Polarization Effects of Holographic Penetrating Imaging Radar

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INTRODUTION

Holographic penetrating imaging radar uses the penetrating characteristics of electromagnetic waves and the working principle of microwave holographic imaging to penetrate the subsurface of the medium to achieve high-resolution perspective imaging of shallow targets or defects in the medium.

Polarization is an important basic parameter other than frequency, amplitude and phase, which describes the vector characteristics of electromagnetic waves trajectories in spatial orientation over time . The polarization state of the receiving antenna should match the polarization state of the received electromagnetic wave, so as to maximize the power of the electromagnetic wave.

For polarization effects of holographic penetrating imaging radar, several sets of experiments are designed in this paper. Through the target experiments of various polarizations and attitudes, by comparing the radar imaging results when the polarization direction of the antenna is parallel, perpendicular to the extension direction of the target, and at other angles, as well as the cross-polarization situation under the imaging results of various pose targets, the extension

HOLOGRAPHIC PENETRATING IMAGING

The imaging processing includes steps such as spatial two-dimensional FFT, wavefield migration and spatial two-dimensional IFFT.

Multiply the spatial spectrum for wave field migration:

$$H\left(k_x,k_y,k,z\right)=\frac{j2\pi\left(2k\right)^3 z_0^3}{k_z^4}\exp\left(jk_z z\right)$$

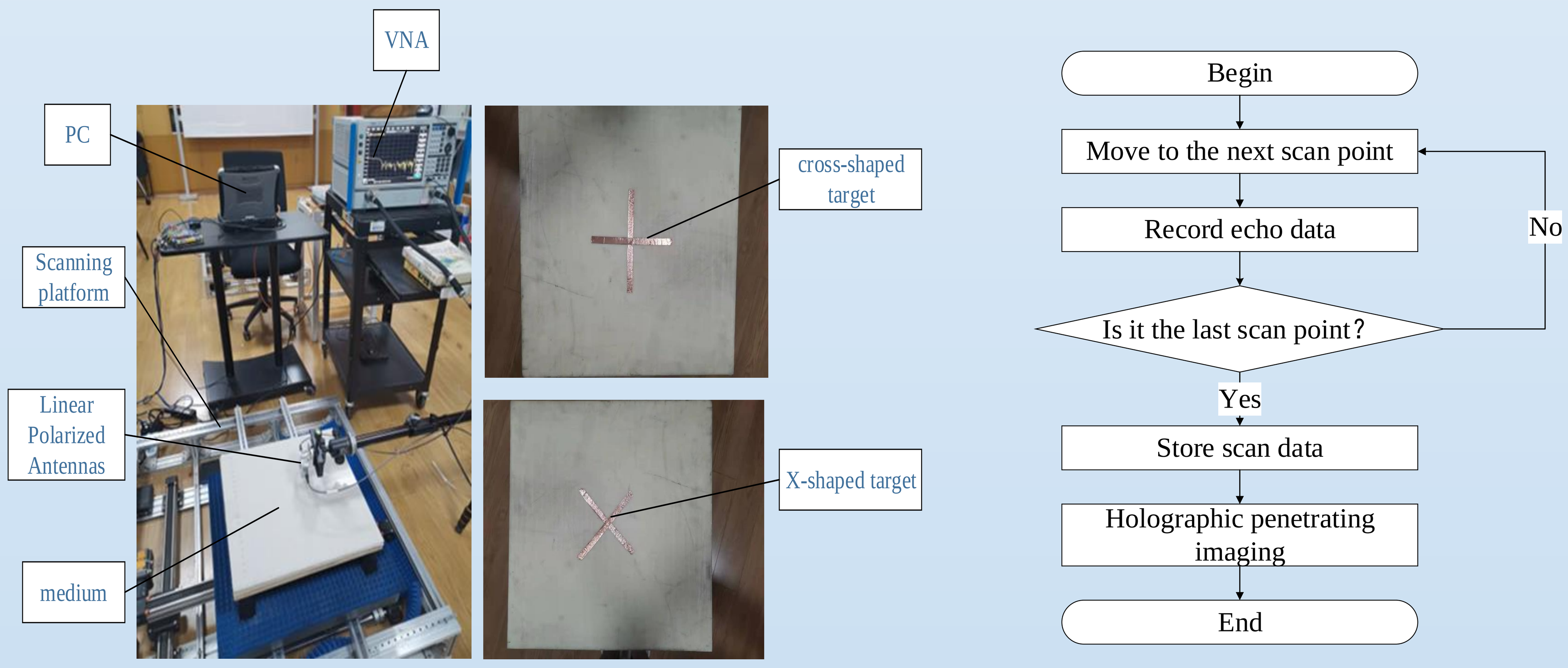
For applications where only 2D imaging results are required, a simplified wavefield migration function can be used:

$$H\left(k_x,k_y,z_0\right)=A\exp\left(jk_z z_0\right)$$

The two-dimensional image obtained at this time can be expressed as:

