

Controlling Factors for Signal – EC (to be checked against INCITE list)

Correlation between signal and noise sources

Notches

- Wire
- HAZ
- Tool condition
- Processes to generate (feeds, speeds)
- Tool materials and dimensions
- Tool shape
- Notch shape

Cracks

- Opening
- Contacting asperities
- Roughness
- Surface condition (shot peening, smeared metal)
- Presence of fretting
- Morphology (shape, orientation, depth, length)
- Multiple cracks vs. single crack

Root causes

- Growth conditions
 - σ/ σ_y time history
 - Constant amplitude
 - Overloads
 - High or low cycle
 - Mode I, II, III or ?
- Initiation conditions
 - Stress corrosion vs. fatigue vs. corrosion fatigue, etc.
 - Intergranular vs transgranular

- Scratches, dings
- Fretting
- Surface vs. subsurface initiation
- Material issues
 - Toughness
 - Grain size
 - Grain boundary condition
 - Mechanism of contact (sliding, oxide debris, plastic deformation)
 - Contacts conducting
 - Roughness

Controlling Factors for Noise - EC

- Scratches, dents, dings
- Roughness
- Surface geometry features (edges, corners, etc.)
- Out of roundness
- Corrosion, pitting
- Dirt
- Liftoff variations
- Microstructure
- Thermal drift
- Fastener/part interface and material
-

System/operator issues: consider relevance to model inputs some of which will be modeled and some of which will be characterized empirically

- Probes, instrumentation, cables, etc.
- Scan plan (speed)
- Quality control of inspection system
- Human factors

Challenge: Variables for Fastener Sites (Aldrin, et.al)

A. NDE technique (measurement system):

1. NDE method
2. Transducer/probe design
3. Contact condition with part (direct, immersion)
4. Scan plan (directions, resolution, orientation)

B. Part geometry, material and condition:

1. Layer material, number, and thickness (shims)
2. Outer layer surface condition (paint, corrosion)
3. Fastener material / type / head condition
4. Hole geometry (oblong, off-angled, surface conditions, scratches, chatter, tool marks)
5. Fastener hole fit (asymmetric fit, irregular contact conditions / loading, sealant)
6. Gaps / sealant between layers (aging)
7. Presence of metal shavings
8. Bushings, residual stress around holes
9. Proximity of adjacent fasteners and edges
10. Presence and condition of repairs

C. Flaw characteristics:

1. Flaw number (number of cracks per site)
2. Flaw type (cracks, EDM notch)
3. Flaw location (layer, location in layer: surface, mid-bore, eye-brow cracks)
4. Flaw orientation (around fastener site, skew angle from normal)
5. Flaw dimensions (length, aspect ratio)
6. Material within flaw (sealant/paint/fluids)
7. Flaw morphology (regular, irregular)
8. Flaw conditions at crack faces
(contact conditions, residual stress)

Controlling Factors for Signal – UT (surface breaking cracks)

Correlation between signal and noise sources

Notches

- Wire
- HAZ
- Tool condition
- Processes to generate (feeds, speeds)
- Tool materials and dimensions
- Tool shape
- Notch shape

Cracks

- Opening
- Contacting asperities
- Roughness
- Surface condition (shot peening, smeared metal)
- Presence of fretting
- Morphology (shape, orientation, depth, length, branching)
- Multiple cracks vs. single crack

Root causes

- Growth conditions
 - σ/σ_y time history
 - Constant amplitude
 - Overloads
 - High or low cycle
 - Mode I, II, III or ?
- Initiation conditions
 - Stress corrosion vs. fatigue vs. corrosion fatigue, etc.
 - Intergranular vs transgranular

- Scratches, dings
- Fretting
- Surface vs. subsurface initiation
- Multiple indications in the area of interest
- Material issues
 - Toughness
 - Grain size
 - Grain boundary condition
 - Mechanism of contact (sliding, oxide debris, plastic deformation)
 - Contacts conducting
 - Roughness

Controlling Factors for Noise – UT

- Scratches, dents, dings
- Roughness
- Surface geometry features (edges, corners, etc.)
- Out of roundness
- Corrosion, pitting
- Dirt
- Micro/macro structure (anisotropy, attenuation,
- Sealant variation, bladders, foam,
- Surface protectants (paint, coatings, etc)
- Couplant variation
- Interface contaminants
- Thermal drift
- Fastener/part interface and material

System/operator issues: consider relevance to model inputs some of which will be modeled and some of which will be characterized empirically

- Probes, instrumentation, cables, etc.

- Scan plan (speed)
- Quality control of inspection system
- Human factors