



FINITE ELEMENT ANALYSIS  
**Predictive Engineering**

## Automation and API Programming with Femap and NX Nastran

An introduction to the Femap Application Programming Interface using a blend of theory and practice that allows students to automate modeling processes, modify the model, import/export data and more.

## Course Outline:

### I. Introduction to the Femap API and Object Oriented Programming

- a.) What is an API?
- b.) What is Object Orientated Programming?
- c.) Femap API Objects
- d.) Entity Types
- e.) Data Types
- f.) Dimension Variables
- g.) Object Syntax

### II. Workshops

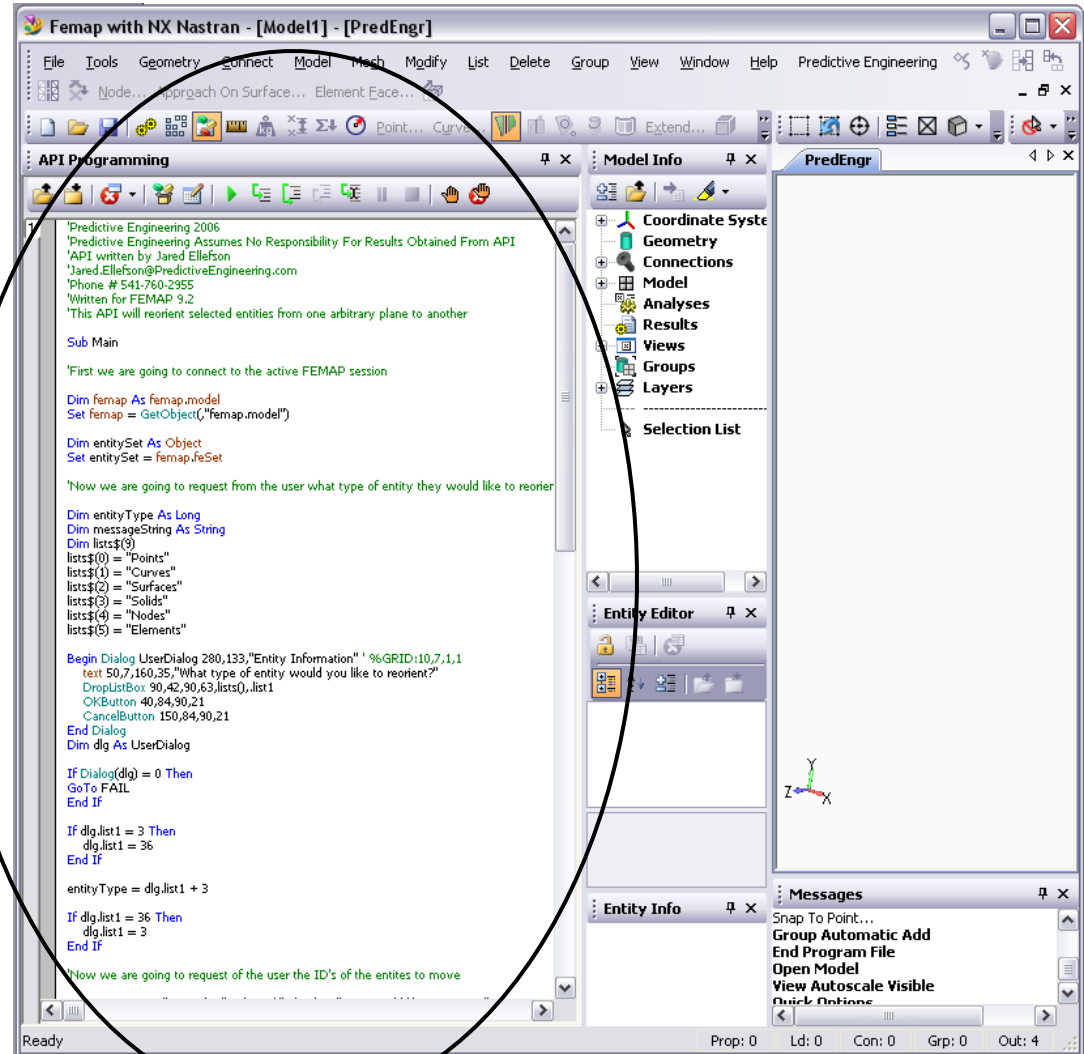
- a.) Workshop 1: Recording a Femap Macro (.pro, .prg)
- b.) Workshop 2: "Hello World" - Your First Femap API
- c.) Workshop 3: Femap Custom Tools
- d.) Workshop 4: Creating Entities within the Femap Database (Femap Help File Example)
- e.) Workshop 5: Extracting Data from the Femap Database
- f.) Workshop 6: Applying Loads from Excel using the Femap API
- g.) Workshop 7: Modifying the Model with the API and Event Callback

