Problem 7.29

To simplify the presentation, hereafter we concentrate on the complex envelope (i.e., complex baseband signal) of the QPSK signal, and likewise for the OQPSK signal. Otherwise, the phase spectra of the QPSK and OQPSK signals would become dominated by the contribution of the carrier, which complicates the graphical plots.

Figure 1 plots the phase spectrum of the QPSK signal with a square wave applied to each of the *I*- and *Q*-channels. The phase spectrum has impulses spaced uniformly at the symbol rate, corresponding to the phase discontinuities that occur at the symbol rate.

Figure 2 plots the phase spectrum of the corresponding OQPSK spectrum, with the same square wave applied to each of the *I*- and *Q*-channels. The phase spectrum of Fig. 2 is similar to that of Fig. 1 for the QPSK in that both of them consist of a series of impulses. However, in Fig. 2 the impulses are shifted in frequency as well as amplitude. Moreover, the impulses in Fig. 2 are spaced by twice the symbol rate, because every second harmonic is cancelled out.

The phase spectra plotted in figs. 1 and 2 depend on the symbol rate of the incoming square wave and the way in which the square wave is positioned with respect to the origin (i.e., time $t = 0$).

Finally, Fig. 3 plots the phase difference between the QPSK and OQPSK. From this figure we readily see that this phase difference is a nonlinear function of frequency.

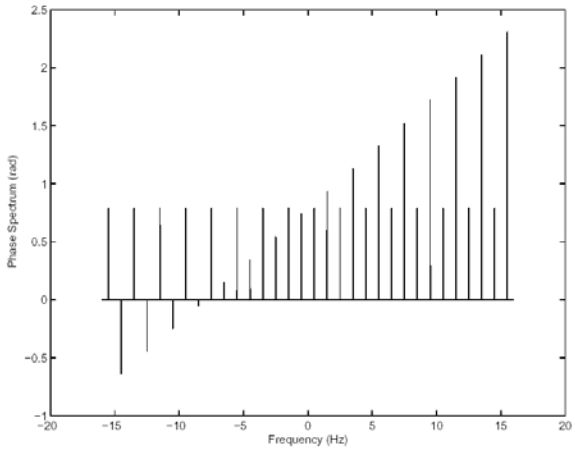
Note

The last sentence in the statement of Problem 7.29 should be corrected as follows:

"Hence, justify the assertion made in Drill Problem 7.3 that these two methods differ by a nonlinear phase component."

Also, add the following:

Hint: Use the complex envelope for the representation of QPSK and OQPSK signals.



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Problem 7-29 continued

Phase spectrum of QPSK with square wave in each of *I* and *Q*-channels

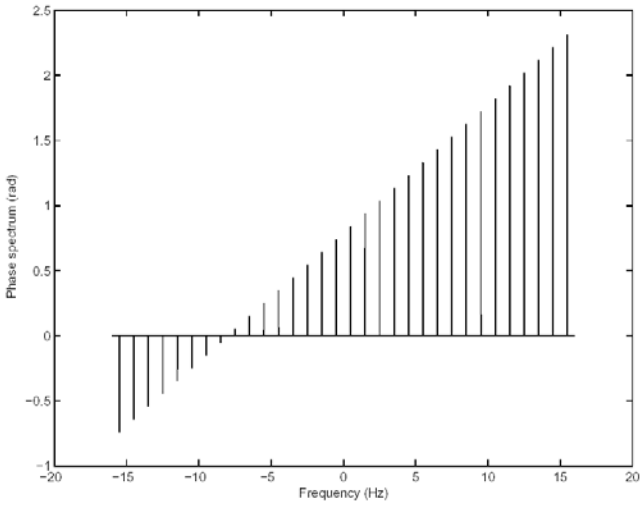

Figure 1

Phase spectrum of OQPSK with square wave in each of *I* and *Q*-channels

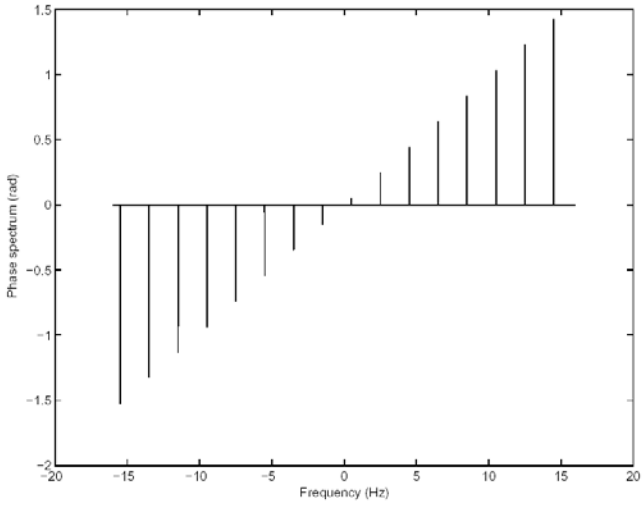

Figure 2

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Problem 7-29 continued

The phase difference spectrum

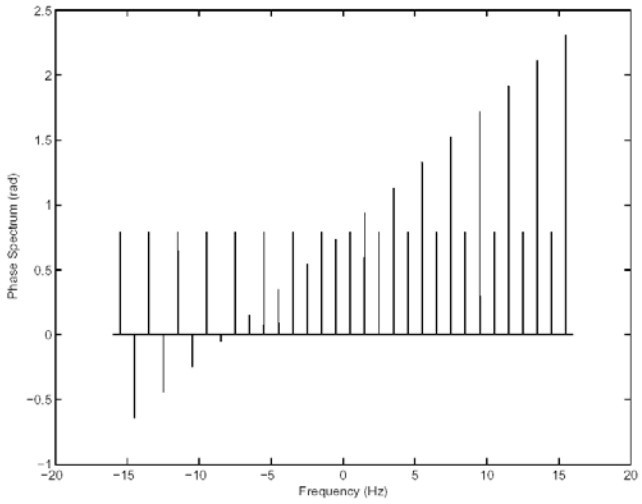

Figure 3