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Signal Processing of Microwave Imaging Brain Tumor Detection Using Superposition Windowing

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Abstract. This paper discusses the selection of window function for signal processing in microwave imaging brain tumor detection. Most of the window functions are non-negative bell-shaped curves. This paper proposed a superposition windowing function for better time series data analyses and enhancement. The performance of the selected five window functions (Hamming, Blackman-Harris, Parzen, Chebyshev and Bartlett-Hanning) and the proposed superposition window were compared and evaluated. The results show the superposition window function is potentially reduce the unwanted noise and preserve important information of the signals.

Introduction

Microwave imaging technique prepares a well-defined view of the internal structure of an object by illuminating it with a low power electromagnetic wave at microwave frequencies. In mono-static microwave imaging system, a single ultra-wideband (UWB) antenna transmits a short pulse into the phantom. The backscattering parameters, S_{11} are then received by the same antenna [1]. The collected data are then processed using signal and image processing techniques to form a 2D image for tumor sizing and locating.

Signal processing is the art to analyze and enhance time series data. Most of the digital signals are infinite and dataset are very large for manipulation as whole. Such signals are difficult for statistical analysis and calculations. In order to avoid the raised problem, windowing is introduced for engineers to analyze small subsets of total data.

Literature Review

Signal Windowing. The process by taking small subsets of a large dataset for processing and analysis is defined as windowing. A rectangular window is the naive approach involves data truncating at the left part (before) and right part (after) of the window while the contents of the window are not modified at all. For instance, a window functions where zero value elsewhere and constant inside the interval is a type of rectangular window. When the time series signal is applied with this window function, the product is inside the overlapping area where others are zeros. This process is defined as 'view through the window', where valuable contents are framed inside the window region. Rectangular window may cause power leakage and hence it is a poor windowing method.

Window functions are typically applied on spectral analysis, filter design and beamforming. Most of the window functions are non-negative bell-shaped curves where the basics are rectangle and triangle shapes [2]. There are eight types of window functions, they are categorized as B-spline windows, other polynomial windows, generalized Hamming windows, high order generalized cosine windows, power of cosine windows, adjustable windows, hybrid windows and Lanczos windows. Figure 1 to Figure 2 shows the window function and its Fourier transform.