## What is an API?

- The FEMAP API is an OLC/COM based programming interface and is **object oriented programming**. If you have never programmed in an object oriented code, it can seem quite different and foreign.
- **API** means “Application Programming Interface”. It is important to understand that the API script you write is **not part of FEMAP**, but is a stand alone program that is **interacting** with FEMAP.
- There are a number of codes that can call FEMAP through the API: Visual Basic, VBA (Excel, Word, Access, ... ), C, or C++.
- The most commonly used codes used are Visual Basic, VBA, and WinWrap.
- WinWrap is a flavor of Visual Basic that is included with FEMAP. In the FEMAP interface, WinWrap is **noncompilable**, for this reason many choose not to use it, but it is a very convenient way to program if your specific application does not need to be compiled.
- This tutorial will focus exclusively on using WinWrap via the FEMAP API window.

# Automation and API Programming with Femap and NX Nastran

- This is the optional FEMAP API editing window.
- Although the window appears to be part of your FEMAP session, it is not. It is merely a code editing tool.



## What is Object Oriented Programming?

- Traditional programming is usually seen as being a set of *functions*, or simply as a list of *instructions*.
- Object Oriented Programming (or OOP) can be seen as a group of *Objects* that cooperate with each other. Each of the objects have their own distinct set of capabilities.
- OOP programming is quite complex and includes topics such as *inheritance*, *encapsulation*, among others. These more complex ideas are not immediately necessary, and will not be discussed. In fact, the FEMAP API has made it pretty much unnecessary to ever have to learn these concepts.

## Organization

It is helpful to think of each of the entities as being separate.

- Your Visual Basic code acts like a traditional code, i.e. as a set of instructions.
- The VB code makes requests of the API, which then acts upon those requests either by retrieving from and putting things into the FEMAP database.
- FEMAP is a database, which only holds and displays data.

```

API Programming
-----
Predictive Engineering 2006
Predictive Engineering Assumes No Responsibility For Results Obtained From API
API written by Jared Ellefson
Jared.Ellefson@PredictiveEngineering.com
Phone # 541-762-2955
Written for FEMAP 9.2
This API will reorient selected entities from one arbitrary plane to another

Sub Main
'First we are going to connect to the active FEMAP session
Dim femap As femap_model
Set femap = GetObject("femap.model")

Dim entitySet As Object
Set entitySet = femap.feSet

'Now we are going to request from the user what type of entity they would like to reorient

Dim entityType As Long
Dim messageString As String
Dim lists$(3)
lists(0) = "Points"
lists(1) = "Curves"
lists(2) = "Surfaces"
lists(3) = "Solids"
lists(4) = "Nodes"
lists(5) = "Elements"

Begin Dialog UserDialog 280,133,"Entity Information" %GRID:10,7,1,1
text 50,7,160,35,"What type of entity would you like to reorient?"
DropListBox 90,42,90,63,lists(),list1
OKButton 40,84,90,21
CancelButton 150,84,90,21
End Dialog
Dim dlg As UserDialog

If Dialog(dlg) = 0 Then
GoTo FAIL
End If

If dlg.list1 = 3 Then
dlg.list1 = 36
End If

entityType = dlg.list1 + 3

If dlg.list1 = 36 Then
dlg.list1 = 3
End If

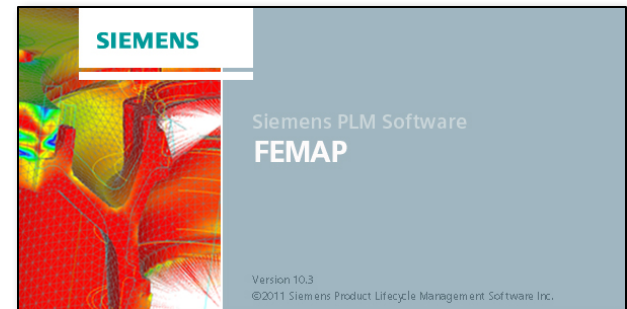
'Now we are going to request of the user the ID's of the entites to move
messageString = "Enter the " + lists$(dlg.list1) + " you would like to reorient"

Dim selCount As Long
Dim selID As Long
    
```

