Coherence

writeLaTeX

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1 Concept

1.1 Spectral Density

The power-frequency spectrum describes the distribution of power across different frequencies. The energy concentrated over a specific time frame for a given signal is called the energy spectral density. More generally, the energy over an infinite period of time is the power spectral density, which is essentially the energy per unit time.

$$S_{xx}(\omega) = \lim_{T\to\infty} E\{F_x^T(\omega)^2\}$$

1.2 Cross-Spectral Density

Combine 2 frequencies instead.

$$S_{xy}(\omega) = \lim_{T\to\infty} E\{F_x^T(\omega) * F_y^T(\omega)\}$$

1.3 Coherence

Cross-spectral density squared divided by the multiplied spectral densities.

$$C_{xy} = \frac{|G_{xy}(f)|^2}{G_{xx}(f)G_{yy}(f)}$$

Coherence predicts to what extent y(t) can be predicted from x(t). It attempts to estimate causality between input and output, not necessarily needing values that line up but watching for leading, lagging, and smoothing relationships. Coherence corresponds to how much power in the output frequency directly results from the input frequency, and thus the closer the coherence is to 1, the higher the correlation between the 2 signals.

2 Algorithm

Algorithm 1 chancoherence: Find coherence between 2 channels

Input: Channel 1 D_1, Channel 2 D_2

Output: Coherence c

1: **procedure** CHANCOHERENCE(D_1, D_2)
2: $F_1 = \text{fft}(D_1)$
3: $F_2 = \text{fft}(D_2)$
4: **return** coherence(F_1, F_2)