

Super-resolution and Accurate 3-dimensional Imaging Method by Combining EM Computational Analysis in Short Range UWB Radar

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Electro-magnetic computational techniques are indispensable tools for advanced radar imaging techniques, especially for inverse scattering topics. As one of the most attractive topics in recent years, UWB (Ultra-wide Band) short range radar has a great potential for higher resolution imaging for short range scale, due to holding higher range resolution or favorable penetrating ability for dielectric object. There are so many demands for establishing super-resolution imaging algorithm for robotic sensor in disaster area, non-destructive testing or non-invasive biomedical imaging issues, where the spatial resolution must be remarkably enhanced for competing other internal sensing approaches, such as X-rays or ultra sound imaging. For these demands, we have already developed super-resolution and highly accurate 3-dimensional imaging methods, called as range points migration (RPM) method. The RPM method has a several important advantages comparing with the other imaging method, as synthetic aperture radar, time-reversal approach or other waveform focusing techniques. This method has been verified numerically or experimentally that it provides us super-resolution and $1/100$ wavelength reconstruction accuracy by using frequency domain interference (FDI) approach, as Capon method, which is extended to correspond to the scattering waveform deformation. This paper introduces this super-resolution imaging methodologies and clarify the role of accurate EM computational technique as FDTD method for achieving $1/100$ wavelength accuracy. This paper also introduces a novel inverse scattering method, namely, the reconstruction of dielectric constant distribution, by combining the unique feature of RPM boundary extraction and the efficient EM computational method. Both numerical and experimental investigations are assessed for proving the effectiveness of the proposed method.