Visual Basic Code



API



FEMAP

## The FEMAP API Objects

- The objects found in the FEMAP API fall into two categories:
  - The *FEMAP Application Object*
  - *Stand Alone Objects*
- Generally speaking, these objects act have the following properties:
  - The *FEMAP Application Object* has all the properties needed to **create** things. It is the object that will be used to create geometry, measure things, mesh geometry, delete entities, etc.
  - The *Stand Alone Objects* are used to **manipulate** existing entities.

## Slide Reserved for Participating Predictive Engineering Clients

If you would like full access to these notes they can be purchased from Predictive Engineering.

Please contact: [Training@PredictiveEngineering.com](mailto:Training@PredictiveEngineering.com) or call 503.206.5571

## Workshop 1: Recording a Femap Macro (.pro, .prg)

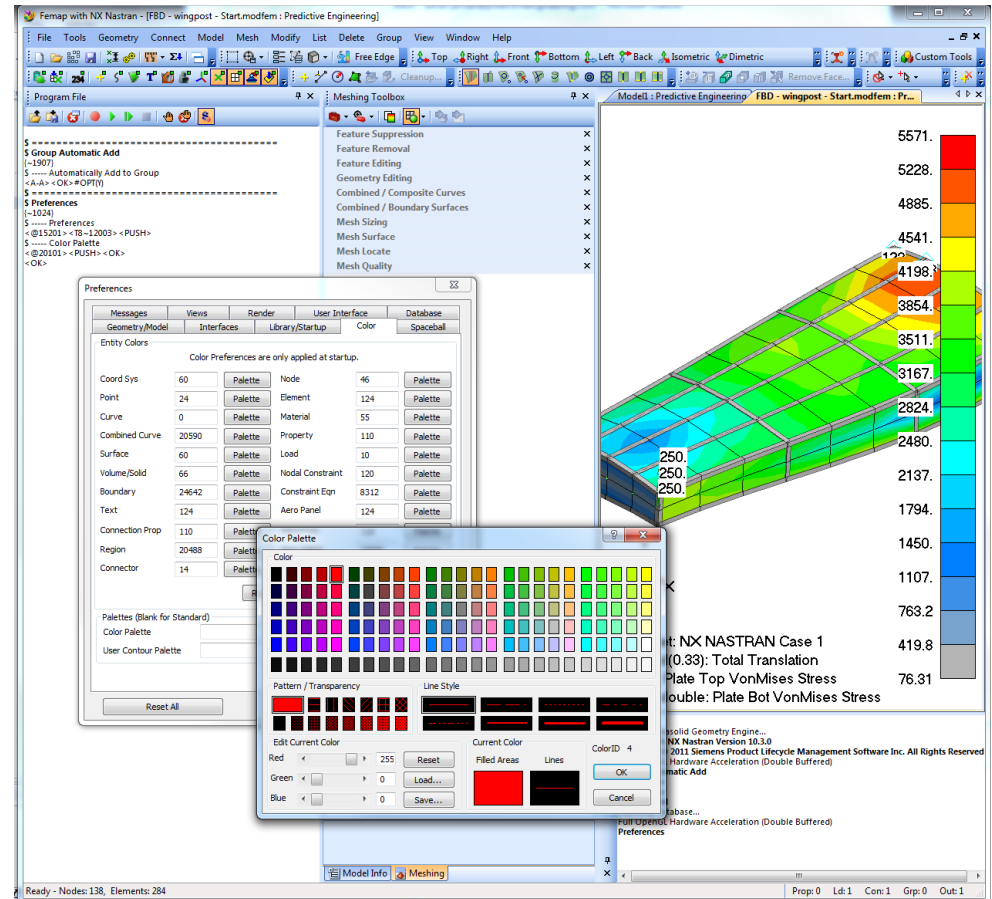
**Introduction:** Femap automation doesn't have to be difficult. In fact, with the macro recording capabilities, it can be down right easy. If you have repetitive modeling process that you want to automate, you can create a program file that will save you serious modeling time.

