Applications of advanced fracture mechanics utilizing StressCheck and AFGROW

Joshua Hodges
T-38 Structural Integrity and Analysis Group
What happens when you intertwine AFGROW ‘s Plug-in capabilities with StressCheck?

BAMF

Broad Application for Modeling Failure
What does BAMF do for you?

\[ \alpha = \frac{K}{\sigma} \]

Far field stress from StressCheck

Extract Stress Intensities

Mesh Model

Import Model

Solve Model
$\Delta K = \alpha \Delta \sigma$

Where $\Delta \sigma$ is the AFGROW spectrum stress
Flavors of BAMF

- **Multi-Elliptical Crack** (allows anywhere from 1-10 elliptical cracks in a single body)

- **Multi-Point Crack Growth** (utilizes StressCheck splines to create unique crack fronts)
Features of BAMF

Benefits of BAMF
• Removes conservatisms
  • Continuing damage models
  • Multi-site damage
  • Flat plate assumptions
• Reduced engineering judgment
• Reduced engineering time
• Reduced risk

Elliptical crack shape
Features of BAMF

Benefits of Mulit-point BAMF
- Reduction of stress intensities at the bore (compared to elliptical crack assumption)
- More realistic crack shapes (compared to elliptical crack assumption)
- Increased load carrying capability (compared to elliptical crack assumption)
- P-shape and other unique crack shapes
BAMF’n Cracks

BAMF’n Cracks in Countersinks

BAMF’n Cracks in Countersinks
BAMF’n 2 Cracks
BAMF’n Multi-Crack
Points may need to be created that lay outside the body. This will ensure that the crack can grow in complex geometries.

Each stress intensity is calculated from a 3 point average of points on the extracted stress intensity curve.

The stress intensity at an end point is calculated from 2 points inboard of the extracted stress intensities.

Initially the 1st point will grow only in the y-direction until that point is no longer on the face of the part.

The cracks will grow a value of $da$, perpendicular to the line created by its adjacent points.

If a point is outside the body it will grow based on the stress intensity just beneath its closest surface.
BAMF’n Multi-Point

• Once the 1st point leaves the surface it will then grow perpendicular to the line created between itself and its adjacent point.
• Large crack growth increments will harm crack growth shape.
• The larger the crack grows the less accurate its predicted shape becomes.
BAMF’n Multi-Point

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Discussion of things to be worked on

- **AFGROW ISSUES**
  - Dealing with small crack lengths <0.05 in
    - AFGROW call to “Calculate Beta” subroutine
  - Growing Rate of Multiple Points/Multiple Cracks

- **BAMF ISSUES**
  - Through thickness failure
  - Failure/Fracture criteria (No current failure criteria)

- **STRESSCHECK ISSUES**
  - Mesh refinement tools (local curve refinement)
  - Multiple points going out of the surface
  - Knowing the surface geometry
Questions/Comments/Concerns

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