ROBOTIC TECHNOLOGIES FOR A NON-STANDARD DESIGN AND CONSTRUCTION IN ARCHITECTURE

Research project
Ref: PTDC/ATP-AQI/5124/2012

REPORT Task 1.1.1

Survey: Computational Design
March 2014

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CENTRO DE ESTUDOS DE ARQUITECTURA E URBANISMO CEAU
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Period:
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Note:
This is the work produced in the scope of a Research Project without any commercial intentions. The purpose of this document is to register and monitorize the developed work.

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Computational Design

Introduction

In the scope of the introductory activities of the project (T1.1, T.1.2 and T1.3), the present task surveys the current state-of-the art in computational design technologies.

Among the wide landscape of digital design tools, the computational ones emerge as those that can promote non-standard design approaches to architectural conception, development and construction. Going beyond of the simple representation of fixed geometries in the screen, computational design technologies allow architects to use calculation as a generative design strategy to conceive, edit and transform geometries in the screen. But this possibility must not be considered solely in the design domain.

To make viable the exploration of variation and uniqueness in architectural design and construction, the whole architectural process should embrace those technologies. For instance, the exploration of a certain complex geometry would require specific engineering calculation procedures and flexible manufacturing processes for its materialization. William J. Mitchell, Branko Kolarevic and Daniel Shodeck wrote seminal publications where this computational ecosystem for architectural design is analyzed, both in terms of its historical precedents and its future directions.

Structure

Recognizing these principles, the current survey was structured in 6 categories of digital technologies for architectural design:

- **Advanced modeling**
  Despite the fact that some modeling software is not computationally driven, it was important to include here some of the existing tools that allow architects to represent complex geometries with precision and flexibility. Also, by using programming strategies, many of these software can see their capabilities extended into the parametric and algorithmic domains.

- **Computational design – software**
  Adding calculation capabilities to the representational ones, computational design processes are critical to embrace parametric and algorithmic design strategies. Currently there are 2 trends: visual programming languages (e.g. Grasshopper), and text programming languages (e.g. Python). This part is focused in the visual programming tools (and plug-ins) that assist representational-based systems for computational design.

- **Computational design – programming languages**
  Despite being a more abstract mode of computational design, programming provides more control and capabilities to embrace such processes. In general, the use of programming is coupled with existing modeling software to take immediate advantage of modeling and visualization possibilities. In more advanced situations, a full stand-alone application can be programmed from the scratch.

- **Performative analysis**
  The digital analysis of digital models represents the possibility to avoid the use of expensive physical tests. Currently there is a wide landscape of different engineering analysis software (CAE) available, that can help designers to collaborate and evaluate or refining their solutions. There is a strong interest in using software solutions that input directly on the algorithmic design, although some mature packages could not be overlooked.

- **Digital fabrication**
  The interest of these tools relies on the possibility to use the information contained in the digital models to directly program CNC fabrication machines. They become viable the physical production of complex geometries or variable parts, Once again, a special interest is kept on solutions that interactively work with the computational design model.

- **Robotics**
  Simulation of the robotic arm is a key part of planning the digital fabrication process using this kind of machines,. These software can also back engineer processes to calculate the optimal movement of the various parts of the robot in relation to various constraints.

Conclusion

This overview showed that architects have today a wide landscape of software to embrace every aspect of their design process through digital means, from conception to construction. By sharing a common media - the digital -, the exploration of these technologies tend to approximate the different participants in the project, like architects, engineers, manufacturers and builders.

Out of the programs that were investigated, the research team selected the following ones to set the digital design base to develop the research project:

- **Advanced Modeling**
  Rhinoceros
- **Computational Design – Software**
  Grasshopper (with plugins, Kangaroo, Hoopsnake), TopSolid
- **Computational Design – Programming Languages**
  Python
- **Performative Analysis**
  Ecotect, Scan And Solve, Pachyderm
- **Digital Fabrication**
  SprutCAM, RhinoCAM, RhinoNEST
- **Robotics**
  KUKA/Prc, HAL

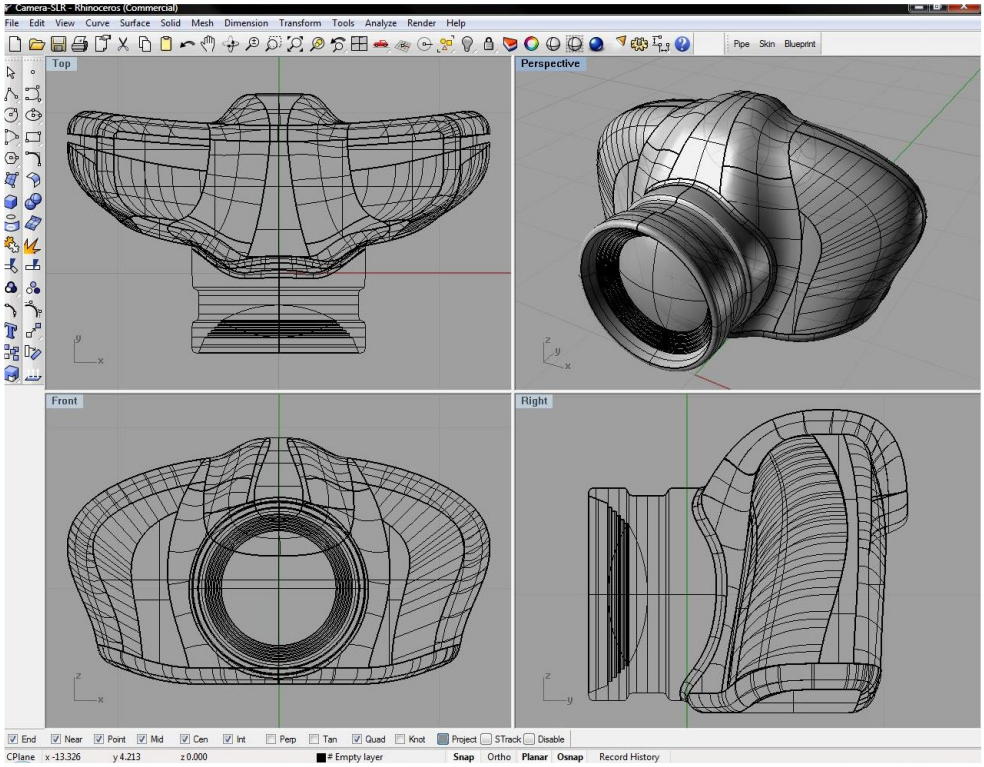
A series of tasks are planned to improve the skills of the team in these technologies, by means of internal training sessions (eg, following tutorials, manuals…) and the attendance of workshops.

