

## AFGROW Workshop 2016

# Recent Developments in AFGROW COM and Plug-In Applications

Alex Litvinov  
LexTech, Inc .

# AFGROW Plugins

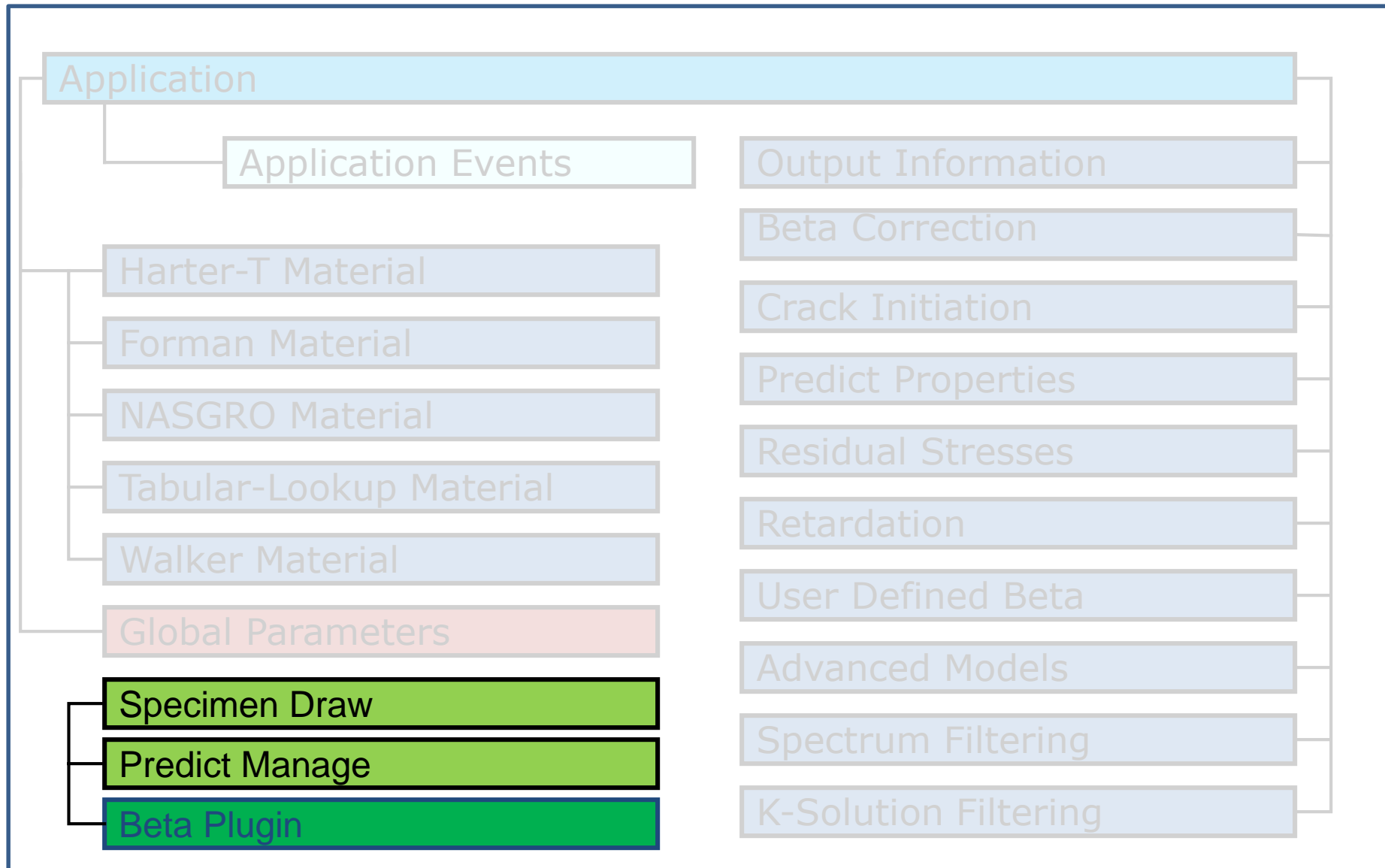
- AFGROW Plug-in capability allows Users to Create/Animate their own structural models for use in AFGROW. It provides the capability for users to develop K-solutions that will manage crack size, solution limits and the general configuration of the solution (K-solution parameters, error checking, prediction process, and screen drawing functionality).
- AFGROW Plug-In technology allows the creation of Proprietary, Closed-Form, Tabular / Interpolative / Extrapolative, and External-K (if available) User-Defined custom solutions.

