Finite Element Modeling of Pulsed Eddy Current Applied to Ferrous and Titanium Fasteners in F/A-18 Airplane Wing Structures

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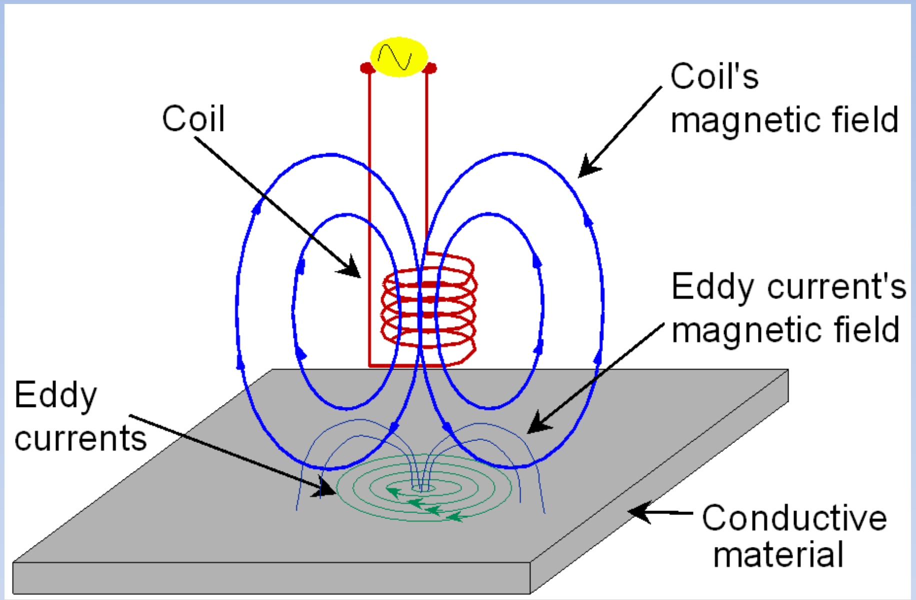
Outline

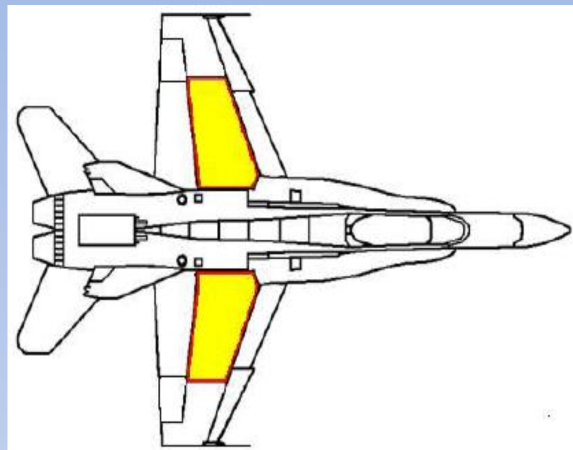
- Introduction
- Finite element modeling
- Results and Comparison with Experiment
- Summary

