A Subband ARMA Modeling Approach to High-Resolution NMR Spectroscopy*

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Abstract

In this paper, a low numerical complexity method for parameter estimation of damped exponential signals is proposed. It allows one to handle with free induction decay (FID) signals of "high complexity" containing hundreds of resonances and composed of more than 100,000 samples. At first, it is recalled that the model of a FID is a particular autoregressive moving-average (ARMA) process in which the AR part contains all useful spectral information. Then the AR parameters may be estimated by solving the high-order Yule-Walker (HOYW) equations using a singular-value decomposition procedure. To deal with high complexity signals, a subband decomposition scheme is proposed. The filtering operation involved by the decomposition produces colored noise that makes the ARMA modeling approach even more essential. Using three real-world 13C NMR signals, the results achieved by the subband ARMA approach are compared with those obtained using the Fourier transform and a deconvolution algorithm.

Key words: High resolution methods; Linear prediction; ARMA modeling; Subband decomposition; Magnetic resonance spectroscopy.

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