Rhinoceros

General Info

Company	McNeel
Official Site	http://www.rhino3d.com/
Type	Software stand-alone
Target	Advanced Modelling

Screencapture



Description / Features

Rhinoceros3D is a modelling software with strong capabilities in NURBS surface creation. It has multiple functions that make it easy to model almost any surface with mathematical accuracy. Another strong feature of Rhinoceros3D is its large plugin database which is also due to an easy API to program with.

References

Manuals
- http://docs.mcneel.com/rhino/5/help/en-us/index.htm

Tutorials
- http://www.rhino3d.com/tutorials

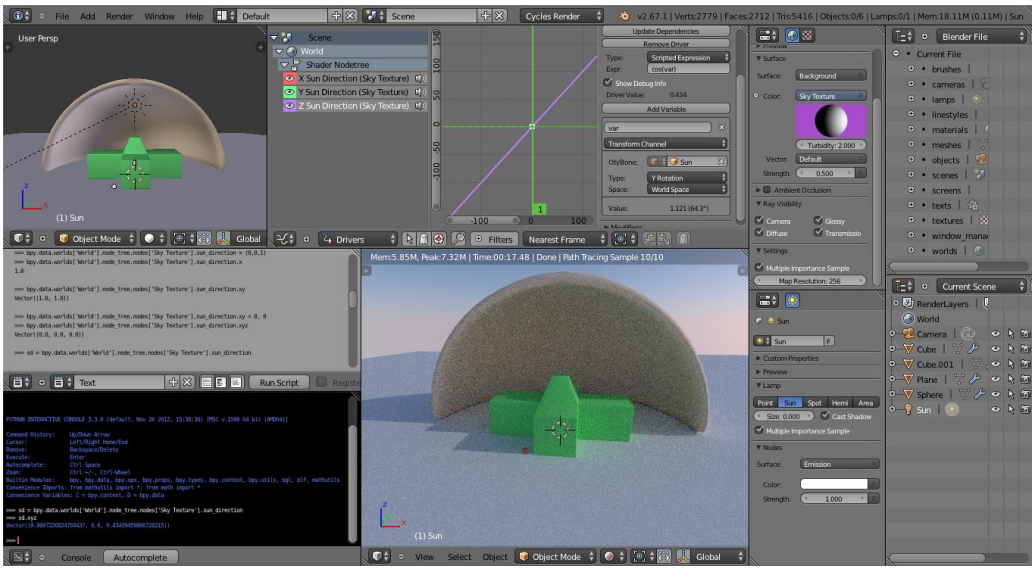
Projects
- http://www.rhino3d.com/gallery/5

Blender

General Info

Company	Blender Foundation
Official Site	http://www.blender.org/
Type	Software stand-alone
Target	Advanced Modelling / Rendering

Screencapture



Description / Features

Blender is an open-source animation package. It is a full-featured mesh modeler, mainly targeted to organic shapes. Besides animation, fabrication and interaction, it is also a solid renderer for visual purposes.

References

Manuals

- http://wiki.blender.org/index.php/Doc:2.6/Manual

Tutorials

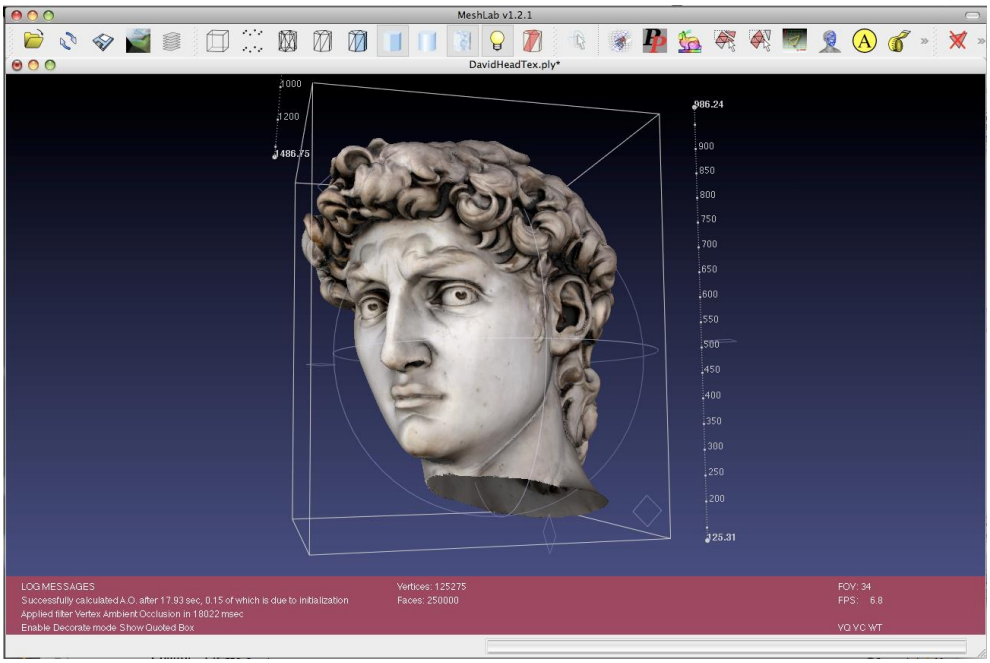
- http://cgcookie.com/blender/category/tutorials/

