Contribution ID: **42** Type: **Oral**

Using 2-D approximation of the 3-D incident field for Born inversion

Wednesday, November 1, 2017 10:10 AM (20 minutes)

In a real ultrasound measurement system, acoustic waves show 3-D propagation characteristics. However, in a majority of recently developed wave based imaging methods, the inverse problem is solved in a 2-D framework due to computational restrictions. This reduction causes problems during inversion. In this work, we use a 2-D approximation for the measured 3-D incident field and show that using this approximated incident field for Born inversion (BI) improves the resulting reconstruction.

(2) Material and Methods

Hankel functions are used as starting point to obtain a 2-D approximation for a given 3-D field as these Hankel functions satisfy the 2-D Helmholtz equation. Consequently, the approximated wave field in cylindrical coordinates reads

\begin{equation}
p_{approx}(r,\phi,\omega) = \sum_{n=-N}^{N}{c_n(\omega) H_n^{(1)}(\frac{\omega}{c} r) e^{i n \phi}},
\end{equation}

where $H_n^{(1)}$ is the Hankel function of the first kind. To find the coefficients c_n, we iteratively minimize the L_2-norm of the mismatch between the measured and approximated field. Once the coefficients are found, the resulting approximated 2-D incident field is used for Born inversion.

(4) Discussion and Conclusion

A new approach is proposed for applying 2-D inversion on 3-D measurement data. This new approach approximates the incident field from the original 3-D incident field and uses this approximated incident field in the inversion. Results with Born inversion show that this new approach give better results compared to the currently applied approaches. The proposed method can also be used with other inversion methods.

(3) Results

To test the proposed approach, we first solve the forward problem in 3-D for a circular array (20 sources and 150 receivers) scanning a cylindrical and a spherical object. Next, we use a 2-D Born inversion method to reconstruct the acoustic medium properties and compare the resulting reconstructions obtained with four approaches. These four approaches are based on computing the incident field using (1) an infinite line source, (2) a point source, (3) a point source followed by a correction to compensate for geometrical spreading, and (4) a point source followed by the proposed method to approximate the field using Hankel functions. It can be clearly observed from the figure that the best result is obtained with our proposed approach.

Author: TASKIN, Ulas (Delft University of Technology)

Co-authors: Dr VAN DONGEN, Koen (Delft University of Technology); Mr HEIJNSDIJK, Lars (Delft University of Technology); Mr HOOGERBRUGGE, Leo (Delft University of Technology)

Presenter: TASKIN, Ulas (Delft University of Technology)

Session Classification: Session 1:Imaging and inversion I

Track Classification: Main Track