Communications

Authors' Reply to Comments by Takuya Sakamoto, Shouhei Kidera, and Toru Sato on "Seabed Algorithm and Comments on 'Modeling and Migration of 2-D Georadar Data: A Stationary Phase Approach'"

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In connection with a recent paper [1], we have been invited to respond to the comments by Takuya Sakamoto, Shouhei Kidera, and Toru Sato [2].

With this Communication, Sakamato *et al.* [2] seek to draw the IEEE readerships' attention to their SEABED Algorithm, which is a way to recover target shape from monostatic omnidirectional pulse radar systems. Their imaging procedure is almost entirely kinematic and does not take pulse shape and amplitude information into account. We were not aware of their research contribution, even though it has been published eight times in the same Japanese journal [3]–[10] (*IEICE Trans. on Commun.*) under slightly different guises. The journal in question is one with which we are not acquainted. In any case, our treatment is more comprehensive than theirs, as explained as follows.

The object space to image space transformation equation (and its inverse) given in our paper, which Sakamoto *et al.* refer to as the boundary scattering transform (and the inverse boundary scattering transform), constitutes only a small part of our paper. The main thrust of our contribution was to rigorously derive the imaging equations and to evaluate the infinite spectral integrals using multidimensional stationary phase. We present new migration and modeling procedures which take account of the wavefield dynamics (amplitude and phase). We showed how the simple kinematic imaging equations arise naturally out of the full wavefield treatment, but we also gave a simpler derivation of these equations based on spatial impulse responses and a generating function. Our paper goes considerably beyond the phase-only treatment offered by Sakamoto *et al.*, which ignores reflectivity changes along the reflector. Even their phase analysis is not entirely rigorous, because the matched filter applied in the preprocessing cannot handle wave theoretic changes in phase associated with reflector curvature. It assumes the same waveform (source signal) at all points along each event. Sakamoto *et al.* claim to be the originators of the boundary scattering transform and cite two papers in 2004 as evidence [3], [11]. This is simply not true. The paper by Greenhalgh *et al.* in [12, pp. 313, eqs. 26–31] gives both the 2-D and 3-D versions of the forward transforms. This international journal article [12] predates the Sakamoto *et al.* papers by some 12 years but was not cited by them.

Finally, we must take issue with the statement in their Comments that the inverse boundary scattering transform [2, eq. 2] "is the sole solution for the imaging with wavefields." Their SEABED Algorithm uses only a small part of the wavefield and is restricted to normal incident paths. They ignore the vast literature in geophysical imaging, medical imaging, radioastronomy, optics, nondestructive testing, etc. There are many approaches to the inverse scattering problem and most are far more elaborate than SEABED.

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