Meshlab

General Info

Company	ISTI - CNR
Official Site	http://meshlab.sourceforge.net/
Type	Software stand-alone
Target	Advanced Modelling / Rendering

Screencapture



Description / Features

MeshLab is an open source, portable, and extensible system for the processing and editing of unstructured 3D triangular meshes.
The system is aimed to help the processing of the typical not-so-small unstructured models arising in 3D scanning, providing a set of tools for editing, cleaning, healing, inspecting, rendering and converting this kind of meshes.
MeshLab is available for most platforms, including Windows, Linux, Mac OS X, and, with reduced functionality, on iOS and Android.The system supports input/output in the following formats: PLY, STL, OFF, OBJ, 3DS, VRML 2.0, U3D, X3D and COLLADA.

References

Manual

- http://sourceforge.net/apps/mediawiki/meshlab/index.php?title=Main_Page

Tutorials

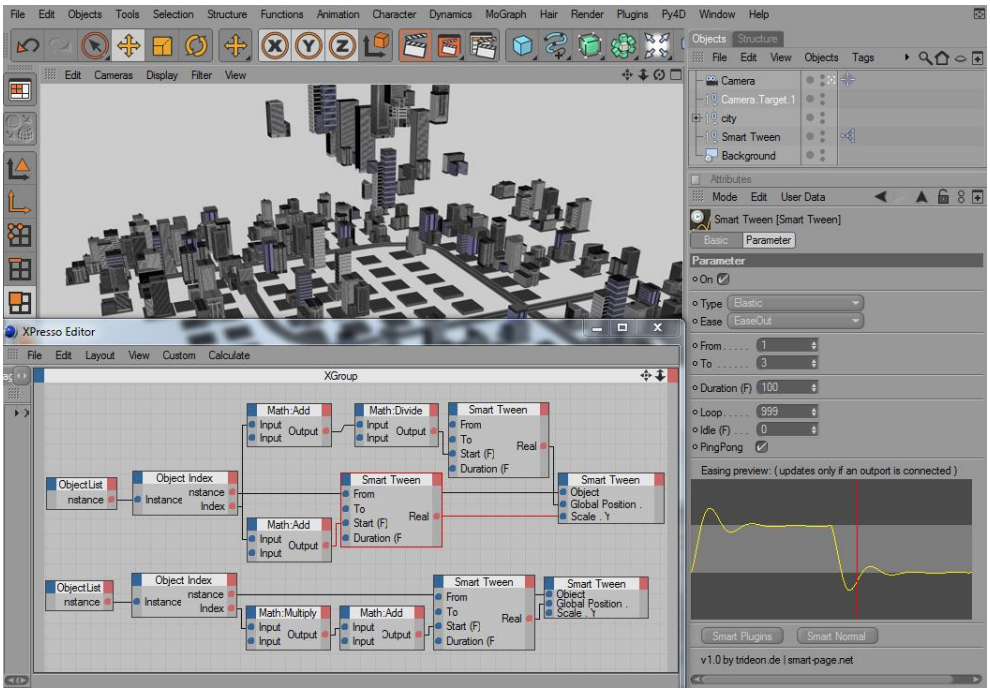
- http://meshlabstuff.blogspot.pt/2009/09/meshing-point-clouds.html

Cinema4D

General Info

Company	Maxon
Official Site	http://www.maxon.net/
Type	Software stand-alone
Target	Advanced Modelling / Rendering

Screencapture



Description / Features

CINEMA 4D is a 3D modeling, animation and rendering application, capable of procedural and polygonal/subd modeling, animating, lighting, texturing, rendering, and common features found in 3D modelling applications. It has strong modelling tools within the parametric capabilities which can be combined with the Xpresso node based algorithm editor or the COFFEE scripting language.

References

Manual

- http://www.maxon.net/support/documentation.html

Tutorials

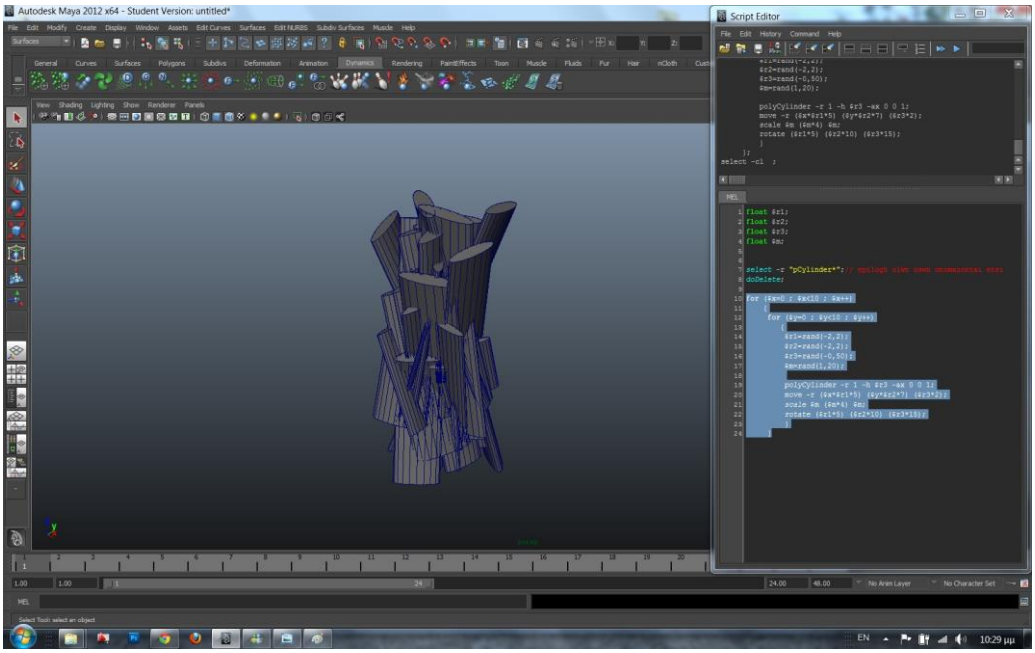
- http://greyscalegorilla.com/blog/tutorials/intro-to-xpresso-in-cinema-4d/

