

StressCheck and AFGROW Interoperability

Brent Lancaster
Application Engineer
ESRD, Inc.
09/02/2010



Overview



STRESSCHECK[®]

- ❑ What is StressCheck?
- ❑ StressCheck and Fracture Mechanics
- ❑ StressCheck API and COM
 - What is a COM API?
- ❑ StressCheck and AFGROW
 - StressCheck->COM->AFGROW
- ❑ Data Flow for Typical StressCheck/AFGROW Plug-Ins
- ❑ Cases
 - 3-Pt Bend Specimen
 - Lug w/ Pin Loading

What is StressCheck?



STRESSCHECK

- StressCheck is an advanced FEA software tool developed by ESRD, Inc. of St. Louis, MO
 - Current Version: 9.1
 - Primary Customers: Major Aircraft OEMs and Defense/Armed Forces
- StressCheck is based on the “p-version”
 - DOF increased by increasing polynomial order of elements instead of adding midside nodes or refining the mesh
 - Hierarchic nature of solutions allows for V&V and quality assurance
 - Verification: Solving the equations right (convergence)
 - Validation: Solving the right equations (experimental observations)
- Primary applications of StressCheck:
 - High-fidelity stress analysis
 - Detailed fracture mechanics extractions/crack analysis
 - Multi-body contact analysis
 - Plasticity analysis
 - Composite material analysis
 - Combinations of the above

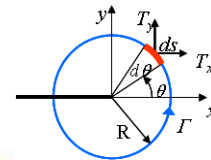
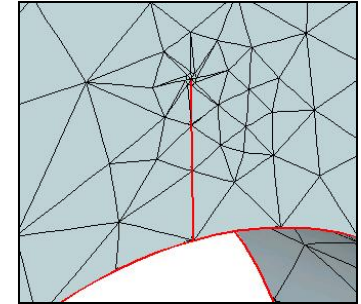
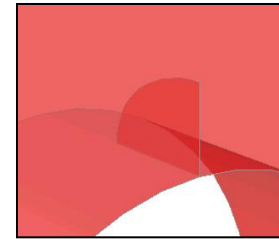
StressCheck and Fracture Mechanics



STRESSCHECK

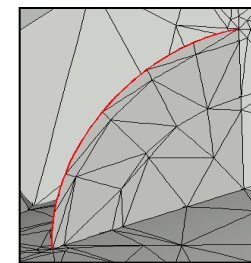
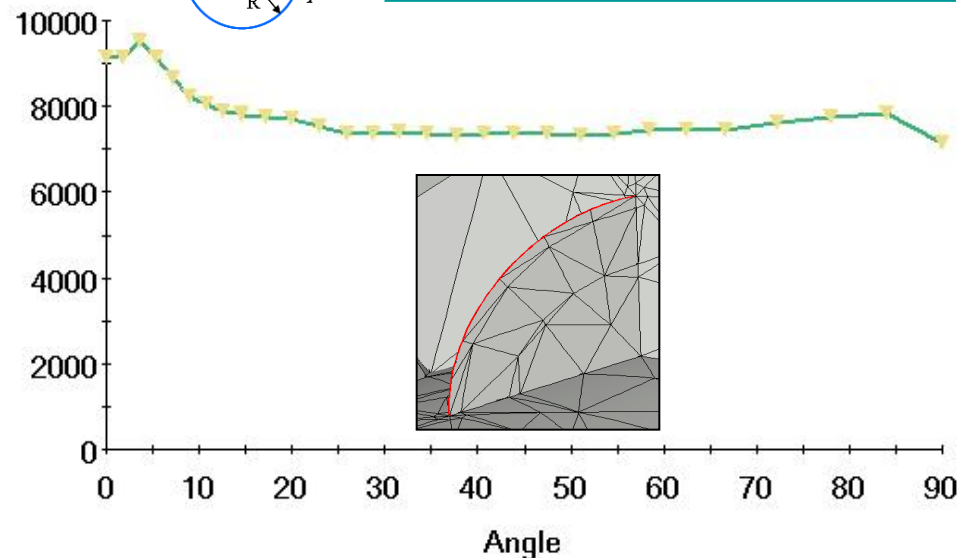
- StressCheck contains many advanced features which aid the DTA analyst in fracture mechanics studies, including:

- 3D Crack Insertion and Advanced Automeshing
- Extraction of robust Stress Intensity Factors and Separated Energy Release Rates (SERR)
- 2D Crack Path Analysis



$$K_1 \approx \sqrt{2\pi} \oint_{\Gamma} (\bar{W}_1 \bar{T}_{FE} - \bar{u}_{FE} \bar{T}^{W_1}) R d\theta$$

K1 Run #3



What is a COM API?



