Acoustic Wave Crack Detection: A First Principles Approach

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Introduction

Why Build a Crack Detection Model?

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Cracks Are Generated in Normal Usage In:

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Roadways,

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Roadways,
Bridges,

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Cracks Are Generated in Normal Usage In:
Roadways,
Bridges,
Cell-Towers,

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Roadways,
Bridges,
Cell-Towers,
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Cracks Are Generated in Normal Usage In:
Roadways,
Bridges,
Cell-Towers,
Pipelines,
Building Materials (Rock, Concrete, Steel, etc.)

Why Build a Crack Detection Model?

Cracks Are Generated in Normal Usage In:
Roadways,
Bridges,
Cell-Towers,
Pipelines,
Building Materials (Rock, Concrete, Steel, etc.)
and numerous other materials

How is this Crack Detection Model Built?

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This Crack Detection Model Employed:
COMSOL® Multiphysics Structural Mechanics Module
Version 5.2a

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Acoustic Waves
A Crack Family and
Differential Fourier Analysis

How does this Crack Detection Model Function?

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Generate Acoustic Waves (Shear and/or Compressional)

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Detect the Single-Point Displacement (Shear Wave), without Crack(s)

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Fourier Analyze Displacement Function (FA1)

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Generate Acoustic Waves (Shear and/or Compressional)
Detect the Single-Point Displacement (Shear Wave),
with Crack(s)

How does this Crack Detection Model Function?

This Crack Detection Model Functions as Follows:
Generate Acoustic Waves (Shear and/or Compressional)
Detect the Single-Point Displacement (Shear Wave), with Crack(s)
Fourier Analyze Displacement Function (FA2)

How does this Crack Detection Model Function?

Now:
Differentially Compare Fourier Analysis Results FA1 & FA2

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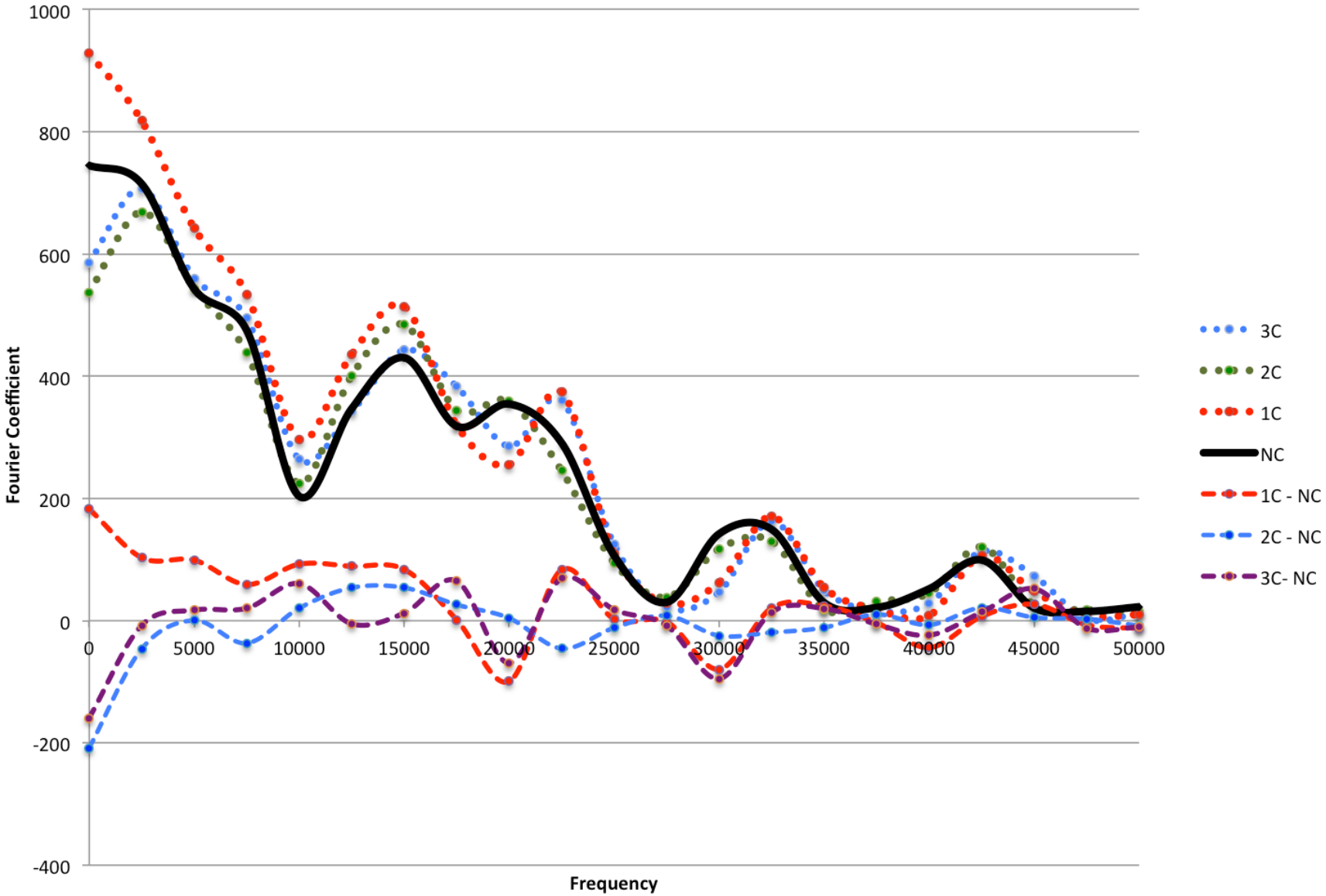
Now:

Differentially Compare Fourier Analysis Results FA1 & FA2

Do the same as above for multiple cracks FA3, FA4

Results

Results: Acoustic Wave Crack Detection: A First Principles Approach



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References

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2. D.N. Alleyne and P. Cawley, *The Interaction of Lamb Waves with Defects*, IEEE Trans. On Ultrasonics, Ferroelec. And Freq. Cont., **Vol. 39, #3,** pp.381 (1992)
3. COMSOL Multiphysics Model 12811.

The END

Thank You!