

Communications

SEABED Algorithm and Comments on "Modeling and Migration of 2-D Georadar Data: A Stationary Phase Approach"

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Index Terms—Inverse transform, radar imaging, reversible transform, SEABED algorithm.

An imaging algorithm with a transform between the real and data spaces was proposed by Greenhalgh and Marescot [1] for georadar data in 2006. This technique utilizes a reversible transform between the real space ($X, Z = F(X)$) and the data space ($x, z = h(x)$) as

$$\begin{cases} x = X - F(X) \cdot F'(X) \\ z = F(X) \sqrt{1 - F'(X)^2} \end{cases} \quad (1)$$

where $F'(X) = dF(X)/dX$ is defined. The inverse transform of this transform is

$$\begin{cases} X = x - h(x) \cdot h'(x) \\ Z = h(x) \sqrt{1 - h'(x)^2} \end{cases} \quad (2)$$

where $h'(x) = dh(x)/dx$ is defined. This inverse transform is equivalent to the imaging method that is proposed by Li *et al.* [2] if an antenna interval is short. This method was applied to preprocessing for breast cancer detection in 2005.

These transforms were originally proposed by Sakamoto and Sato [3], [4] in 2004 for an imaging with ultrawideband radar systems. By utilizing these transforms, a high-speed imaging algorithm, which is called as SEABED algorithm, was developed, which was extended to compensate for the phase rotation at caustic points [5], which was also described by Greenhalgh and Marescot [1]. In addition, the SEABED algorithm was extended to apply to noisy data [6], 3-D systems [7], [8], experimental data [9], and bistatic radars [10].

Note that the transform is fundamentally sensitive to noise because it includes derivative operations. A new algorithm was developed by

extending the SEABED algorithm to avoid the derivative operations [11], which is stable and has a high resolution even for noisy data.

The reversible transform in (2) is now simultaneously and independently studied by some research groups because it is the sole solution for the imaging with wave fields. In addition, the transform has a variety of applications because it can be applied to electromagnetic waves, sonic and ultrasonic waves, seismic waves, and other waves.

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