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On the Hilbert transform of wavelets

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A wavelet is a localized function having a prescribed number of vanishing moments. In this correspondence, we provide precise arguments as to why the Hilbert transform of a wavelet is again a wavelet. In particular, we provide sharp estimates of the localization, vanishing moments, and smoothness of the transformed wavelet. We work in the general setting of non-compactly supported wavelets. Our main result is that, in the presence of some minimal smoothness and decay, the Hilbert transform of a wavelet is again as smooth and oscillating as the original wavelet, whereas its localization is controlled by the number of vanishing moments of the original wavelet. We motivate our results using concrete examples.

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