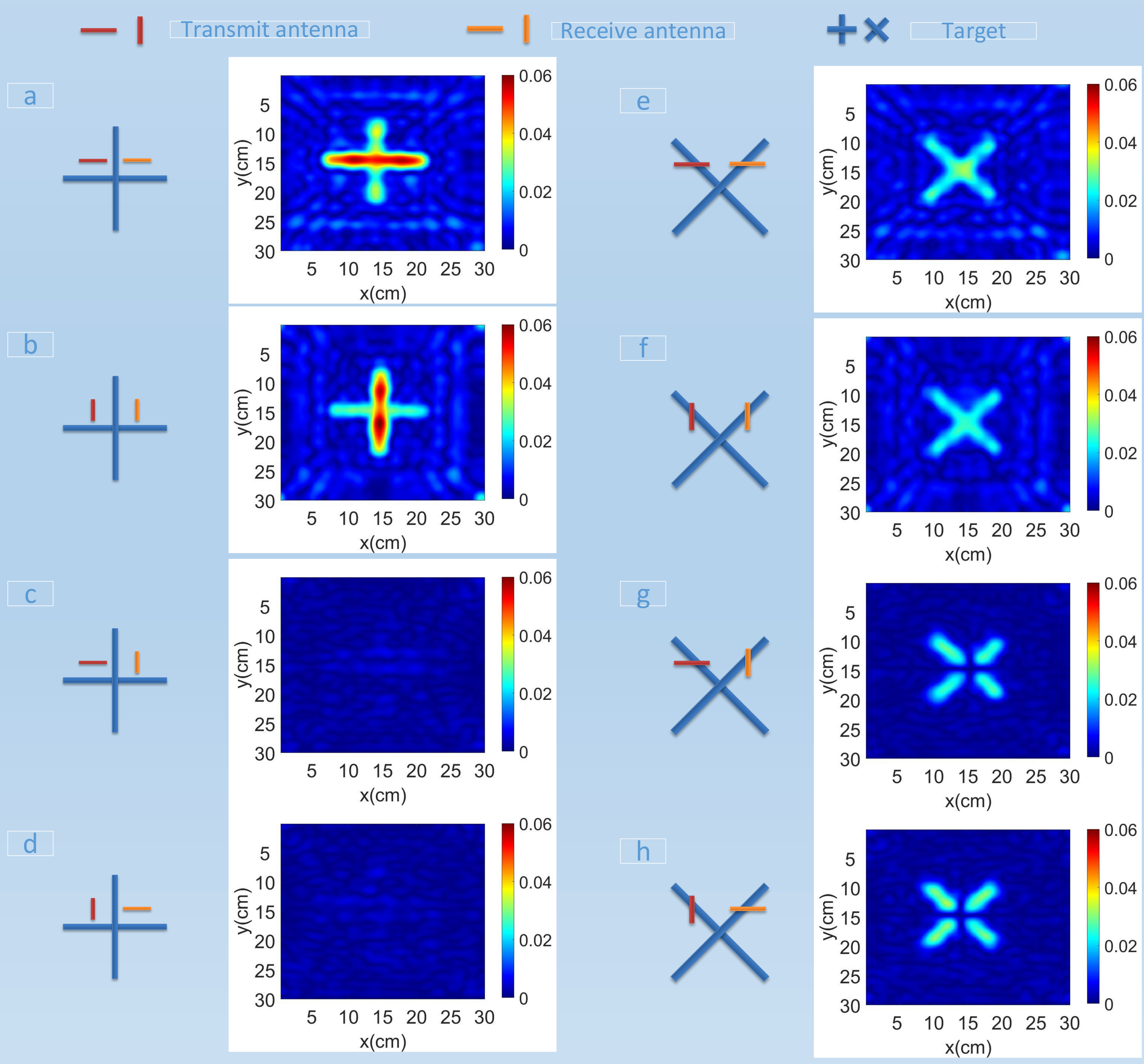
$$p\left(x,y;z,v\right)=IFFT_{2D}\left\{S\left(k_x,k_y\right)\times H\left(k_x,k_y,z_0\right)\right\}$$

EXPERIMENTAL SYSTEM



Options	Parameters
Target	Cross-shaped and X-shaped copper foil, length:15cm, width:1cm
Medium	ABS,length:40cm,width:40cm,thickness:10cm
Antenna	C-band linearly polarized horn antenna

RESULTS AND CONCLUSION



The experimental imaging results of each group are shown in Figure. In the eight groups from a to h, the left part of each group represents the experimental scene, in which the red bar represents the transmit antenna, the orange bar represents the receive antenna, and the color bar can be placed vertically or horizontally, respectively represent the two polarization modes; the blue part represents the target, including a cross-shaped target and an X-shaped target. The right part represents the corresponding imaging results.

In this paper, we have designed several sets of experiments and obtained some rules of the radar polarization method and target detection ability. For example, when using co-polar antenna radar for penetrating imaging, after one detection, the antenna can be rotated at a certain angle to measure again, and this is repeated many times to obtain richer target information. Through in-depth analysis of these experimental results, we can also get more rules, which have guiding