STRESSCHECK™

- Component Object Model (COM)
 - Formal Definition (Wiki)
 - A binary-interface standard for software componentry introduced by Microsoft in 1993.
 - It is used **to enable interprocess communication and dynamic object creation** in a large range of programming languages.
 - It is a platform for the realization of Object-Oriented Development and Deployment.
- Application Programming Interface (API)
 - Formal Definition (Wiki)
 - An interface in computer science that defines the ways by which an application program may request services from libraries and/or operating systems.
 - An API determines the vocabulary and calling conventions the programmer should employ to use the services
 - It may include specifications for routines, data structures, object classes and protocols used **to communicate between the requesting software and the library**

StressCheck and COM



STRESSCHECK

- ❑ The StressCheck COM API allows users access to all of the objects, methods and properties found within the StressCheck GUI
 - You may build, solve and extract information as you would interactively
- ❑ The major benefit is that the COM API allows for external applications to communicate with StressCheck, and vice versa
 - Visual Basic/Visual Studio
 - Excel
 - MATLAB
 - Python
 - **AFGROW**
 - Any other COM-enabled utility/language
- ❑ This means automation and scripting is possible!

StressCheck and AFGROW



STRESSCHECK

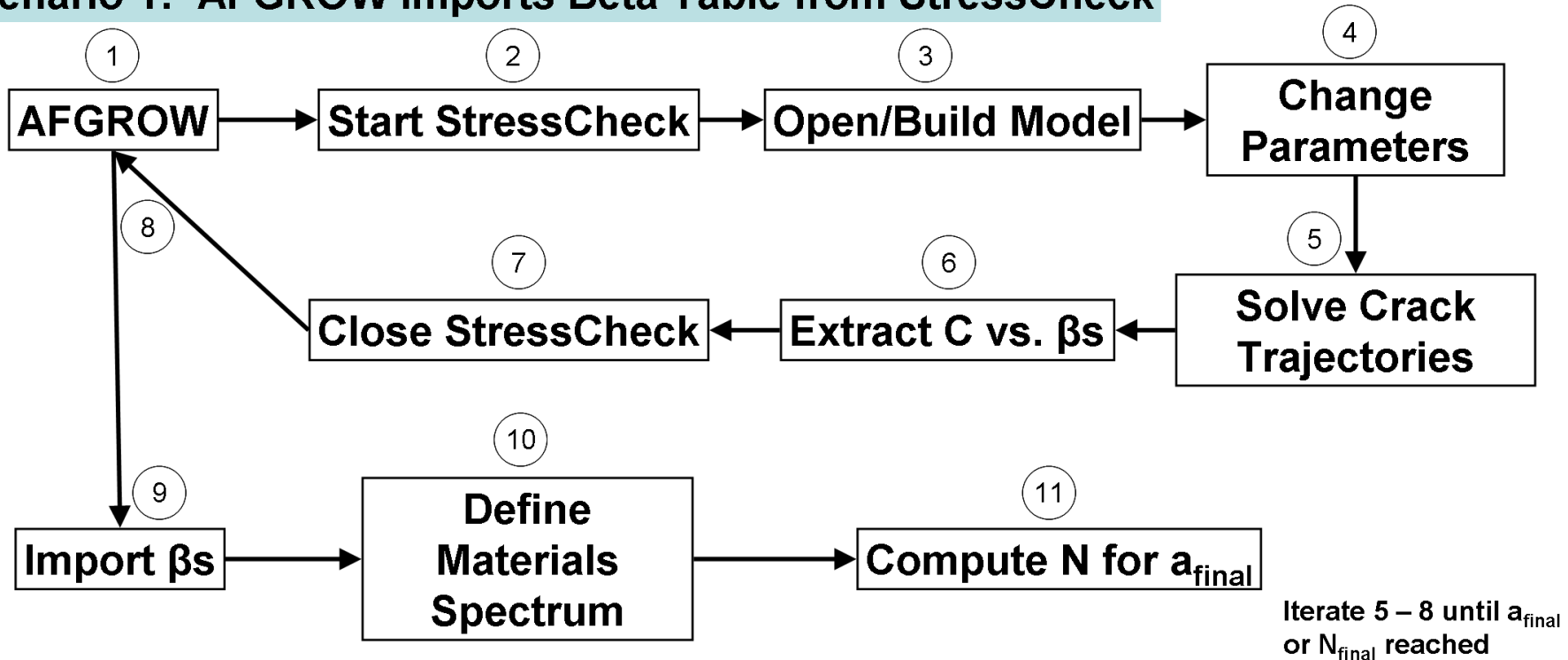
- Since StressCheck and AFGROW are COM-enabled, “plug-in” modules can be written to perform advanced/custom computations in the event that existing solutions are unavailable or inappropriate for the analysis
 - StressCheck/AFGROW Plug-ins allow StressCheck FEA K-solutions to be computed and passed directly to AFGROW for life prediction
- Plug-in development typically requires Microsoft Visual Studio 2008 (or equivalent) and .NET Framework, in addition to AFGROW and StressCheck
 - VB.NET or C# recommended
 - Plug-ins are configured to appear in AFGROW under “Plug-In Models” by modifying afgrow.exe.config file
 - Plug-in is typically installed with simple setup kit
- Consult with LexTech, Inc. for additional details

