
An improved technique for distortion removal in Raman spectra using impulse response filter banks

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For accurate analysis and characterization of materials using Raman spectroscopy, it is often necessary to remove signal distortions, including the noise from the spectra, using a filter such as the Savitzky-Golay (SG) spectral filter. However, distortion filtering accuracies are limited for SG filters due to their polynomial-fitting-based distortion removal process and the inherent inability to select required distortion removal frequencies. In contrast to the SG filtering techniques, Impulse Response (IR) based stable digital filtering techniques using Filter Banks (FB) should be more accurate in removing only the unwanted distortions, especially, due to their ability to control the filtering process based on the signal frequency sub-bands. Thus this paper describes a new and more efficient Impulse Response Filter Bank (IRFB) band-pass filtering technique to remove the distortions in Raman spectral signals using two-band filter banks. The distortion removal performances for the proposed IRFB and typical SG techniques were compared experimentally by estimating the output Signal to Noise Ratios (SNRs) for different input signal SNR levels. Clean Raman spectral data signals were obtained from an appropriate Raman spectral database and were contaminated with noise and background distortions. The contaminated signals were input into the IRFB filtering technique-based distortion removal system. The proposed IRFB filtering technique showed a significantly improved distortion removal performance when compared with the SG technique. Compared to the SG filter, the average improvement of the output signal SNR of the IRFB filter was 3.1 dB. The newly proposed IRFB filtering is an efficient, yet simpler technique, to simultaneously remove different Raman spectral distortions.

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