### Topics Covered:

- Programming Panes
- Programming Files
- Custom Toolbars and User Commands
- Preferences

### Workflow:

- Select a process to automate.
- "Clean it up" – You want your program to only record the necessary clicks and commands.
- Start recording and run through the process.
- Save the program file.
- Set the program to run automatically at startup.

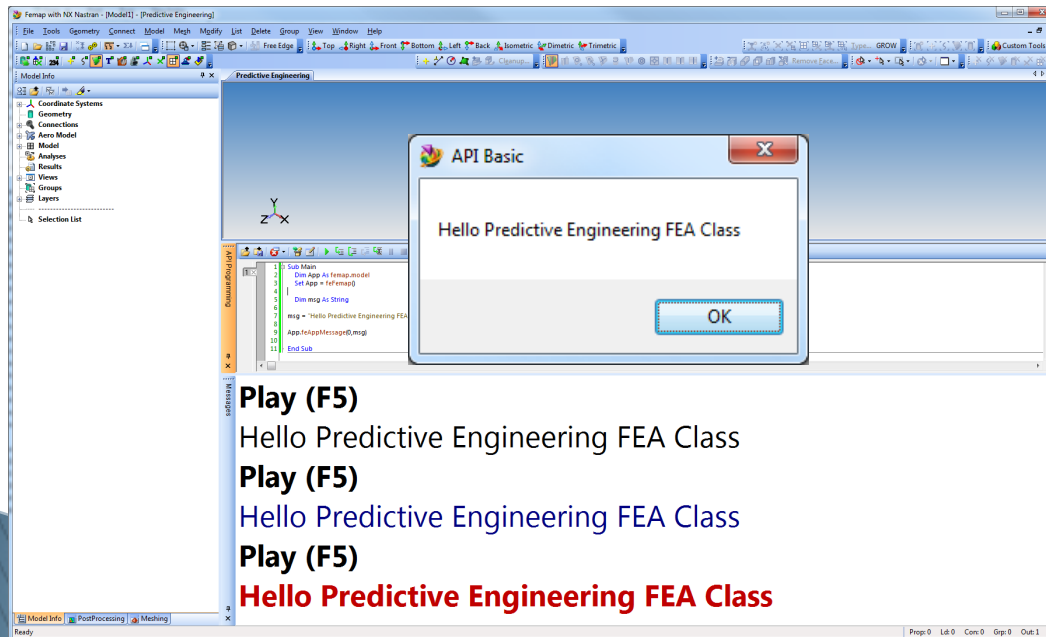
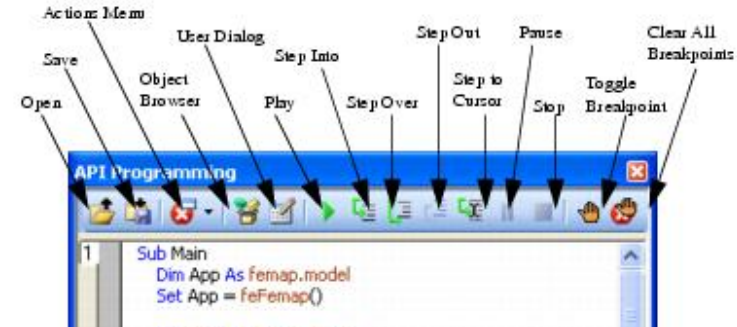


## Workshop 2: "Hello World" - Your First Femap API

**Introduction:** Programming can be very intimidating. For the uninitiated, the code sitting within a Femap API file is confusing and overwhelming. In this workshop, we will take the first step in programming and simply prove to ourselves that connection to the Femap interface through the API can be accomplished by "non-programmers".

