A PHASE-SPACE BEAM SUMMATION IMAGING IN INHOMOGENEOUS MEDIUM

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ABSTRACT

We introduce a beam-based approach for the purpose of local subsurface imaging. The formulation is implemented in the multi-frequency domain where we use frequency-by-frequency approach. We use the beams in order to transform the imaging problem into the beam domain. In the beam domain, the representation is a priori localized in both the data and the beam propagators. The theory utilizes the ultra-wideband phase space beam summation (UWB-PSBS) method. This method is based on windowed Fourier transform (WFT) frames (a frame over an inner product space is an over complete set of functions that can be used for redundant and stable signal expansions, as a generalization of the concept of basis). In the UWB-PSBS method, the radiated field is expressed as a discrete superposition of beams. Specifically, we use a set of iso-diffracting Gaussian beams (ID-GB). The term iso-diffracting implies that the propagation parameters of these beams are frequency independent and need to be calculated only once and then used for all frequencies. The local imaging approach consists of two localization phases. First, a pre-processing phase, where we transform both the sources and receivers fields into a set of beams. Their amplitudes are referred as the beam-domain data. In this phase we filter out beams with negligible amplitude. Second, is the imaging phase where the beam data is back propagated into the target domain. Given an imaging point, only beams which pass near the imaging point are considered. This two phase procedure helps to reduce the complexity, reduce the amount of data and filters out irrelevant data. The efficacy and accuracy of the beam formulation is explored via numerical examples.