Customization and Scripting in Cubit

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Agenda

- Introduction
- Cubit Command Language
- Aprepro
- Parameterization
- Q&A

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Cubit Command Language

- **Cubit is controlled by a command language.**
  - This command language is generated by the GUI and passed into the Cubit processor.
  - The commands can be journaled to a file to provide a history.
  - The commands are echoed to the command window in the GUI.
  - User help via email is frequently given in terms of Cubit commands.
  - Cubit can be programmed via this language.
- **It is VERY helpful to understand the syntax and power of the Cubit command language.**

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Cubit Command Syntax

- Case is not significant.
- Commands may be abbreviated to the smallest unique set of characters.
- A hash mark (#) denotes a comment.
- Lines may be continued to the next line with a backslash (\) at the end of the continuing line.

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Cubit Command Syntax

- **Commands are typically verb noun format.**
  - mesh volume 1
  - Mesh is the verb acting on volume 1.
- **However . . . the verb may be optional**
  - cylinder radius 2 height 10
  - This is really
    - **create cylinder radius 2 height 10**
    - **The create keyword is optional.**
- **Or . . . the syntax is just noun first**
  - surface 1 scheme pave
  - This is frequently used when setting an attribute on an entity.

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Specifying Ranges

- **Cubit commands frequently take a range of ids and there are specific keywords that can be used in ranges.**
  - draw surface all
  - list volume 1 to 10 by 2
  - volume all except 3 scheme auto

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Ranges by Topology Traversal

- **Ranges may also be specified by topological relations.**
  - Draw vertex in volume 1
  - List volume in vertex 1 and 10
  - Curve in surf 2 size .3
- **If there is a range of entities on both sides of the "in" keyword the result is the intersection of the ranges.**
  - curve 1 to 3 in body 4 to 8 by 2
- **Topology may include mesh entities**
  - draw node in surface 3
  - draw surface in node 3

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Specifying by Criteria

- **Cubit allows specification by a given criteria using the “with” keyword.**
  - {Entity_Type} With {Criteria}
  - draw curve with length <1
  - locate surface with is_meshed = false
  - highlight volume with not is_virtual
- **The boolean operators “and” “or” control how statements are combined.**
  - node with x_coord > 10 And y_coord > 0
- **The “of” keyword returns the value of a single entity for comparison**
  - list curve with length < length of curve 5 ids

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Operators on Criteria

- **Boolean operators**
  - = or ==
  - <=, >=, <, >
  - <> not equal
    - **draw surface with x_max <= 3**
    - **draw volume with z_max <>12.**
- **Arithmetic operators**
  - +, -, *, /
    - **draw surface with length * 3 + 1.2 > 10**

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Criterion Functions

ID	ID of an entity
Length	The length of a curve or edge
Is_Meshed	Whether an entity is meshed
Is_Spline	Whether an entity is a NURBS
Dimension	Topological dimension of entity
X_Coord, Y_Coord, Z_Coord	The x, y, or z coordinate of the centroid of an entities bounding box.
X_Min, Y_Min, Z_Min	The x, y, or z coordinate of the minimum extent of the entity's bounding box
Is_Merged	If the entity is merged

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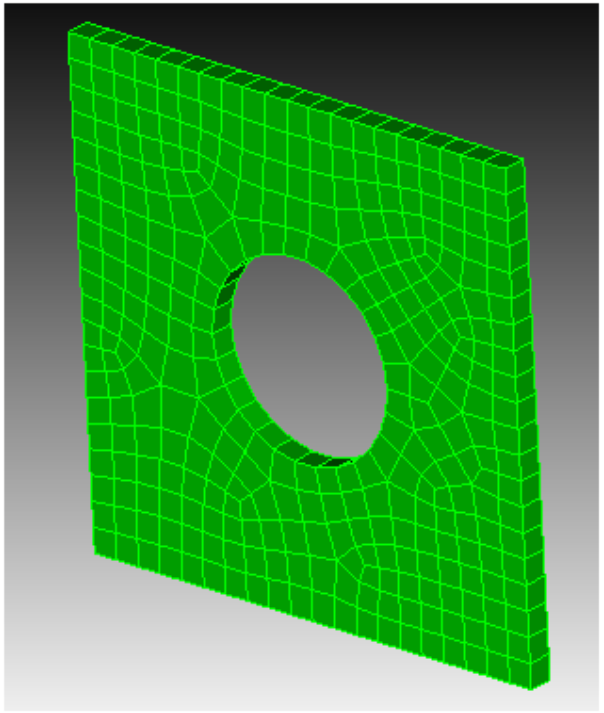
Example 1

```
bri x 10
cyl radius 2 z 12
subtract vol 2 from vol 1
vol 1 size .5
vol 1 scheme auto
mesh vol 1
draw surf in vert 1
draw hex in node in surf 6
```