Data Flow for a Typical StressCheck/AFGROW Plug-In



STRESSCHECK

Scenario 1: AFGROW Imports Beta Table from StressCheck

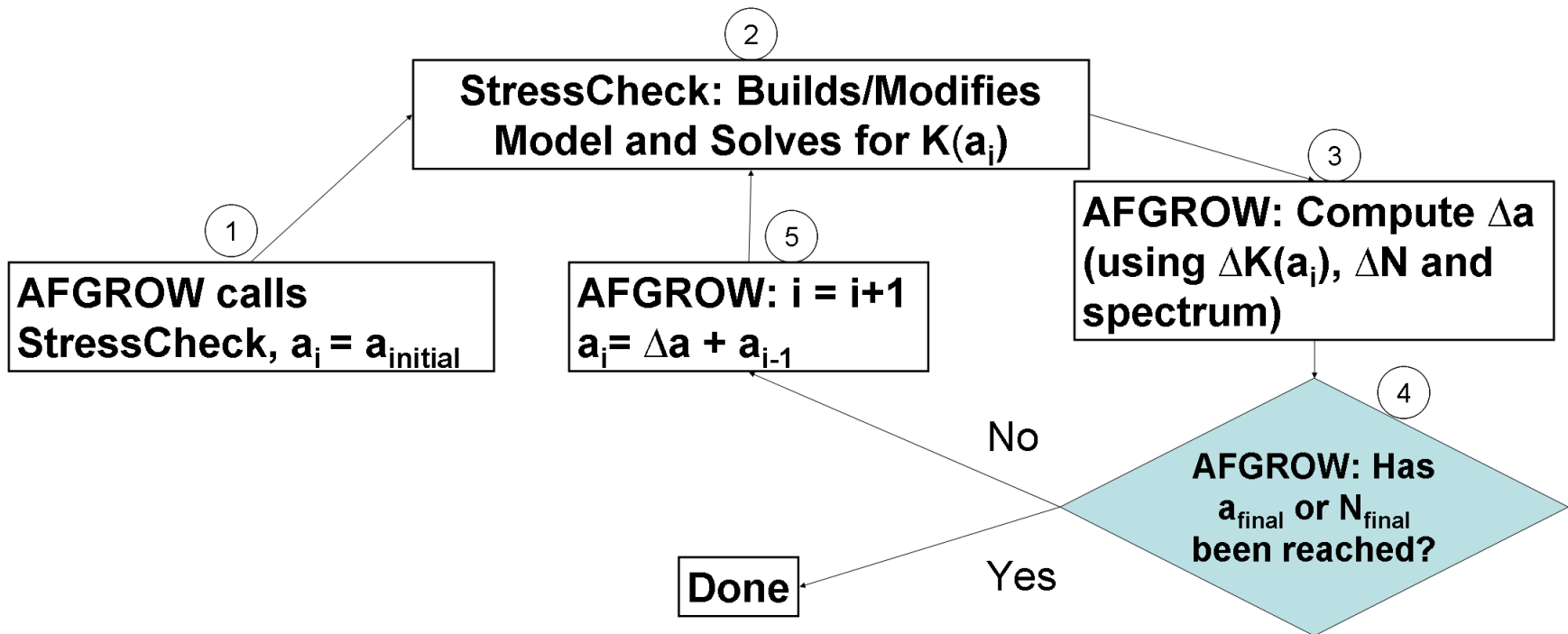


Data Flow for a Typical StressCheck/AFGROW Plug-In



STRESSCHECK[®]

