X-ray mammography is the current standard for breast cancer detection. It poses some health risks owing to the ionizing radiations involved. Microwave imaging (MWI) can be a painless, non-ionizing alternative. It relies on the high dielectric contrasts between normal and malignant tissues in the GHz frequency range. To add to the credibility of MWI, it is observed that the dielectric properties of the breast tissues from patient to patient do not vary significantly. A study of using the scatter signals for classification of the tumor presence is conducted numerically here. We use an Electromagnetic (EM) simulator to build a phantom breast model. A resistively loaded Ultra-Wide Band (UWB) dipole antenna is scanned to create a synthetic array around the phantom breast. This directional antenna is used to transmit and receive the UWB pulse signals in the frequency range of 4-8 GHz. The differences in the dielectrics of the tumor (5±9%) and breast tissue (50±7%) are useful to reduce the bias of the algorithm. Our classification is a two step model. In the first stage, due to the high number of data points generated during simulations, we need to identify the “informing” data set from it. This is performed using a multiscale wavelet principal component analysis. Due to its multiscale nature, they efficiently denoise the signal by soft thresholding. Thresholding kills the effect of the noise without killing the effect of the signal i.e. data containing significant contributions from events whose behavior is dependent on frequency are preserved in this case. In the second stage a neural network is used for classification which evaluates the average rate of correct classification as a performance measure. A near full detection rate was obtained at each wavelet resolution. This characterization of the scattered data could also be extended in classifying the shape and size of the target in conjunction with the main imaging procedure.