### Topics Covered:

- API Files vs Program Files
- Connecting to Femap
- Auto Complete within the API Programming Window
- Data Types
- Parameter Info



### Connecting to Femap (Help Section 3.1.2)

```
Dim App As femap.model
Set App = feFemap()
(Does not work from VB in Excel)
```

```
Dim App As femap.model
Set App = GetObject("femap.model")
(Does not work from VB in Excel)
```

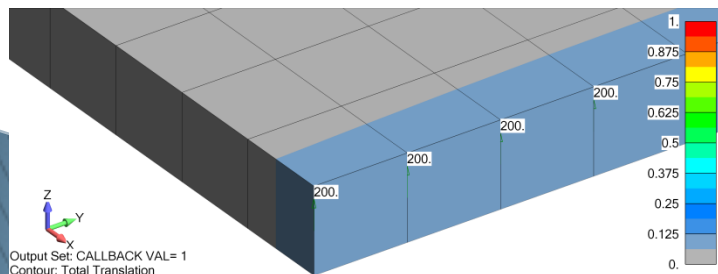
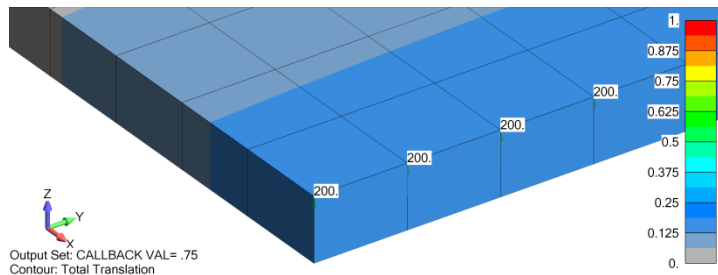
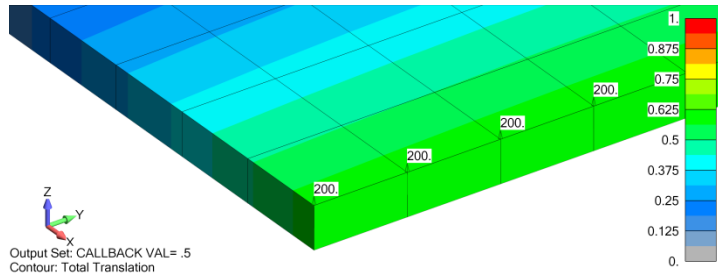
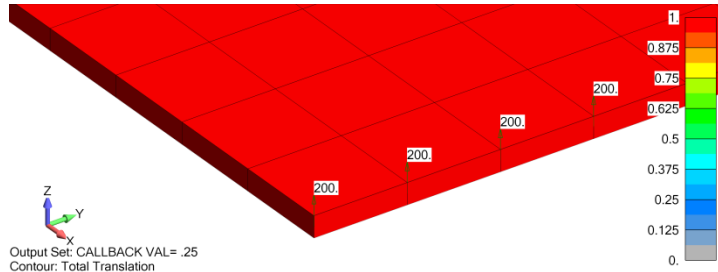
```
Dim App as Object
Set App = GetObject("femap.model")
```

## Slide Reserved for Participating Predictive Engineering Clients

If you would like full access to these notes they can be purchased from Predictive Engineering.

Please contact: [Training@PredictiveEngineering.com](mailto:Training@PredictiveEngineering.com) or call 503.206.5571

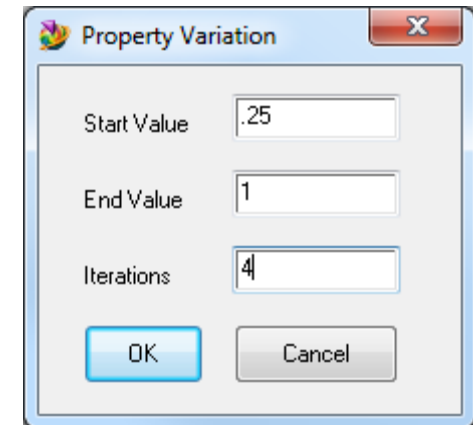
## Workshop 7: Modifying the Model with the API and Event Callback



**Introduction:** The key components of the program are model modification and the event callback command. The event callback command activates a specified command when an event occurs. In the case of this program, the command is analysis and the event is the loading of an output set.

### Topics Covered:

- Connecting to Femap
- Property Object
- Set Object
- Variable Object
- Entity SelectID Dialogue Box
- User Dialogue Box
- feAppEventCallback
- Analysis Object
- Material Object



Workshop Files: Workshop 7 – Modifying the Model / Simple Plate.modfem, Startloop.bas, callback.bas

Movie File: Workshop 7 – Modifying the Model / API Workshop 7.wmv