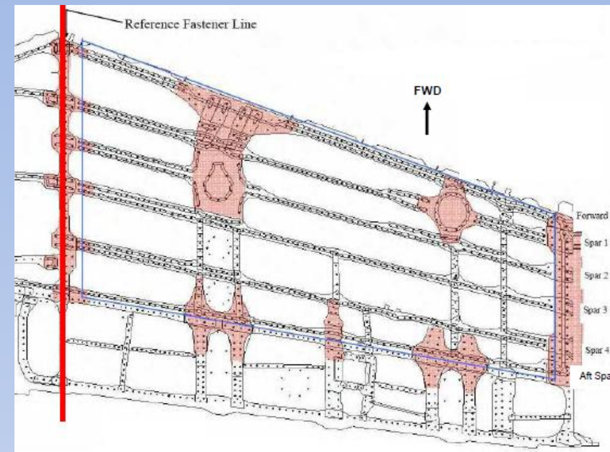
Pulsed Eddy Current/Eddy Current

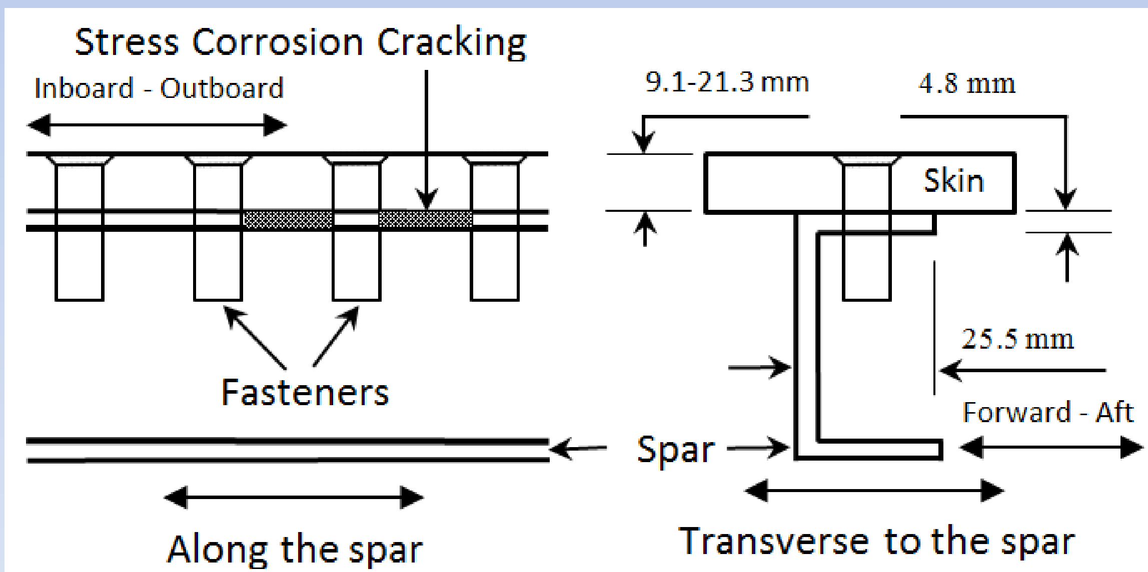


- PEC method has potential application of detection of defects in thick multilayered structures at greater depth than conventional eddy current techniques.