# Managing the AFGROW plugin Lifecycle

The purpose of this presentation is to demonstrate the usage of plugin functions through the different stages of it's lifecycle:

- Plugin initiation
- User interaction with the plugin
- Setting up life prediction parameters
- Interaction with AFGROW during life prediction

# Plugin Portion of the AFGROW Interface



# Beta Plugin Interface

- Responsible for providing properties, methods and events that AFGROW needs to implement and manage data input, validation, and life prediction for stress intensity factor solution models. The Beta Plugin Interface needs to be implemented by user.
- Examples are: Model name, model picture, geometry parameters, parameter validation.

# Beta Plugin Interface Events

- Provided through the PredictEvent function:
  - AfgrowEventOutput - provide output information,
  - AfgrowEventCrackFailure - failure,
  - AfgrowEventCrackTransition - transition,
  - AfgrowEventError – not used,
  - AfgrowEventPredictStarted - predict started,
  - AfgrowEventPredictFinished - predict finished,
  - AfgrowEventCalculateBeta - need to calculate beta,
  - AfgrowEventStatusBar – not used,
  - AfgrowEventRefreshModel - set default parameters,
  - AfgrowEventDeltaLengthReady – delta length is calculated,
  - AfgrowEventBeforePredict - before prediction

# Example Beta Plugin Interface

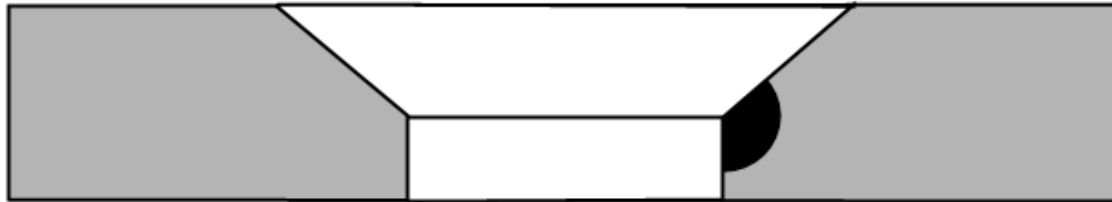
The screenshot displays the AFGROW software interface. The main window is titled 'Crack Length vs Life' and contains two empty coordinate systems for plotting crack length against cycles. The top graph is labeled 'A, A11' and the bottom graph is labeled 'C, C11'. Both graphs have a y-axis ranging from 0 to 0.05 and an x-axis ranging from 0 to 20. To the right of the graphs is a diagram of a specimen with a counter-sunk hole, titled 'Crack in Counter Sunk Hole'. Further right is a 'Properties' panel with a 'Parameters' section containing several checked items:

- Crack in Counter Sunk Hole
- 1.000000
- 0.175000
- 0.100000
- 0.283000
- 0.005000
- 0.005000
- C:\Program Files (x86)\LexTech\Afgrow\_Beta

At the bottom of the interface is an 'Output' window with a 'Notification List' tab. The output area contains a placeholder for comments, indicated by a block of asterisks.

# Specimen Drawing Interface

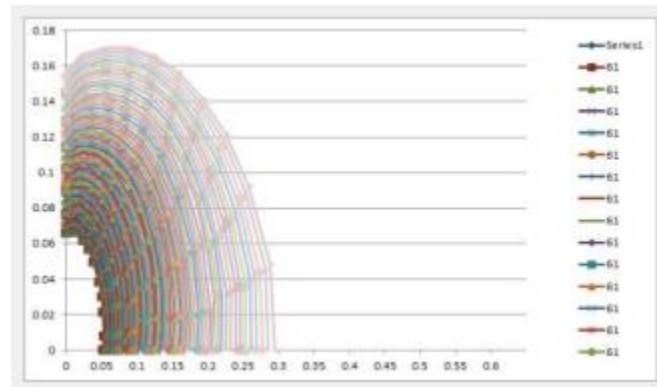
- It is used to draw a picture of the model as a visual aid for the user





