

*Implications of Microwave Holography using Minimum Required Frequency  
Samples for Weakly- and Strongly-Scattering Indications*

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**ABSTRACT**

Microwave imaging techniques, an integral component of nondestructive testing and evaluation (NDTE), have received significant attention in the past decade. These techniques have included the implementation of synthetic aperture focusing (SAF) algorithms for obtaining high spatial resolution images. The next important step in these developments is the implementation of 3-D holographic imaging algorithms. These are well-known wideband imaging technique requiring a swept-frequency (i.e., wideband), which unlike SAF that is a single frequency technique, are not easily performed on a real-time basis. This is due to the fact that a significant number of data points (in the frequency domain) must be obtained within the frequency band of interest. This not only makes for a complex imaging system design, it also significantly increases the image-production time. Consequently in an attempt to reduce the measurement time and system complexity, an investigation was conducted to determine the minimum required number of frequency samples needed to image a specific object while preserving a desired maximum measurement range and range resolution. To this end the 3-D holographic algorithm was modified to use properly-interpolated frequency data. Measurements of the complex reflection coefficient for several samples were conducted using a swept-frequency approach. Subsequently, holographical images were generated using data containing a relatively large number of frequency samples and were compared with images generated by the reduced data set data. Quantitative metrics such as average, contrast, and signal-to-noise ratio were used to evaluate the quality of images generated using reduced data sets. Furthermore, this approach was applied to both weakly- and strongly-scattering indications. This paper presents the methods used and the results of this investigation.

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