Autodesk Maya

General Info

Company	Autodesk
Official Site	http://www.autodesk.com/maya
Type	Software stand-alone
Target	Advanced Modelling / Rendering

Screencapture



Description / Features

Autodesk Maya is a 3D computer graphics software mainly used to create visuals for animations in the entertainment industry. It has been used to some extent in generative and parametric design due to its MEL scripting language.

References

Manual

- http://download.autodesk.com/global/docs/maya2014/en_us/
- http://download.autodesk.com/us/maya/2011help/index.html?url=./files/Maya_Python_API_Using_the_Maya_Python_API.htm,topicNumber=d0e678623

Tutorials

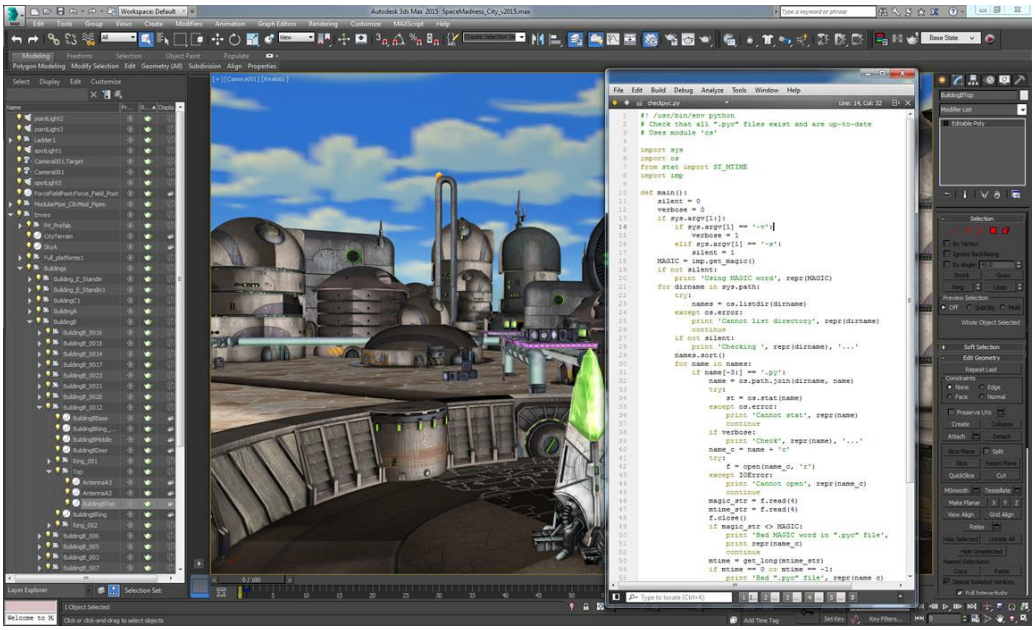
- http://www.creativecrash.com/maya/tutorials/scripting/mel/c/

Autodesk 3ds Max

General Info

Company	Autodesk
Official Site	http://www.autodesk.com/3dsmax
Type	Software stand-alone
Target	Advanced Modelling / Rendering

Screencapture



Description / Features

Autodesk 3ds Max is the most popular software package regarding computer graphics for the entertainment and visualization industry. It is feature complete and supports Maxscript and python as scripting languages.

References

Manual

- http://docs.autodesk.com/3DSMAX/14/ENU/MAXScript%20Help%202012/

Tutorials

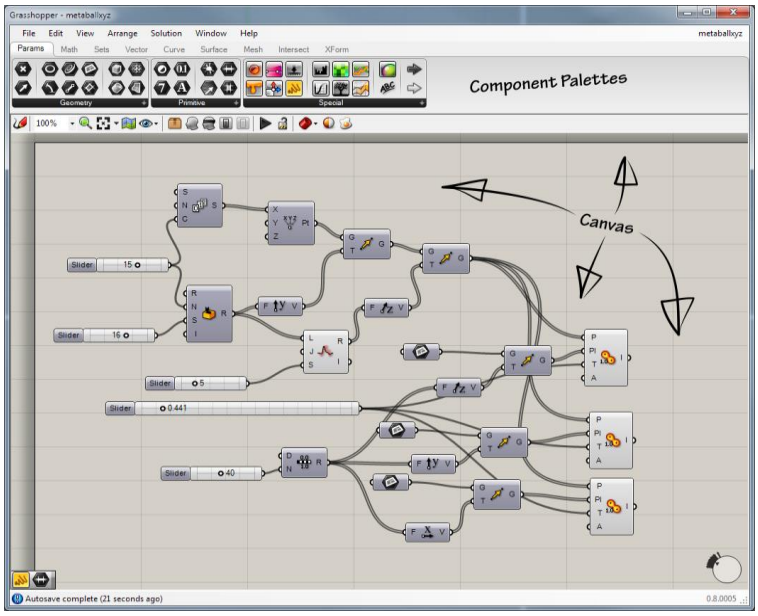
- http://www.scriptspot.com/3ds-max/scripts

Grasshopper

General Info

Company	McNeel
Official Site	www.grasshopper3d.com
Type	Plug-in for Rhinoceros
Target	Computational Design

Screencapture



Description / Features

Grasshopper is an algorithmic modeling for Rhinoceros. The main interface for algorithm design in Grasshopper is the node-based editor. Data is passed from component to component via connecting wires which always connect an output grip with an input grip. Data can either be defined locally as a constant, or it can be imported from the Rhino document or a file on the computer. Data is always stored in parameters, which can either be free-floating or attached to a component as input and outputs objects.