F/A-18 Hornet Inner Wing Spar

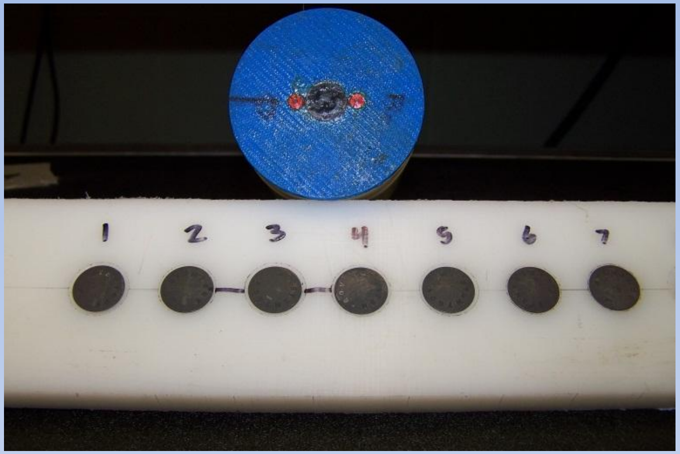


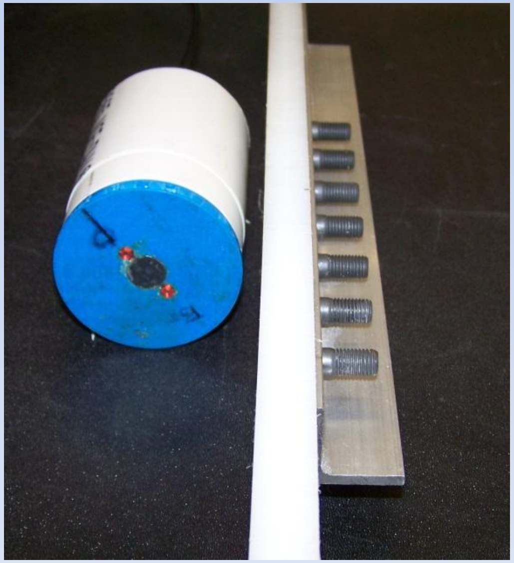


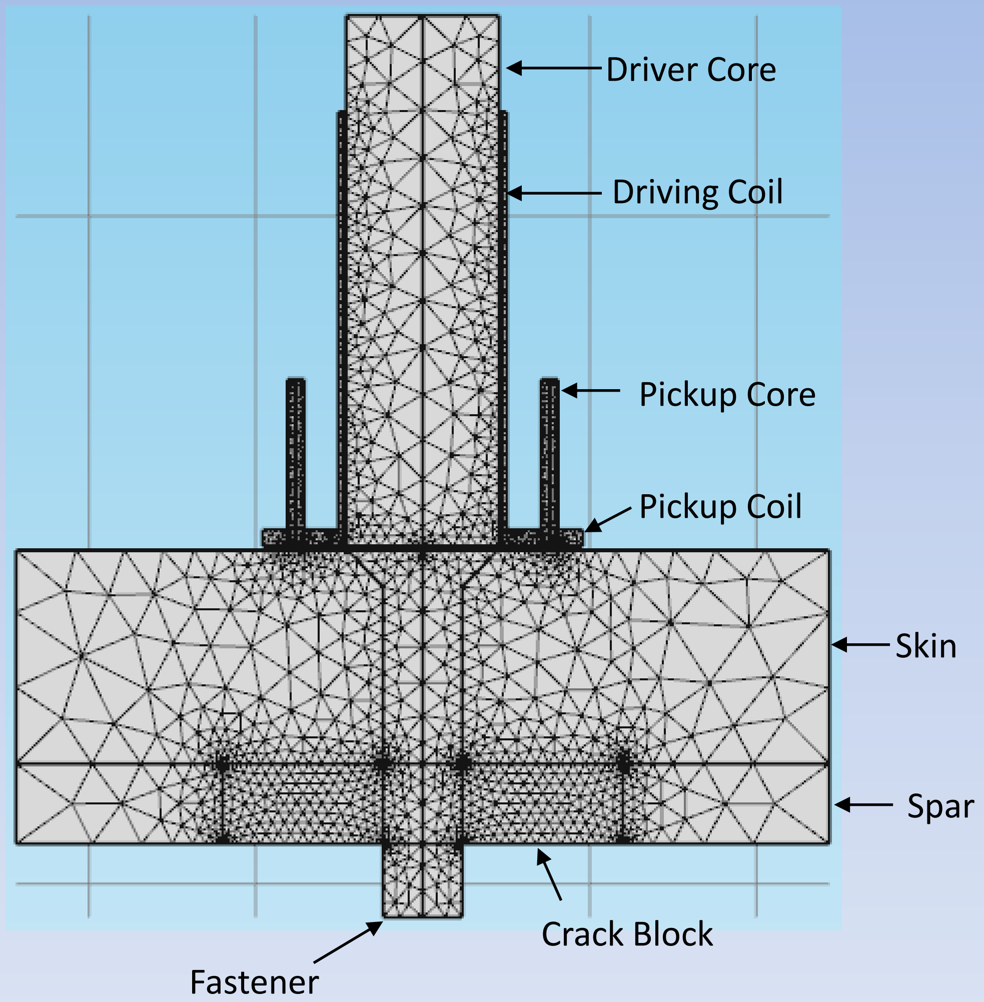


Stress corrosion cracks develop between fasteners. Locations of cracks at depth are not normally inspectable by conventional techniques (ET or UT) and require removal of both skin and fasteners.