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Introduction to Aprepro

- **Aprepro = Algebraic Pre-Processor**
- **A built-in miniature programming language**

- **Purposes**
  - Parameterize a journal file
  - Error checking
  - Other control logic

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Basic Aprepro Syntax

- **Aprepro expressions are wrapped in curly braces**
- **Aprepro evaluated first, results inserted into command:**

```
Brick X {10}
```

And

```
Brick X {5*2}
```

Are Equivalent To

```
Brick X 10
```

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Aprepro Variables

- **Variables are named values**
- **Names are case sensitive**
- **Variable type is Number or String**
- **Defined in a comment**

```
# {width=2}
# {r="radius"}
```

- **Use anywhere in a command, as if you typed the variable's value:**

```
brick x {width}
cylinder height 5 {r} 10
```

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Aprepro Equations

- **Variable values can be changed**

```
# {x = 1}
# {x = 5}  ##This will give you a warning
# {x++}  ## Increase value of x by one, no warning
```

  - To avoid warnings, make variable name start with an underscore (_), or use ++ and --

- **Convenient way to see variable value: *comment* command**

```
Comment x
User Comment: 6

Comment “x is” x “and y is” y
User Comment: x is 6 and y is <undefined>
```

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Operators

- **Addition: +**
- **Subtraction: -**
- **Multiplication: ***
- **Division: /**
- **Power of: ^ (**{3^2} **= 9)**

- **Math expressions can be used just about anywhere:**

```
# {width=3}
# {width_squared = width^2}
brick x {width} y {width*2} z {width_squared}
```

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Aprepro Functions

- **Functions calculate or look up values**
- **Function name followed by parameters in parentheses**
- **The number and type of parameters depends on the function**
- **Commas between parameters**
- **Parameters can be constants, variables, or equations**

```
# {errs = get_error_count()}
# {x=cos(PI/2)}
# {vertex_x = Vx(30)}
# {random_number = rand(10, 20)}
# {Print ("Hello World")}
```

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Types of Functions

- **Math Functions**
  - sin(num), cos(num), asin(num), etc…
  - sqrt(num), exp(num), log(num), ln(num), etc…
- **String Manipulation Functions**
  - Quote(string), toupper(string), tolower(string)
- **Utility Functions**
  - Print(string), PrintError(string)
  - FileExists(string), HasFeature(string)

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Types of Functions

- **Session Information Functions**
  - NumVolumes(), NumSurfaces(), etc…
  - get_error_count(), set_error_count(num)
- **Entity Information Functions**
  - Vx(num), Nz(num)
  - Radius(num), SurfaceArea(num), Length(num)
  - CurveAt(num, num, num), HexAt(num, num, num)

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Flow Control

- **Three types of flow control**
  - If statements
  - Loops
  - Include files

If Statements

- **If true then do**

```
#{if (my_variable < 3)}
  brick x 3
#{else}
  brick x {my_variable}
#{endif}
```

- **If defined and not zero then do**

```
#{ifdef(make_a_brick)}
  brick x 3
#{endif}
```

- **If zero or not defined then do**

```
#{ifndef(skip_the_brick)}
  brick x 3
#{endif}
```

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Loops

- **Repeat a set of commands some number of times**

```
# Create 3 bricks
#{Loop(3)}
  brick x 10
#{EndLoop}
```

- **Loop statement accepts numbers or variables, but not expressions**

```
# {Loop(3)}  #OK
# {Loop(x)}  #OK
# {Loop(x-1)}  #error
```

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Example 1 – Accurate Coordinates

Create Vertex {Vx(1) + 10} {Vy(1)} {Vz(1)}

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Example 2 – Name that Volume

Create Brick Width 1
Create Brick Width 1
Volume {Id("volume")-1} Name "Martha"
Volume {Id("volume")} Name "George"