References

Manuals

- http://www.schwartz.arch.ethz.ch/Vorlesungen/ParamTE/Dokumente/GrasshopperWorkspace.pdf

Tutorials

- http://www.grasshopper3d.com/page/tutorials-1

Projects

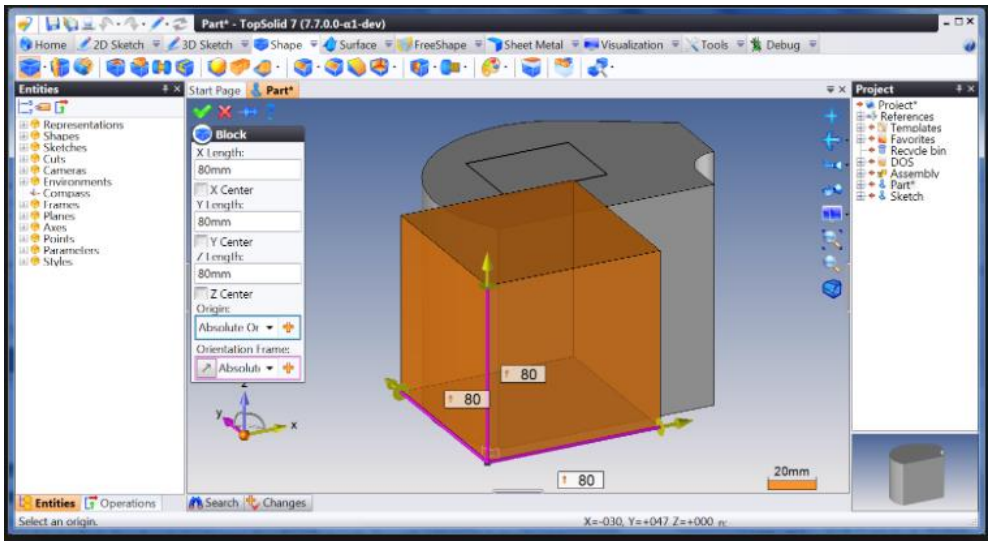
- http://www.grasshopper3d.com/page/architecture-projects

Top Solid

General Info

Company	Missler Software
Official Site	www.topsolid.com
Type	Stand-alone application
Target	Computational Design

Screencapture



Description / Features

Top Solid is an integrated CAD CAM (Computer Aided Design and computer Aided Manufacturing) software. I allows users to design and manufacture their parts by (by programming numerically controlled machines) using the same software. The TopSolid range of software includes a whole family of industry solutions: from the more general, mechanical oriented (TopSolid'Design) to job specific solutions: sheet metal (TopSolid'SheetMetal), wood (TopSolid'Wood), toolmaking: TopSolid'Mold for mold makers and TopSolid'Progress for press tool designers. TopSolid also incorporates an integrated Computer-aided manufacturing (CAM) line of products: Mechanical machining (TopSolid'Cam), sheet metal (TopSolid'SheetMetal), wood (TopSolid'WoodCam), wire electroerosion (TopSolid'Wire). TopSolid also incorporates a 2D draft module (TopSolid'Draft) and a structural computation module (TopSolid'Fae).

TopSolid is a CAD/CAM solution based on the geometric modeler ParaSolid. It is claimed to be capable of reading and creating files in all available formats as well as in such formats as Catia and ParaSolid.
TopSolid'Cam, one of the main products of the TopSolid portfolio, manages multi axis machining such as 5 axis machining, mill turn operations, twin Spindle and twin turret technology.TopSolid 7 the next generation of CAD/CAM software has been released in 2009.
TopSolid 7 is claimed to offer huge innovations on the CAD/CAM market by simplifying the design and modification of large assemblies in an organized and structured environment.

References

Tutorials

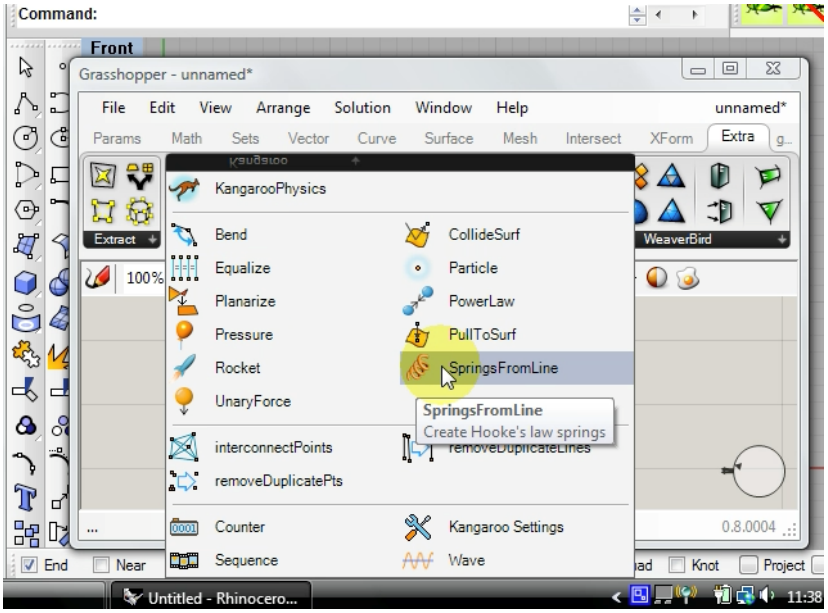
- http://www.topsolidusa.com/?page_id=524
- http://www.youtube.com/watch?feature=player_detailpage&v=yXoNTpWN4kw
- http://www.youtube.com/watch?v=7Jio_2HctIM
- http://www.youtube.com/watch?v=1nQhW3kUpI4

