Brief report of "Program to Accelerate the Internationalization of University Education in 2008" (Japanese Government Support for Long-term Study Abroad)
H20 年度　大学教育の国際化加速プログラム海外先進教育研究実践支援（研究実践型）報告

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Objective:

- Development of numerical simulation tools for elastic wave propagation in anisotropic, heterogeneous and lossy material.
- Development of non-destructive ultrasonic imaging techniques for internal flaws, such as stress corrosion crack (SCC) in components of nuclear power plants.

Main Research

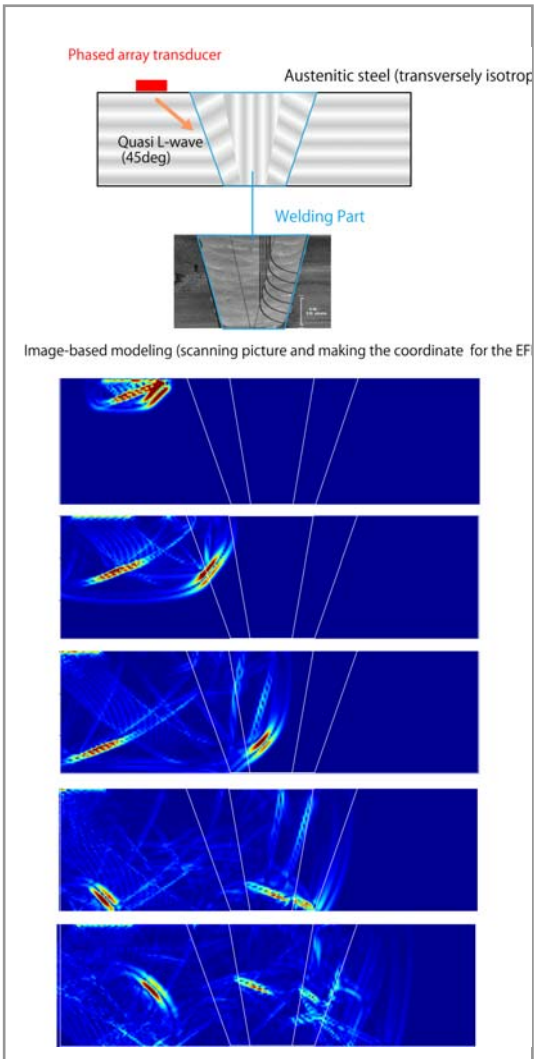
- Image based modeling with the elastodynamic finite integration technique (EFIT) in anisotropic, heterogeneous and lossy materials.
- Mathematical modeling of ultrasonic phased transducer and its application to flaw imaging with time and frequency domain SAFTs.

(1) EFIT

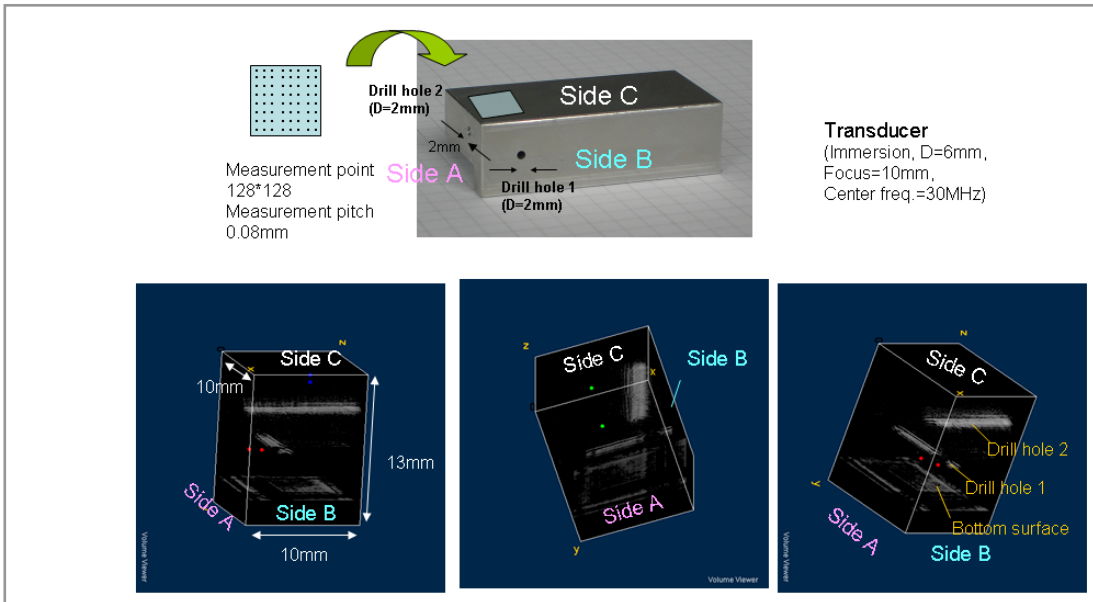
Our numerical simulation is based on the image-based EFIT modeling. In this simulation, the grid geometry of the EFIT is determined by scanning pixel or voxel image. The wave ray-path in the complicated material can be determined by means of this image-based EFIT modeling. This approach enhances the accuracy of the imaging or detectability of flaw in complicated materials.

