Acoustic One-way Wave Theory in Highly Heterogeneous Media and its Application in Acoustic Imaging

Acoustic wave propagation through a 3-D heterogeneous medium may be quantified by an integral representation that is *non-linear* in the contrast parameters (i.e., the difference between the true material parameters and a piecewise smooth background model). This non-linearity implies that the wave field may be seriously dispersed by the rapid spatial variations of the material parameters at a scale smaller to much smaller than the wavelength. Accounting for these effects in numerical schemes requires a very fine discretization of the medium and many iterations, which is very unattractive from a computational point of view. As an alternative the 3-D 'generalized primary representation' is proposed. In this 'one-way' representation a piecewise smooth '*extended* background model' accounts for the dispersion effects of the small scale variations. Moreover, this new representation is *linear* in the so called 'contrast operator'. This linearity implies that in numerical schemes the discretization of the medium is much less restrictive and that only one 'iteration' is required. Moreover, it implies that acoustic imaging in highly heterogeneous media may be formulated as a *linear* inversion of the generalized primary representation.

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