Kangaroo Physics

General Info

Company	Mc Neel
Official Site	www.grasshopper3d.com/group/kangaroo
Type	Plug-in for Grasshopper
Target	Computational Design

Screencapture



Description / Features

Kangaroo is a Live Physics engine for interactive simulation, optimization and form-finding directly within Grasshopper. Kangaroo can be used for either form-finding, or simulation of actual structures, but these are often quite separate things.
Version 0.06 of the Kangaroo physics contains bug fixes and many new features – wind, planarization, vortex, shear, alignment, anchor-springs, constrain to curves, rigid origami, etc.

References

Manuals

- https://docs.google.com/document/d/1X-tW7r7tfC9duICi7XyI9wmPkGQUPIm_8sj7bqMvTXs/edit

Tutorials

- http://www.grasshopper3d.com/group/kangaroo/page/example-files
- http://rhinotuts.com/502/

Videos

- http://www.topsolidusa.com/?page_id=524

Tutorials

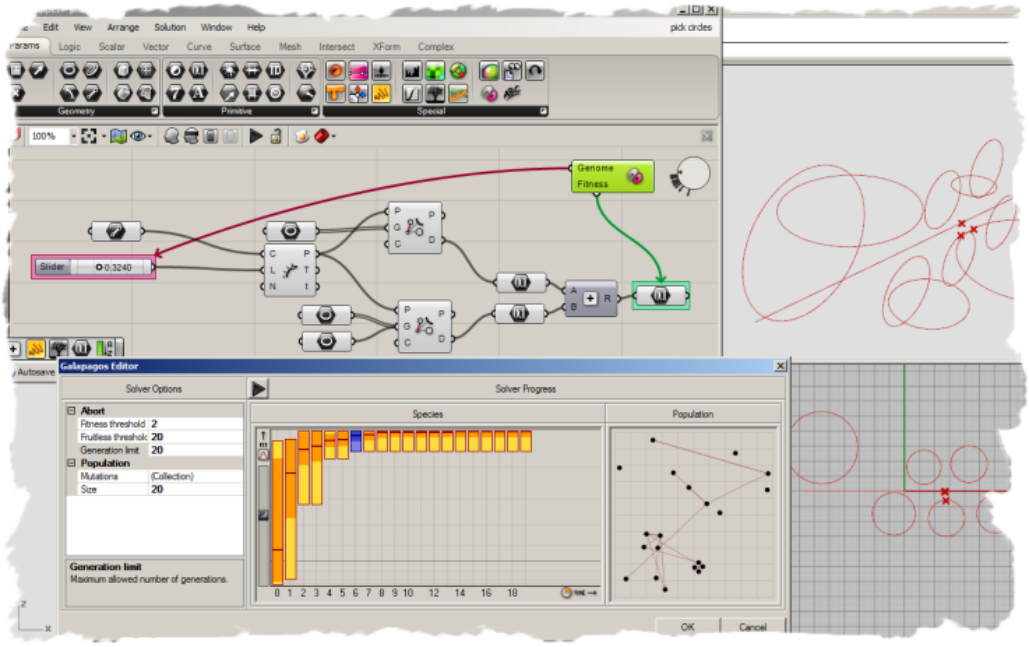
- http://spacesymmetrystructure.wordpress.com/2010/01/21/kangaroo/
- http://www.youtube.com/watch?v=vYElXcvomj8
- http://www.youtube.com/watch?v=a6Tcar3vieM
- http://www.youtube.com/watch?v=gZmoe-G-03M
- http://vimeo.com/album/199263

Galapagos Evolutionary Solver

General Info

Company	McNeel
Official Site	http://www.grasshopper3d.com/group/galapagos
Type	Plugin for Grasshopper
Target	Computational Design

Screencapture



Description / Features

This plugin runs within Grasshopper, which is a plugin for Rhinoceros 3D modeler. It is an evolutionary solver, and its correct usage is dependent on a basic understanding of the logics behind Genetic Algorithms. Once the gene pool and fitness are tuned, it is quite easy to use, as its only inputs are genes (in the form of Slider and Gene Pool) and Fitness (in the form of a number)

References

Tutorials

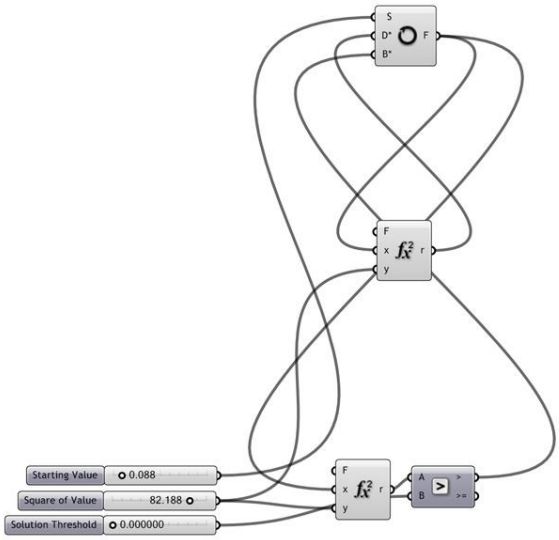
- http://www.grasshopper3d.com/profiles/blogs/evolutionary-principles

Hoopsnake for Grasshopper

General Info

Company	Yannis Chatzikonstantinou
Official Site	http://yconst.com/software/hoopsnake/
Type	Plugin for Grasshopper
Target	Computational Design

Screencapture



Description / Features

Hoopsnake is a recursion engine for Grasshopper. It is capable of running the same algorithm on the ouput of it. It is able to manually iterate, or to iterate until a False Boolean is input.

