GPR Noise Reduction Based on BPD and BPD-EMD

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Abstract

GPR is a non-destructive method for exploring near surface objects, but sometimes it contains noise. The observed noise in this study is random noise. This study focuses on de-noising GPR data with two de-noising methods called Basis Pursuit De-noising (BPD) and BPD-EMD. Empirical mode decomposition (EMD) empirically decomposes a non-stationary signal to a limited set of stationary and oscillatory sub signals, called IMFs (Huang et al., 1998). The Basis Pursuit (BP) and BP De-noising suggested for depiction of signals. BPDN and BP are solved with iterative algorithms. The SALSA is used for solving BP and BPD (Selesnick, 2012). For comparison, each method is applied to synthetic data. To generate it, the Ricker wavelet with dominant frequency of 250 MHz is convolved to a random series of reflection coefficients. White Gaussian noise is added, to create a noisy model. Evidently, BPD is not capable to reduce the noise sufficiently, although by changing its parameters it will be better. But for comparison of the two methods the parameters are the same. Using BPD-EMD, the noise is reduced and its result is more reliable than BPD. The damaged parts are recovered and the continuity is improved. One of this method's drawback is that it loses its coherency, which appears in the events that originates from 80th sample. Its most important privilege is that it does not lose any signals and all of them are preserved. Results of de-noising reveal that BPD-EMD attenuates noise better than BPD. Unfortunately, several samples did not improved with efficient continuation and EMD produce signal distortion. These can be enriched by alternative transforms.