpose of this note is to point out these differences.

In the first place, auto-spectral densities are real and non-negative. For this reason, the auto spectra at frequencies both above and below the sink frequency are positive. The value of the spectrum at the sink frequency may be zero or any positive value. Unfortunately, the value of the spectrum at the sink frequency is not given.

In contrast to the auto-spectrum, the cross-spectral density is, in general, a complex function. However, only the magnitude of the cross spectrum is shown in the curves given in the paper. If one decomposes the cross-spectral density into its real and imaginary parts, it becomes apparent that the sink frequency effect may have quite a different interpretation. For example, it has been shown[2] that in the special case of symmetrically located observation points the cross spectrum is always real. Furthermore, if only simple two-node space dependence is assumed then the sink frequency of the cross spectrum is a null frequency,[3,4] that is, the cross spectrum is zero at the sink frequency. Also, in this case, the cross spectrum is positive for frequencies below the null (or sink) frequency and negative for frequencies above the null frequency. A near-symmetrical case is the case of the cross spectrum between space points 1 and 4 in the paper. It would be interesting to know the amplitude of the imaginary part of the spectrum in this case, as well as the sign of the real part. It would also be interesting to know the real and imaginary parts of the cross spectra in the asymmetrical cases reported.

The paper made no effort to correlate the value of the sink frequency with the parameters of the reactor. It has been found previously[3,4] that the degree of decoupling of the two fuel regions and the mean time delay for the propagation of a disturbance from one region to the other determine the position of the sink frequency. There must be some analogous relationship when a modal model is used which relates the properties of higher modes to the value of the sink frequency.

It has been shown previously,[5] that the *coherence function* emphasizes spatial effects and lends itself to physical interpretation more readily than the spectral-density functions. All of the information necessary to display the coherence function is available in the calculations performed in this paper. If the coherence function would have been analyzed, it may have led to a more detailed interpretation of the analytical results.

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[1] R. A. DANOFSKY, *Nucl. Sci. Eng.*, **36**, 28 (1969).

[2] J. R. SHEFF and R. W. ALBRECHT, *AEC Symposium Series No. 7* (1966).

[3] R. W. ALBRECHT and W. SEIFRITZ, *Nukleonik*, **11**, 143 (1968).

[4] W. SEIFRITZ and R. W. ALBRECHT, *Nukleonik*, **11**, 149 (1968).

[5] R. W. ALBRECHT and W. SEIFRITZ, *Japan-U.S. Seminar on Nuclear Reactor Noise Analysis*, pp. 285 (1968).

Further Comment on 'A Space-Dependent Reactor-Noise Formulation Utilizing Modal Expansions'

It has been pointed out by Albrecht[1] that there are fundamental differences between the auto-spectral-density function for a localized stochastic absorber and the cross-spectral-density function obtained for space-dependent observation points. In the case of a localized absorber, it would appear, from an analogy with the classical input-output noise relationship that the auto-spectral-density function is proportional to the magnitude of the space-dependent response of the reactor to a localized oscillating absorber. The characteristics of the cross-spectral-density function, however, are related to the space dependence of the observation points and noise sources.

"Sink frequencies" have been observed[2] for both of these cases and it has been suggested that it would be desirable to indicate the magnitudes of the auto-spectral-density function in the vicinity of the sink. These are reported in Table I. It has been noted[2] that the characteristics of the solutions for space points 4 and 5 show sensitivity at high frequencies to the number of modes used.

The real and imaginary parts of the cross-spectral-density function for space points 4 and 5 are shown in Table II. The real part changes signs at approximately

[1] R. W. ALBRECHT, *Nucl. Sci. Eng.*, **37**, 322 (1969).

[2] R. A. DANOFSKY, *Nucl. Sci. Eng.*, **36**, 28 (1969).