References

Tutorials

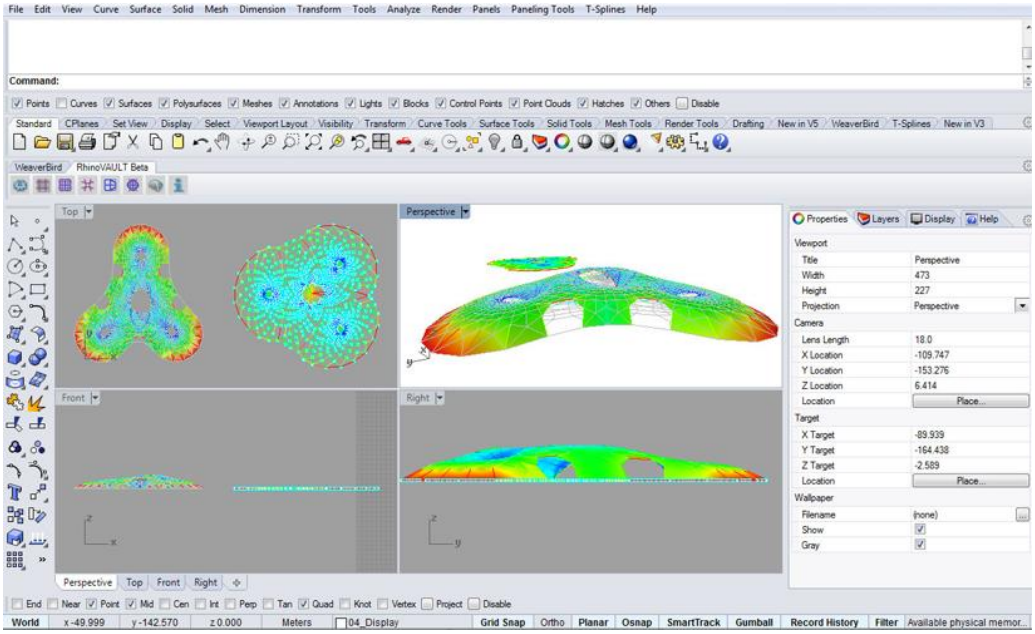
- http://vimeo.com/25182853
- http://www.grasshopper3d.com/group/hoopsnake

Rhinovault for Rhinoceros

General Info

Company	Block Research Group - ETHZ
Official Site	http://block.arch.ethz.ch/brg/tools/rhinovault
Type	Plugin for Rhinoceros
Target	Computational Design

Screencapture



Description / Features

Rhinovault is a plugin for structural form finding. It is based in Graphics Statics, and its way of working is somewhat similar to Gaudi's funicular models.

References

Projects

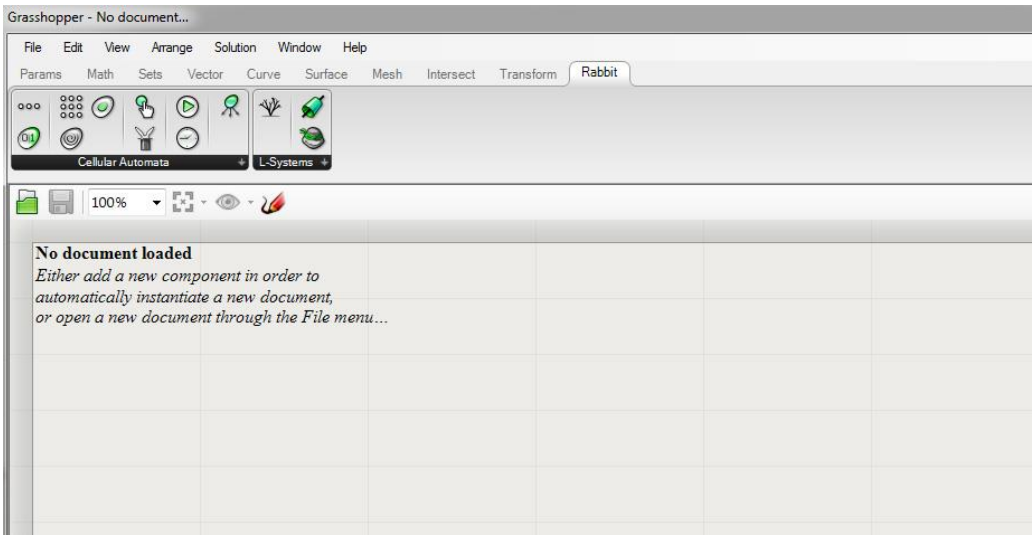
- MLK Jr. Park Stone Vault, Austin, TX, USA

Rabbit

General Info

Company	Morphocode
Official Site	http://morphocode.com/rabbit/
Type	Plugin for Grasshopper
Target	Computational Design

Screencapture



Description / Features

Rabbit is a plug-in for Grasshopper that simulates biological and physical processes such as L-Systems and Cellular Automata.
Rabbit provides an easy way to explore natural phenomena such as pattern formation, self-organization and emergence. The add-on gives architects and designers the opportunity to integrate these models of organization in their own designs.