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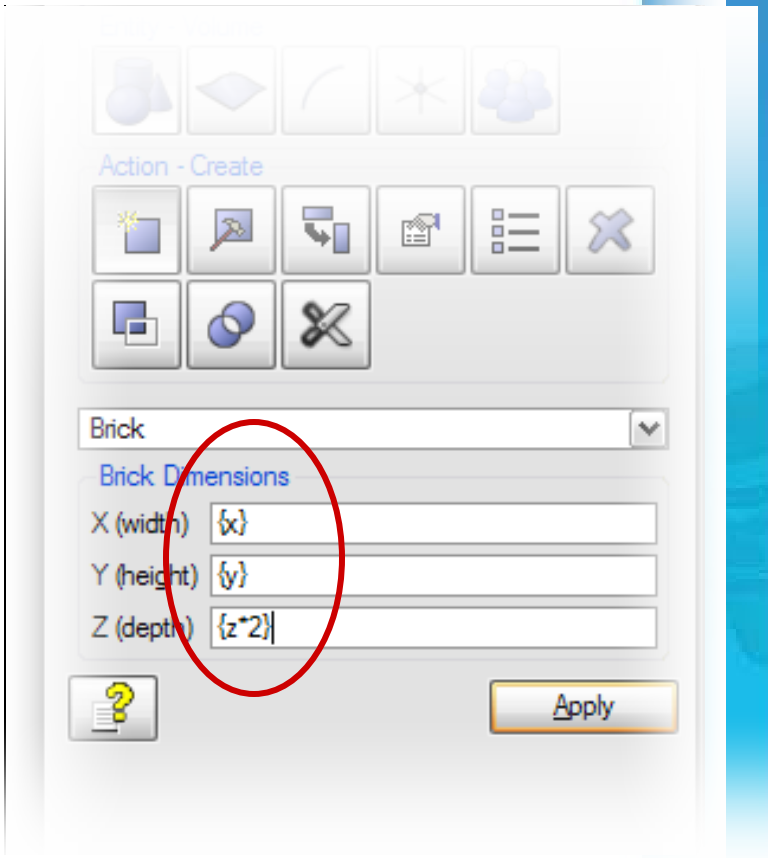
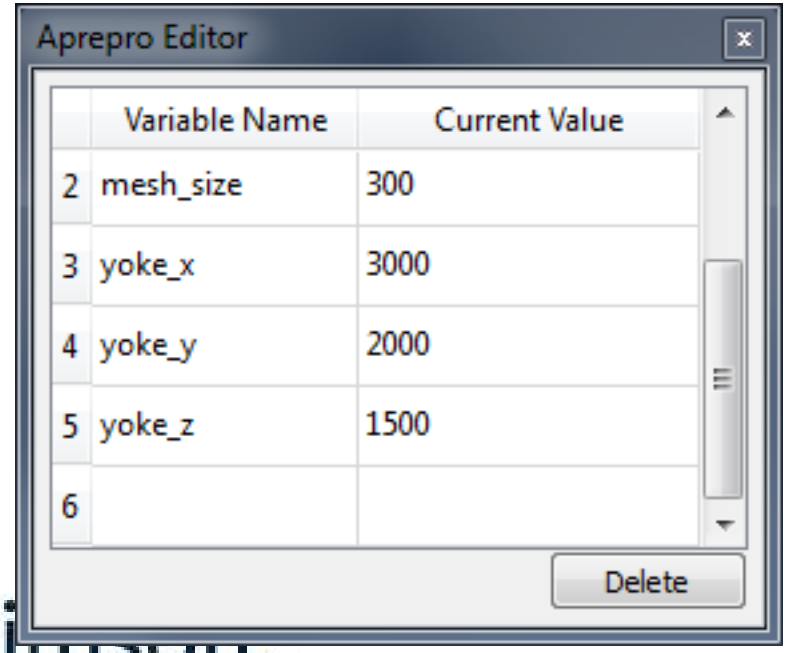
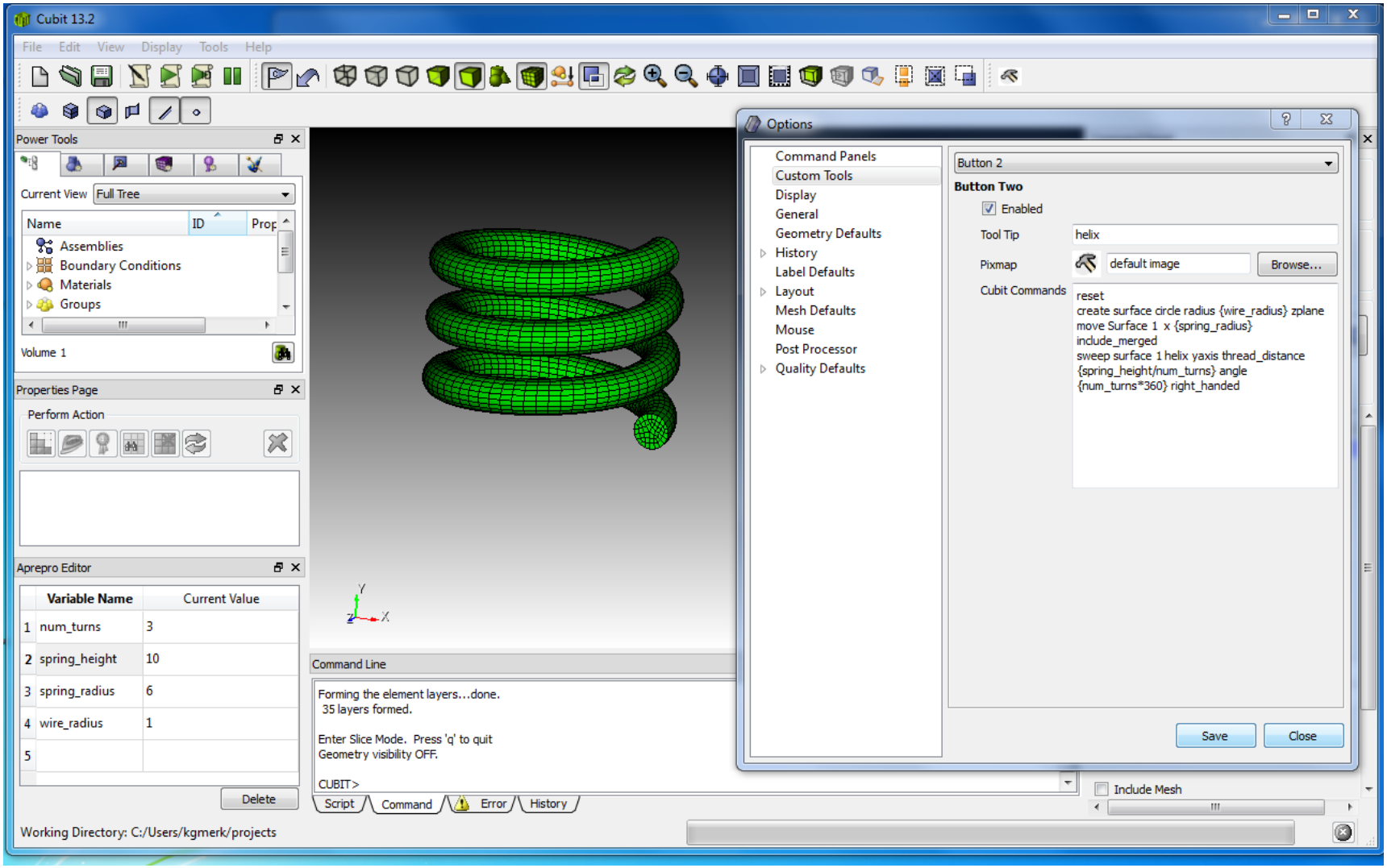
Aprepro in the GUI