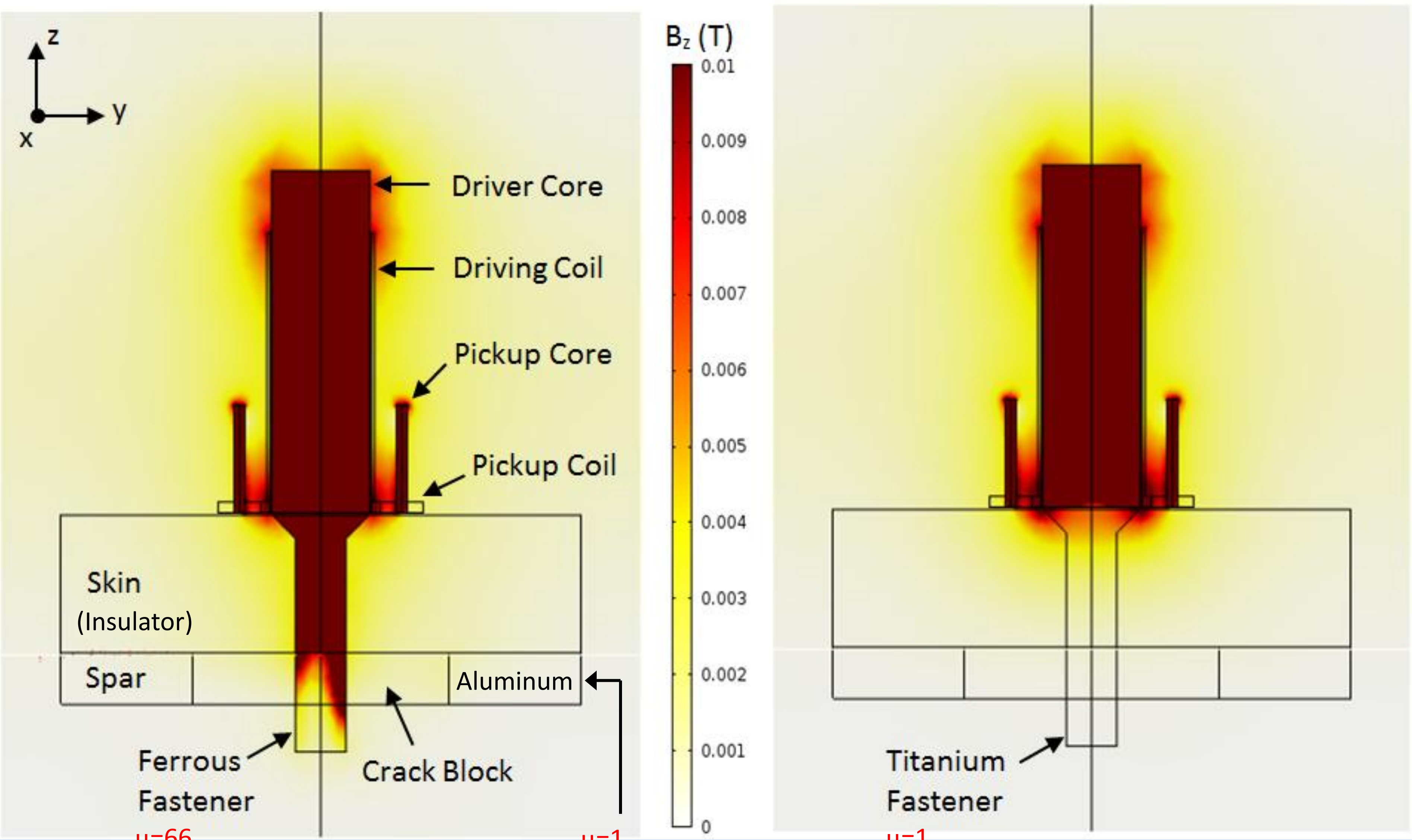
Sample, PEC Probe and FE Model







Flux Penetration: Ferrous vs. Titanium

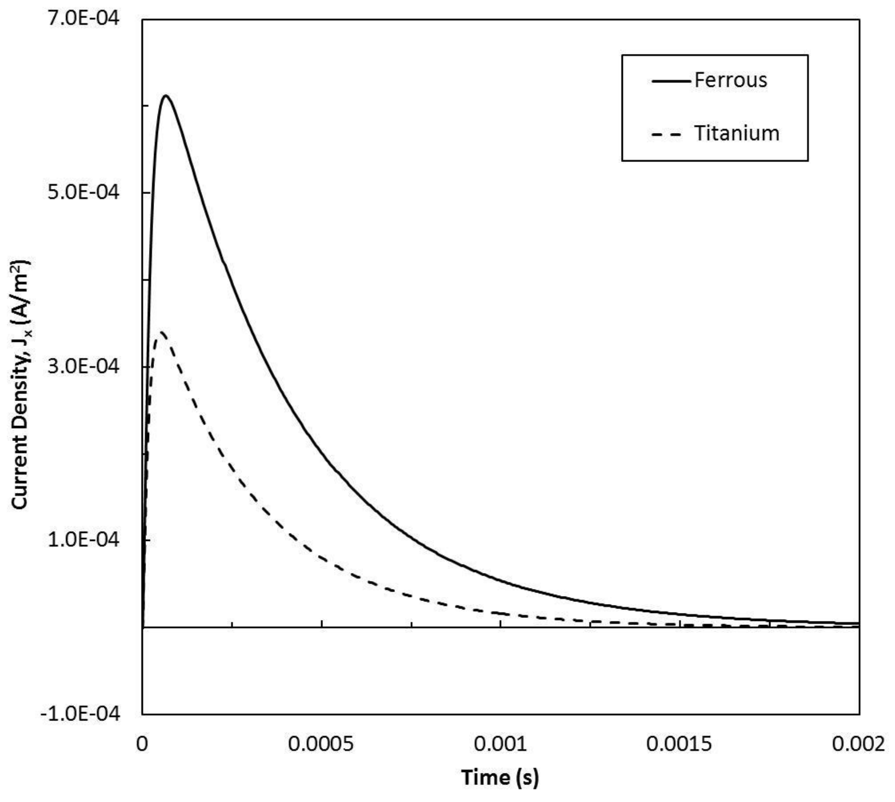


μ=66
σ=3.6×10^6 S/m

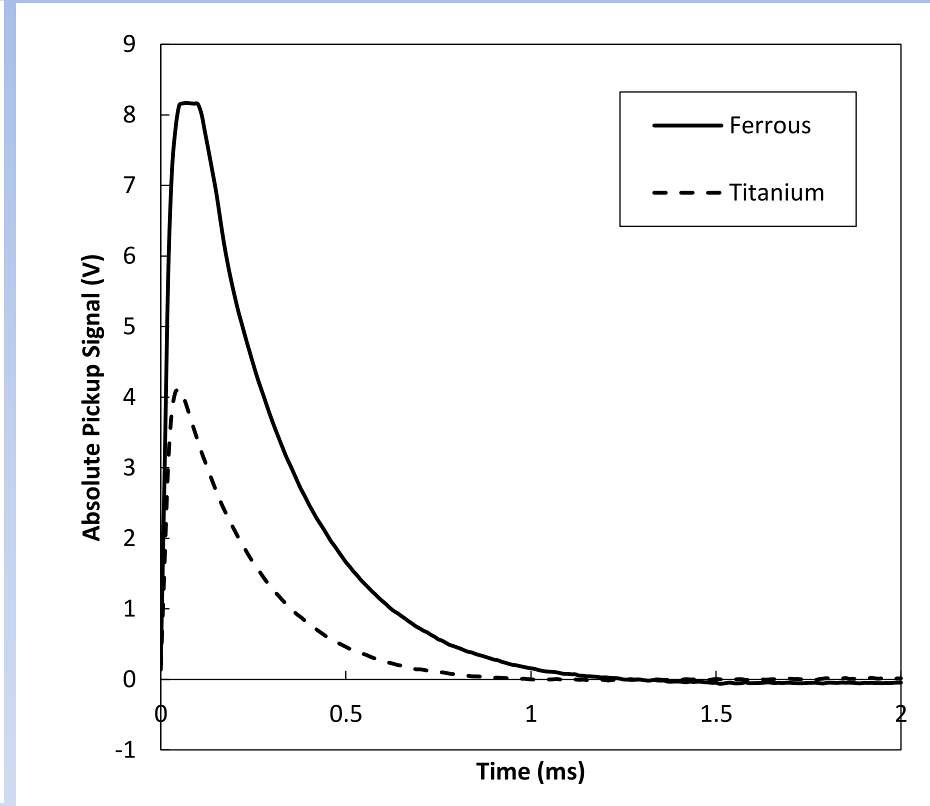
μ=1
σ=2.6×10^7 S/m

μ=1
σ=2.0×10^6 S/m

Pickup Absolute Signals: Ferrous vs. Titanium

