

Lesson 3 – Rhino, Grasshopper

Parametric/Generative companion for Rhino (“Tools/Grasshopper”)

File Format - "GHX" (text) or "GH" (binary) - multiple files, but only one active at a time

Separate (2D) interface from Rhino

- Main Menu (pull-down)

- Tabs + Panels

- Canvas (+ Canvas Toolbar) - Objects placed on canvas. Zoom & Pan same

Objects - Two types - Parameters & Components. Double-click in canvas to search.

Parameters - Contain/Store data

- Volatile Data - **Obtained** from an object (parameter/component) or Rhino

- Persistent Data - **Stored** with parameter

- States:

 - green = good

 - orange = warning (note: empty, no data is a warning)

 - red = error

Tooltip - Identify. Warning/error messages

Right-click over object/nodes = contextual menu

- "name" - In place of icon

- Preview - Shows in Rhino, Enable – Activates/deactivates object

- Set xxxx – Define or modify persistent data (i.e. number, point, etc...)

- Disconnect/ Disconnect All - removes connection(s)

Components - Contain Actions. Need data.

- Input(s) - Left

- Output(s) - Right

Preview Feedback (in Rhino)

- Green - Geometry belonging to the selected component

- Red - Geometry belonging to an unselected component(s)

Global (“Display” or Canvas Toolbar) - None, Wireframe, Shaded.

- “Selected only”, Settings (colors), Mesh Quality

Bake Selected – Converts Grasshopper “geometry” into Rhino geometry

- Select objects to convert and right-click.

- Choose layer for baked object(s).

Lesson 3 – Rhino, Grasshopper (cont...)

Params – Objects for collecting and storing data

Geometry - Specific types of geometry from Rhino

Point

Circle

Curve – Lines (polylines). Curves (polycurves)

Line – Draws (or collects) a “line” in Rhino

Surface - Individual Surface(s) only. Even if joined.

Brep - "**B**oundary **REP**resentation" (Surface or Polysurface)

Primitive - Non-geometric (numbers, etc...)

Integer – Whole number (positive or negative)

Number - Real number (whole, fraction)

String - Text

Input - Various tools for collecting/creating data

Number Slider, Control Knob

Type of number - **R**eal, **i**Nteger, **E**ven or **O**dd

Domain – Sets range of object. Min and Max values.

Panel - Notes, Display of values, inputs, etc...

Util – Extra tools

Maths – Objects for mathematical operations

Domain – Creating and managing a range of numbers

Matrix – Creating and managing a matrix

Operators

Add, Subtract, Multiply, Divide

Equality, Larger than, Smaller than (returns True or False)

Polynomials – Exponential operations

Square, Square Root, Cube, Cube Root, etc...

Powers, Logarithm – Base 10 or natural

Script

Evaluate – 1 or 2 variable functions, Expressions

Scripts – Computer code (programming)

Time – Construct/deconstruct time (Day, Month, Year, Hours, etc...)

Lesson 3 – Rhino, Grasshopper (cont...)

Maths

Trig

- Sine, Cosine, Tangent, etc....
- Degree <-> Radians conversions
- Triangle construction

Util

- Constants – Pi, Natural Logarithm, etc...
- Min & Max tests
- Average

Curve – Manipulates curve from parameters or creates one in Rhino

Analysis - Evaluates a curve

- Endpoints – Find endpoints of a curve
- Point on Curve – From one endpoint (0.0) to the other (1.0)
- Closed, Planar – Tests curve condition
- Length

Division

- Divide Curve – Creates equally points
- Distance, Length
- Perp(endicular) Frames, Horizontal Frames – Creates drawing planes

Primitive – Creates “geometry”

- Line
- Circle – Circle, 3 Point, Fit, etc...
- Arc – Arc, 3 point, etc...
- Polygon

Spline

- Curve – Interpolate, etc...
- Polyline
- Tween Curve
- Blend Curve

Util

- Extend, Join
- Fillet, Offset
- Flip Curve – Reverses direction
- Rebuild Curve

Lesson 3 – Rhino, Grasshopper (cont...)