- Use aprepro anywhere in the GUI, using curly braces
- See and modify aprepro variables in the power tools





Example 3 - Parametric Spring



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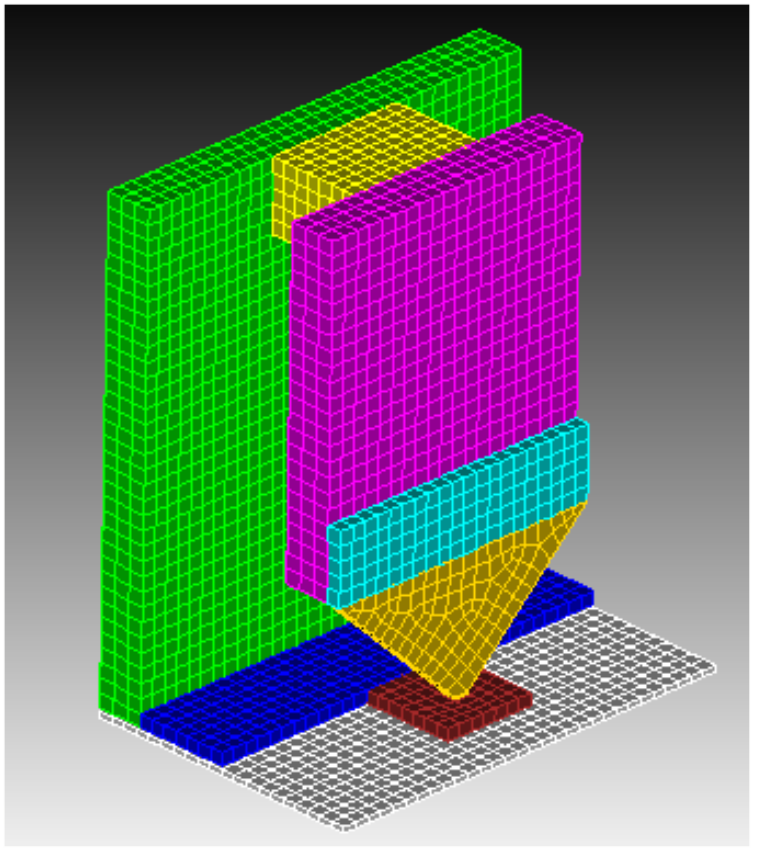
Example 4 - Write Head

- Play ‘write_head.jou
- Open the file in the journal editor
- Change the values of yoke_x, yoke_y, yoke_z
- Play the journal file again.
- Set hex_mesh = 1
- Play again
- Set up a new variable for the return pole z
- Why doesn’t everything move correctly?



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Thank You

Thank you for attending the webinar. If you have additional questions about Cubit scripting and parameterization, please contact us.

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