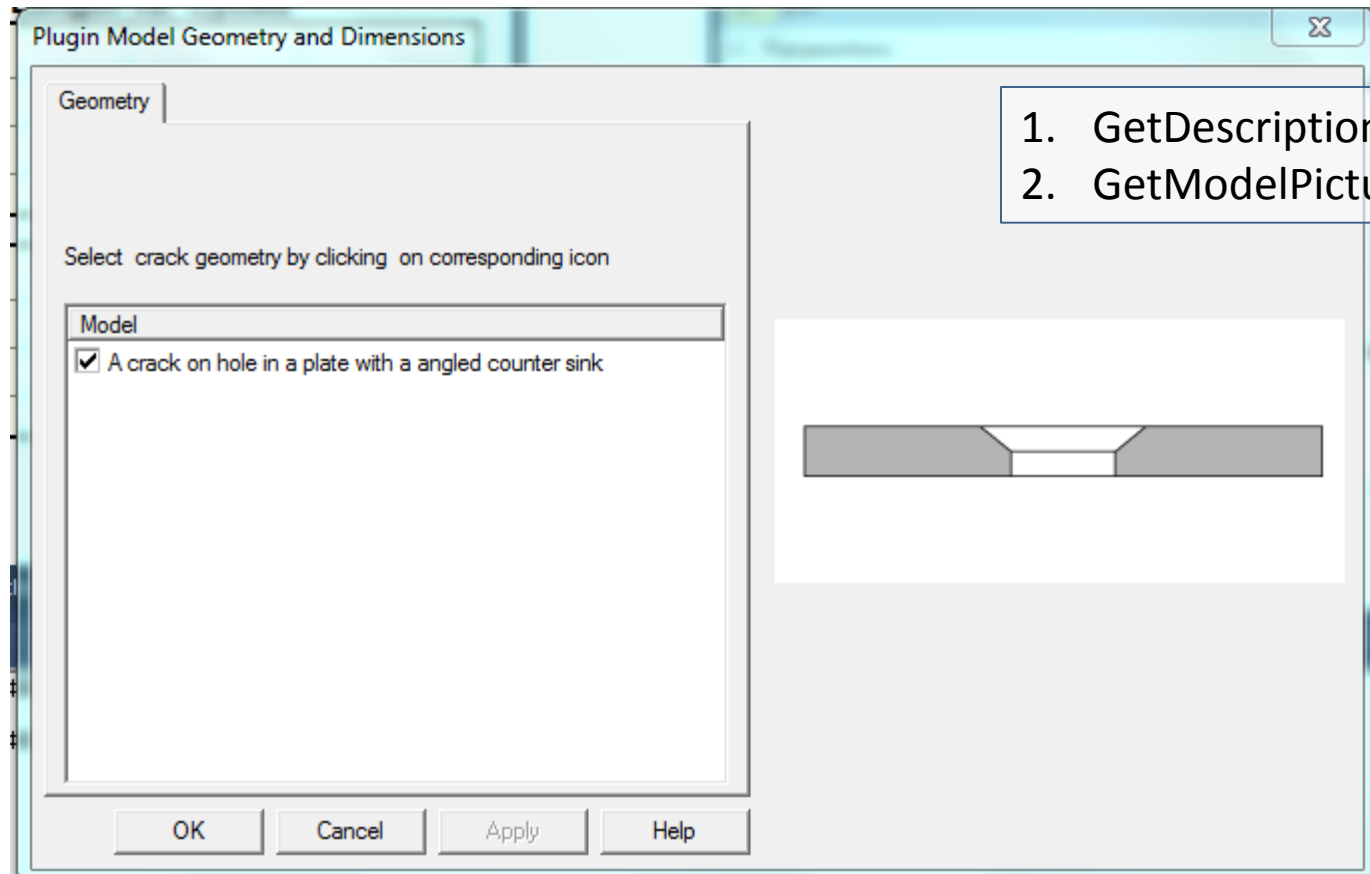
# Predict Manage Interface

- Used to setup/read/modify number of cracks, crack directions, and crack direction parameters in AFGROW. AFGROW supports an unlimited number of cracks and crack directions for plugin models.