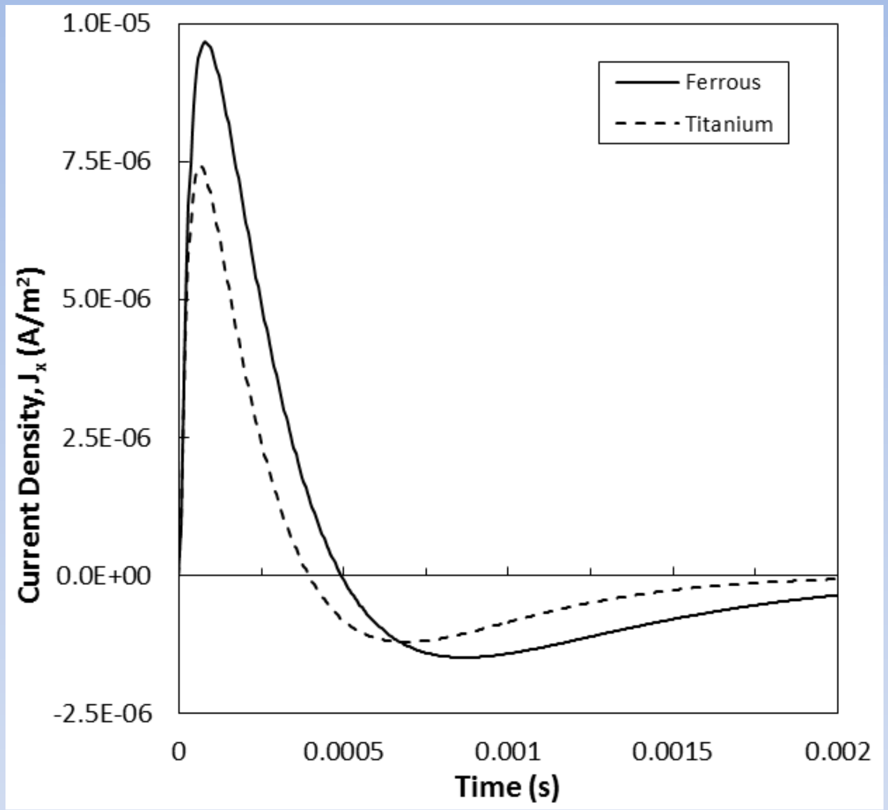


Model

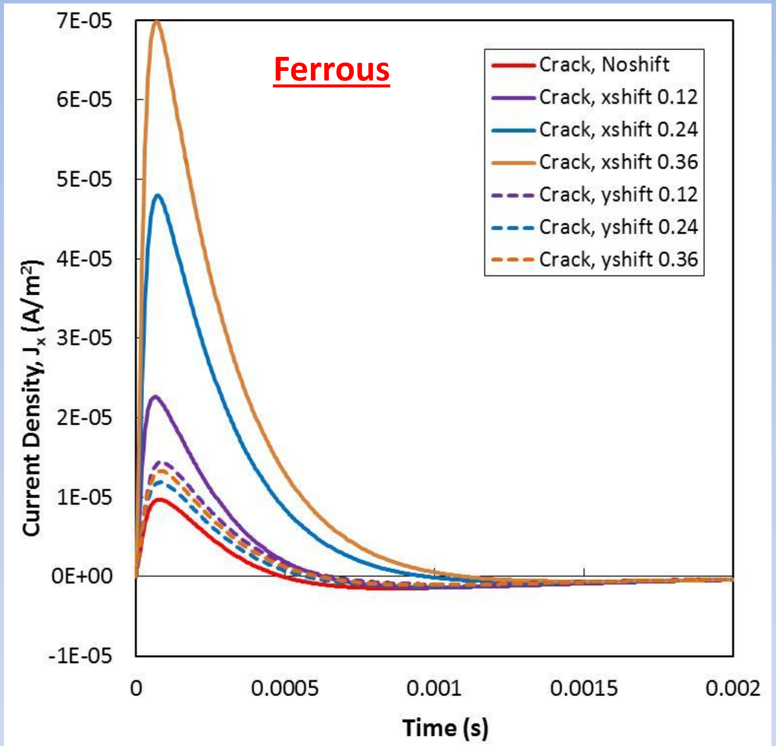


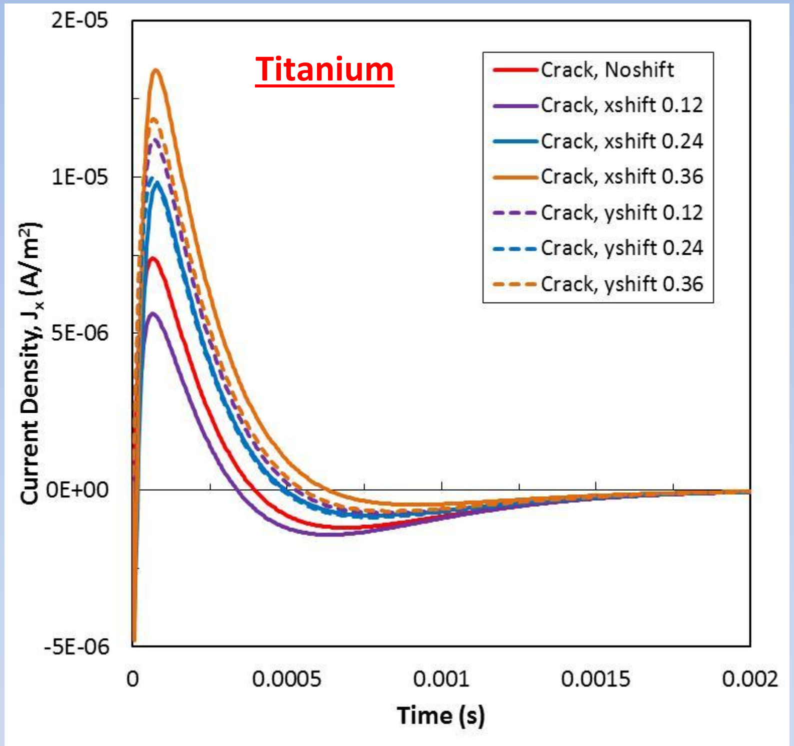
Experiment

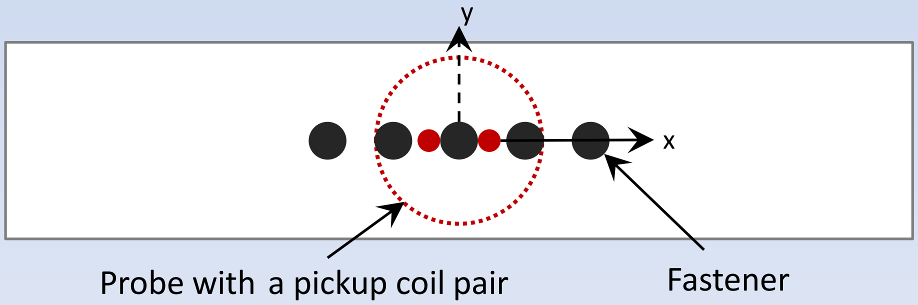
Modeled Pickup Differential Signals from a Defect



Differential Signals: Effect of Probe Shift







Summary

- FE Modeling of a PEC Probe along with a simulated F/A-18 Hornet sample provides useful information about flux penetration in ferrous and titanium fasteners and generation of output signal.
- The PEC signals are stronger and detection depths are larger for the case of ferrous fasteners as compared with titanium fasteners. A change in signal analysis will be required to accommodate these differences.
- The differential PEC signal is very sensitive to probe off-centering for ferrous fastener as compared to titanium, especially when the shift is parallel to the line joining the coil pair. However, the signals are not affected as much when the shift occurs perpendicular to this line.