Transform

Affine

Scale (uniform) – Geometry, Center (base point), Scale factor
Scale NU (non-uniform) – Geometry, Plane (base point), Scale factor
Project – To a plane

Array

Linear – 1D
Rectangular – 2D, Box – 3D
Polar
Curve – Array along a curve

Euclidian

Move – Needs a vector
Rotate, Rotate Axis, Rotate 3D – Rotation in radians (option - degrees)
Mirror

Morph

Util – Group/Ungroup

Vector

Field

Grid – Point distribution

Grid – Rectangular, Radial
Populate 2D, 3D – Random points inside rectangle or box
Populate Geometry – Random points ON user chosen geometry

Plane – Creating and manipulating construction planes

Point – Construct and evaluate points

Sort points – By X, Y &/or Z coordinates
Sort along a curve

Vector (Direction + Length)

Unit X, Y or Z – Sets vector in a single axis. Output is length and direction
Vector XYZ – Sets vector in X, Y &/or Z. Output is length and direction
Rotate – Rotates a vector

Lesson 3 – Rhino, Grasshopper (cont...)

Surface

Analysis – Area, Volume, Dimensions, Control Points, etc... of surfaces

Freeform – Creating surfaces

Extrude, Extrude along

Loft

Edge Surface (2, 3 or 4 edge curves), Ruled surface (2 curves)

Network Surface

Pipe

Sweep1, Sweep2 – Sweep with rail(s)

Revolution, Rail Revolution

Primitive (Solids) - Box, Cylinder, etc...

Util

Divide Surface - U & V (both need to be set)

Brep Join – Joins surfaces/polysurfaces.

Cap Holes – Caps planar holes (i.e. makes solid from extrusion)

Flip – Flips surface normals

Offset Surface

Sets

List – Manage sequence of numbers (i.e. points on a curve)

Shift – Offsets a list of numbers by a value.

Reverse

Split, Sub List, etc... - Creates smaller sub-set lists

Sequence – Create list of numbers (usually)

Range - Domain (Low and/or High number) + Number of steps (divisions).

Series - Start Number + Increment in between + Number of elements

Sequence - Text ("strings")

Random – Creates a list of random numbers

Jitter – Randomizes a list

Sets – Working with sets (i.e. points on a curve)

Difference, Intersection, etc... – Compares sets

Union – Joins sets

Lesson 3 – Rhino, Grasshopper (cont...)

Sets (cont...)

- Text – strings of character data
 - Concatenate (Joining)
 - Splitting
 - Sort

- Tree – Branching (Decisions)

Intersect

- Mathematical – Geometrical intersections (may or may not physically touch)

- Physical - Geometrical intersections (MUST physically touch)

- Region – Splits and Trims

- Shape – Booleans (solids, regions)

Other Tabs

Mesh

- Analysis
- Primitive – Box, Plane, etc...
- Triangulation
- Util

Display

- Colour
- Dimensions – Adds dimensions to objects
- Graphs

- Kangaroo2 - ????

- V-Ray – Adds V-Ray geometry, lights and materials. Plug-in must be installed.

- Groups – Combines Parameters/Components

- “Edit/Group” (or “Edit/Ungroup”)

- Bake Selected – Converts Grasshopper “geometry” into Rhino geometry

- Select objects to convert

- “Solution” or Right-click

- Choose (existing) layer on which to place baked object(s).

Display pull-down

When the Fancy Wires option is enabled in the Grasshopper View menu, then the wire display tells you something about the data that flows through them. There are 4 different wire display types:

1. Single orange wire: no data is transferred, the parameter on the left end is empty.
2. Single grey wire: a single data item is transferred.
3. Double grey wire: a list of data items is transferred.
4. Double dashed grey wire: multiple lists of data items are transferred.

