NDE TDT Virtual Annual Meeting, 4 October 2021

Peter Spaeth

Nondestructive Evaluation Sciences Branch, NASA Langley Research Center

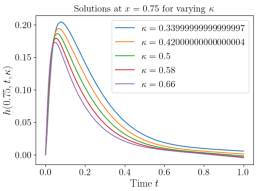
Brief introduction



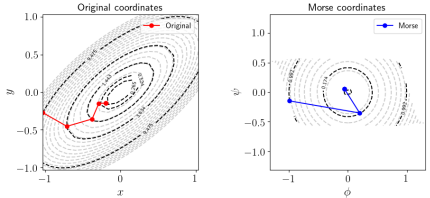
- Education
  - PhD, MA, Mathematics, UW–Madison
  - BS, Mathematics, Penn State
- Experience
  - Research Physicist, NASA LaRC (since Jan ‘21)
  - Senior Analyst, Daniel H. Wagner Associates
  - Applied Mathematician, GE Global Research
  - Assistant Professor, Penn State Altoona
  - Research Fellow, Korea Institute for Advance Study
- Research Areas
  - Applications of mathematics to physics-based modeling and data analysis
  - Hamiltonian systems theory

Research interests

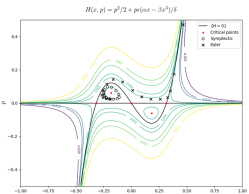
Physics-based modeling



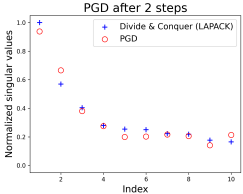
Machine Learning



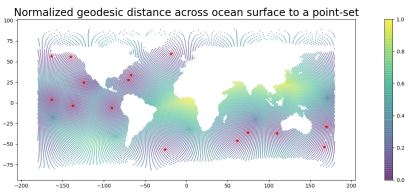
Hamiltonian systems



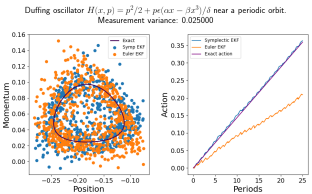
Numerical methods



Applications of mathematics



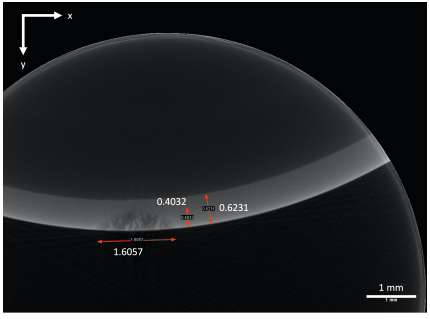
Bayesian estimation



Probability of Detection (POD) study of fatigue cracks in thin Inconel tubes

Thin Inconel tubes (approximately 100mm in length and 25mm in diameter) prepared as fatigue crack POD specimens for testing of radiographic inspection methods:

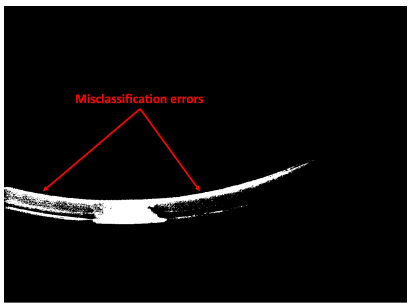
- Small circumferential PFIB notch created at midpoint
- (After machining) target wall thickness of 0.762mm and target crack-depth of 0.5334mm
- CT imaging applied to measure crack depth



Challenges involved

- Segmentation difficult due to artifacts in the images such as beam hardening and variation in intensity near the boundary of the region of interest
- Crack observed in roughly 10 out of 560 z-slices (corresponding to approximately 0.45mm)
- Slice-to-slice variation in texture/intensities

Example of poor segmentation



Status update

- PCA projection highlights damage regions in this POD study
- RANSAC improves estimate of the elliptical shape of the boundary
- Comparisons against destructive crack measurement data will help assess the quality of the model

