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Title: NDE Solutions: Imaging SCC with Acoustic Techniques

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NDE Solutions

Imaging SCC with Acoustic Techniques

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Context

- 2014 meeting at EPRI resulted in a 5 year plan to:
 - Provide point inspection on SCC → once an area of concern has been identified visually (e.g., camera), can we interrogate this specific area?
 - The interrogation technique should be able to quantify penetration depth + orientation of the SCC and indicate if through-thickness penetration is occurring.

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Time Table

- 2014
 - 2015
- **Feasibility:** Can the proposed technique be used for SCC imaging?
- 2016
 - 2017
 - 2018
- **Deployability:** Integration in a tool for use in tight/confined spaces?
- **Understanding the Physics:** What happens when acoustic waves interact with SCC?

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Proposed Approach

- Time reversal (TR) acoustics is used to focus energy onto a specific area and inspect this area.

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Previous Work – Orientation

- TR can focus acoustic energy independently in different directions:

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Previous Work – Orientation

- SCC – Sample 1

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Penetration Depth

- Energy is focused on sample surface but also penetrates the sample, with a depth proportional to frequency.

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Penetration Depth

- SCC – Sample 2

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Penetration Depth

The SCC crack actually goes below the weld line

Focal spot depths:
 @100kHz = 9.75 mm
 @200kHz = 4.87 mm

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Deployability

- Experimental setup for the proof of concept

Steel pipe fitted in a
block of sandstone

Sensor: laser head
mounted on wheels

Source: transducers
on inflatable device

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Deployability

Acoustic source inside pipe

Use of laser head inside pipe

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Deployability

- Focusing and probing inside a steel pipe fitted in a block of sandstone and consolidated with cement

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Understanding the Physics

- In experiments, we scan the surface of the sample
- We need to complement experiments with numerical modeling:
 - Analysis of the results related to what is below the surface
 - Resolution of an inverse problem on the size of the crack

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Understanding the Physics

- Finite-element method

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Conclusions and Path Forward

- 2014 } - **Feasibility:** TR can image SCC.
- 2015 }
- 2016 } - **Deployability:** TR can be integrated in a tool for imaging in tight spaces – we need to go beyond proof of concept now.
- 2017 }
- 2018 } - **Understanding the Physics:** Numerical analysis seems essential at this stage.

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