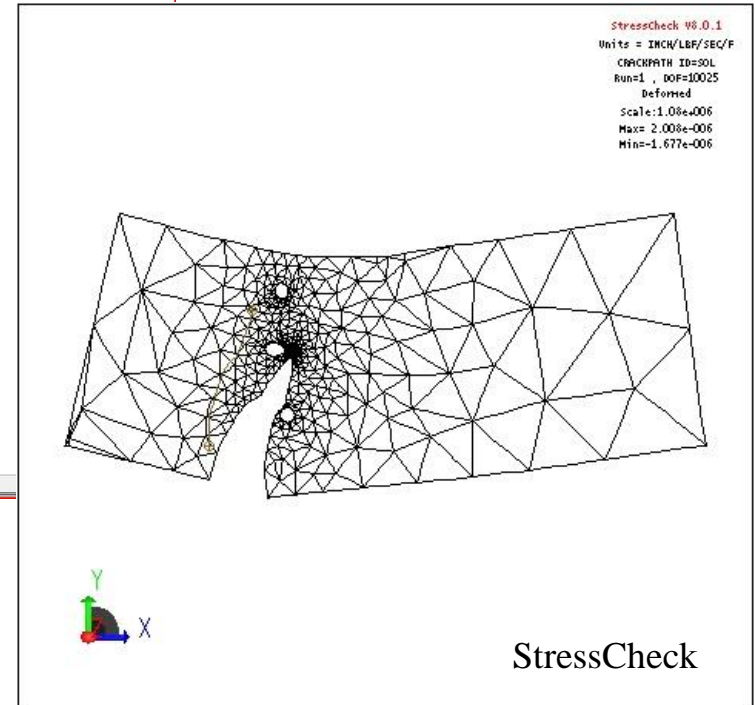
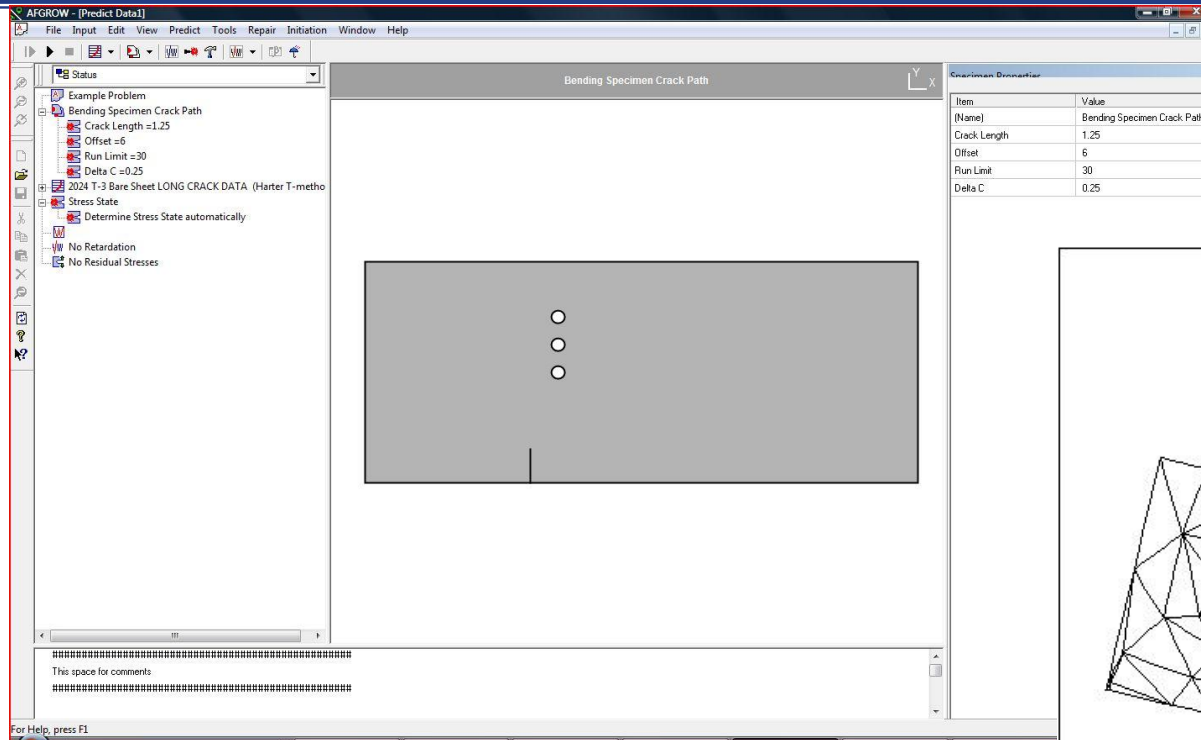
Scenario 2: AFGROW Increments Crack Interacting with StressCheck