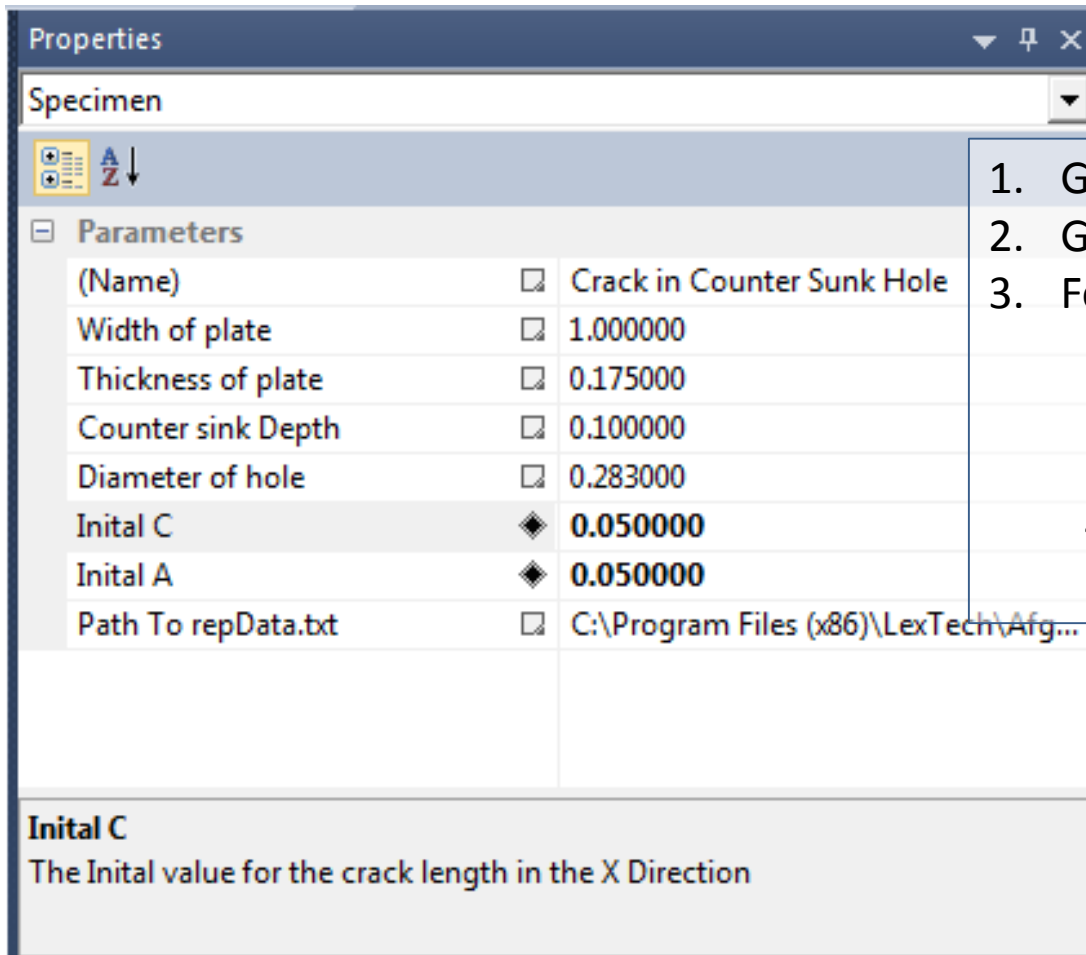


Picture from “BAMF with Residual Stresses” presentation by Joshua Hodges, T-38 Structural Integrity and Analysis Group at AFGROW Workshop 2014

# Plugin Initiation – Select Plugin



# Plugin Initiation – Preprocessing Properties



The screenshot shows a 'Properties' window for a 'Specimen'. The window contains a table of parameters and their values. The parameters are listed in the following order:

(Name)		
Crack in Counter Sunk Hole	<input type="checkbox"/>	
Width of plate	<input type="checkbox"/>	1.000000
Thickness of plate	<input type="checkbox"/>	0.175000
Counter sink Depth	<input type="checkbox"/>	0.100000
Diameter of hole	<input type="checkbox"/>	0.283000
Initial C	◆	0.050000
Initial A	◆	0.050000
Path To repData.txt	<input type="checkbox"/>	C:\Program Files (x86)\LexTech\Afg...

Below the table, the 'Initial C' property is highlighted, with a description: 'The Initial value for the crack length in the X Direction'.

1. GetName
2. GetParameterList
3. For each parameter:
  1. GetParameterName
  2. GetParameterType
  3. GetParameterDescription
  4. Get...ParameterValue (double, enum, string, file)

# User Interaction with the Plugin (updating plugin model properties)

1. GetParameterType
2. Set...ParameterValue (double, enum, string, file)
3. In case if error returned from plugin:  
Get...ParameterValue (double, enum, string, file)

# Setting Up Life Prediction Parameters

1. PrePredictTest – Final data validation test
2. AfgrowEventBeforePredict – Used to extract non-model related data from AFGROW
3. AfgrowEventPredictStarted – Setup cracks, crack directions, and crack direction parameters such as: length, length limit, equivalent thickness

# Interaction with AFGROW During Life Prediction

- After all crack length increment calculations: AfgrowEventDeltaLengthReady (opportunity to modify direction increment before it is used by AFGROW)
- When K-values are required (managed by Vroman increment): AfgrowEventCalculateBeta
- At each output increment: AfgrowEventOutput
- At each transition from part through to through crack: AfgrowEventCrackTransition
- At Failure: AfgrowEventCrackFailure
- When the analysis is finished: AfgrowEventPredictFinished

# Questions?

# Requested additions to AFGROW plugin model

- Add a plug-in model variable that can return the cycle count
- Access plugin models through COM
- Add ability to have plugin defined fracture criteria (declare fracture from plugin)
- Add function that checks if a crack direction exists



# AFGROW COM API

COM Automation is one of the most popular and frequently used features of AFGROW. Automation is an industry-standard technology that applications use to expose their objects to development tools and macro languages. The COM abilities of AFGROW allow users to save time and money by automating manual tasks, incorporating AFGROW services into proprietary software, and enable the reuse of code that has been pre-built and tested.

# Requested additions to AFGROW COM API

- Add/Fix the ability to manage multiple instances of AFGROW using the COM API
- Add a block size variable for constant amplitude loading (COM)