Distributed approximating functional treatment of noisy signals

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Abstract

Based on their so-called "well-tempered" property, distributed approximating functionals (DAFs) are shown to be very good data filters, and consequently, they have many potential applications in all fields of engineering and the natural sciences. In this paper, a periodic extension of a noisy signal is proposed to generate a "pseudo-signal" in the infinite domain, enabling the use of noncausal, zero-phase window filters that require a knowledge of the signal in the extended domain. The extended signal is also useful for the application of fast Fourier transforms (in which the preferred number of sampled data points is a power of 2). The most attractive feature of the method is that it introduces little aliasing between the original and true signal. The resulting extended signal is then filtered by using DAFs as low pass filters under the assumption that the true signal is bandwidth limited and most of the noise components are in the high frequency region. A "signature" based on computing the root-mean-square value of the filtered signal is introduced to indicate when the high frequency noise has been eliminated with the choice of the DAF parameters. To illustrate the usefulness of the present algorithm, two noisy signal examples are periodically extended and filtered using DAFs.