(2) Time and frequency domain SAFTs

There are two inversions we are dealing with. One is the frequency domain SAFT based on the linearized inverse scattering method. The advantage is fast calculation. The other is the time domain SAFT combined with sampling phased array technique. The advantage is this method can apply flaw imagings in inhomogeneous and anisotropic media.



Ultrasonic wave propagation in the anisotropicsteel with a welded part. The crystalline orientations of welding part are different from austenitic material steel.



Shape reconstructions of the drilled holes in aluminium specimen with the 3-D frequency domain SAFT.

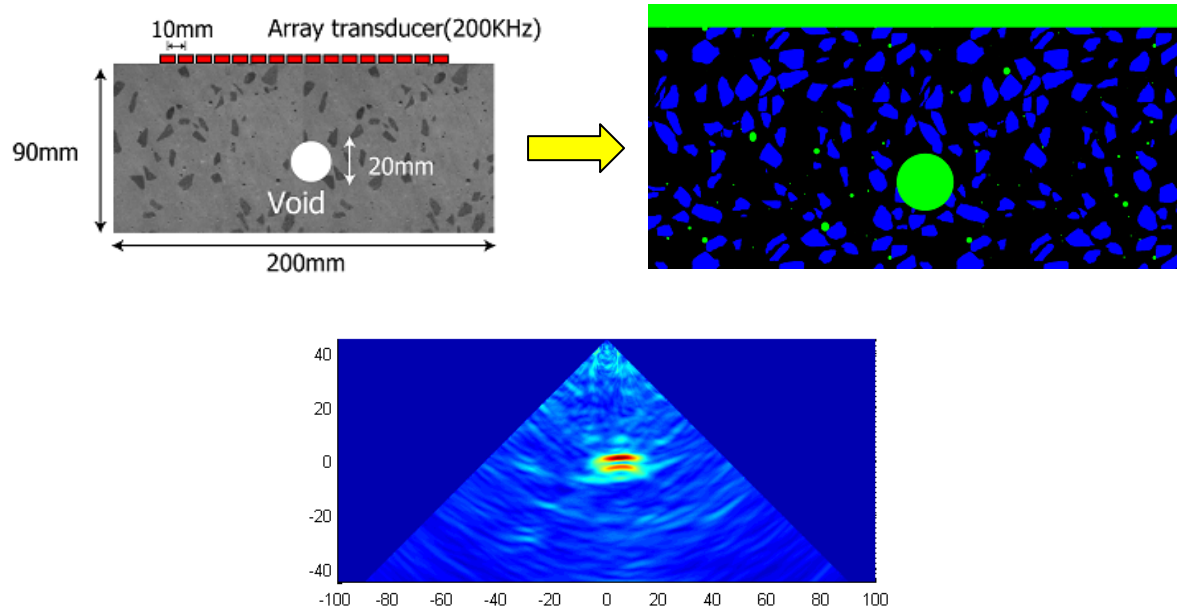


Image based EFIT modeling of concrete material (upper figure) and imaging of void by the time domain SAFT-combined with revolutionary filtering techniques (bottom figure).

Service offering

- Simulation of ultrasonic (elastic) wave propagation in solid, liquid and air media.
- Wave ray-path prediction for configuration of appropriate position and delay law for array transducer.
- Proposal of appropriate ultrasonic imaging in complicated material, such as weld part, concrete, FRP, etc.

Areas of application

- Non-destructive testing.
- Medical imaging.
- Geophysical exploration.
- Training and study of wave theory