Case 1 – 3 Pt Bend Specimen



STRESSCHECK



AFGROW/StressCheck Interaction to Predict Crack Growth Life for a Non-Linear Crack Path

Scenario 1

Developed by LexTech and ESRD (2009)

Case 2 – Lug w/ Pin Loading



STRESSCHECK

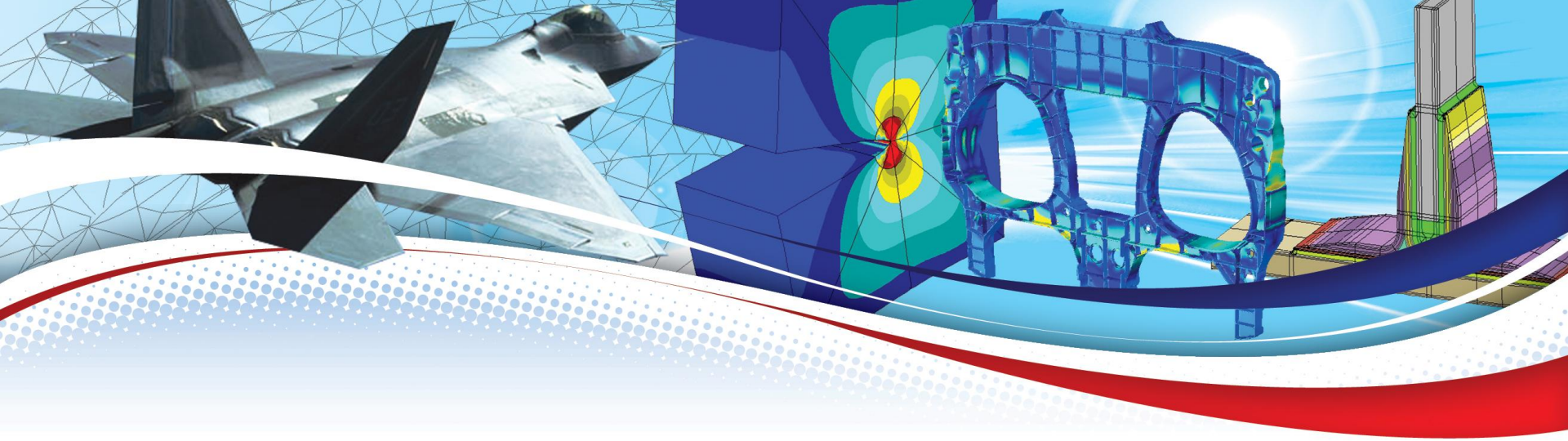
AFGROW - [C:\Program Files (x86)\AFGROW\StressCheck\CrackedLug\StressCheckDemo\test_cracked_lug.dax]

File Input Edit View Predict Tools Repair Initiation Window Help

Pinned Lug with Automatic Crack Initiation

Item	Value
(Name)	Pinned Lug with Au...
Section Width	6
Section Height	12
Fillet Radius	2
Lug Outer Radius	4
Lug Inner Radius	1.5
Part Thickness	2
Initial Crack Length	0.05
Pin Load Magnitude	1000
Pin Load Angle	10
Pin Interference/Cle...	0

Scenario 2



Questions?

Thanks for having us!