References

Tutorial

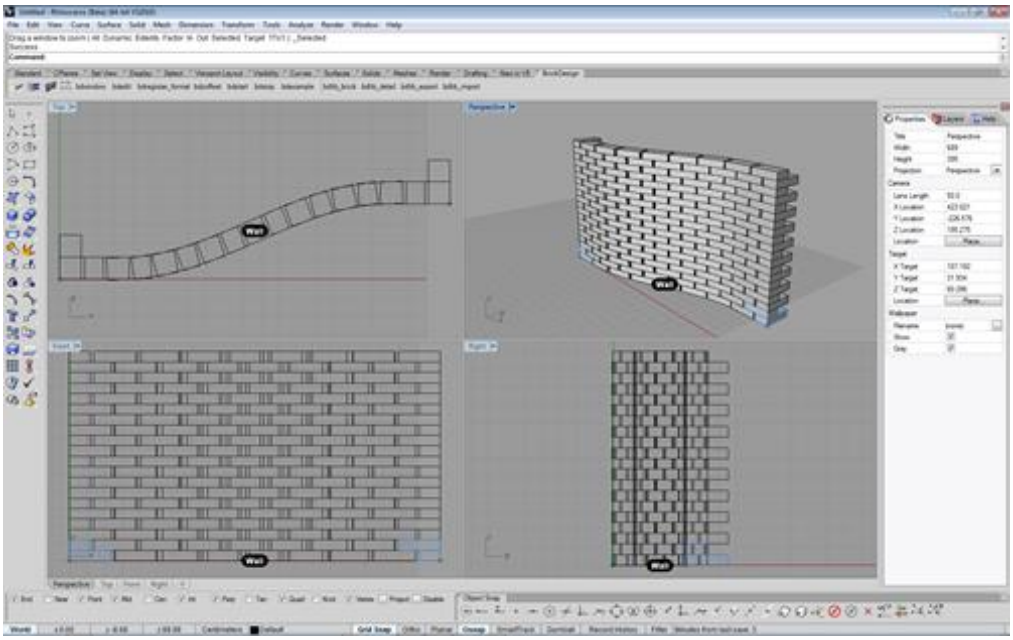
- http://morphocode.com/install-rabbit-into-grasshopper/

BrickDesign

General Info

Company	Rob Technologies AG
Official Site	http://brickdesign.rob-technologies.com
Type	plug-in
Target	Advanced Modeling

Screencapture



Description / Features

BrickDesign enables the controlled design and manipulation of a large amount of discrete elements. The plug-in provides a parametric design environment, which allows for a fast build-up of brick façade geometries, which can easily be adapted to changing design intentions and requirements. The core concept of the software is that the brick unit is the basis for every action performed. Basically, a design is generated through drawing, placing and manipulating individual bricks. BrickDesign offers different methods to manipulate the individual bricks in order to map patterns on a façade. These methods can be extended ad libitum through an open script interface, which gives access to a number of brick parameters.

References

Manuals

- http://brickdesign.rob-technologies.com/wordpress/wp-content/uploads/downloads/2013/05/UserManual.pdf

Tutorials

- http://brickdesign.rob-technologies.com/wordpress/wp-content/uploads/downloads/2012/03/120316_BrickDesignGettingStarted.pdf

Projects

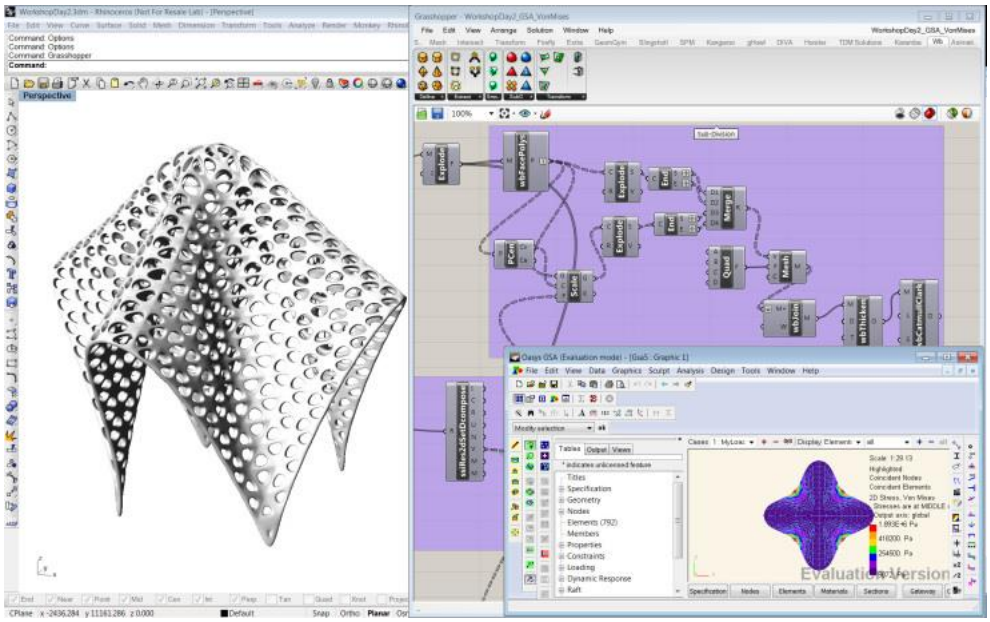
- ROB Unit was already in the field on the Venice Biennale and fabricated an installation out of local bricks in New York.
- Flight Assembled Architecture, 2011-2012 FRAC Centre Orléans
- Gantenbein Vineyard Facade, Fläsch, Switzerland, 2006 Non-Standardised Brick Façade

WeaverBird

General Info

Company	Geometrydepth (Giulio Piacentino)
Official Site	geometrydepth.com
Type	Plug-in
Target	Computational Design

Screencapture



Description / Features

Weaverbird is a topological mesh editor plug-in for Grasshopper/ Rhino.
Weaverbird is a topological modeler that contains many of the known subdivision and transformation operators, readily usable by designers. This plug-in reconstructs the shape, subdivides any mesh, even made by polylines, and helps preparing for fabrication. Weaverbird is excellent for working with watertight polygonal models for rapid prototyping.

References

Tutorials

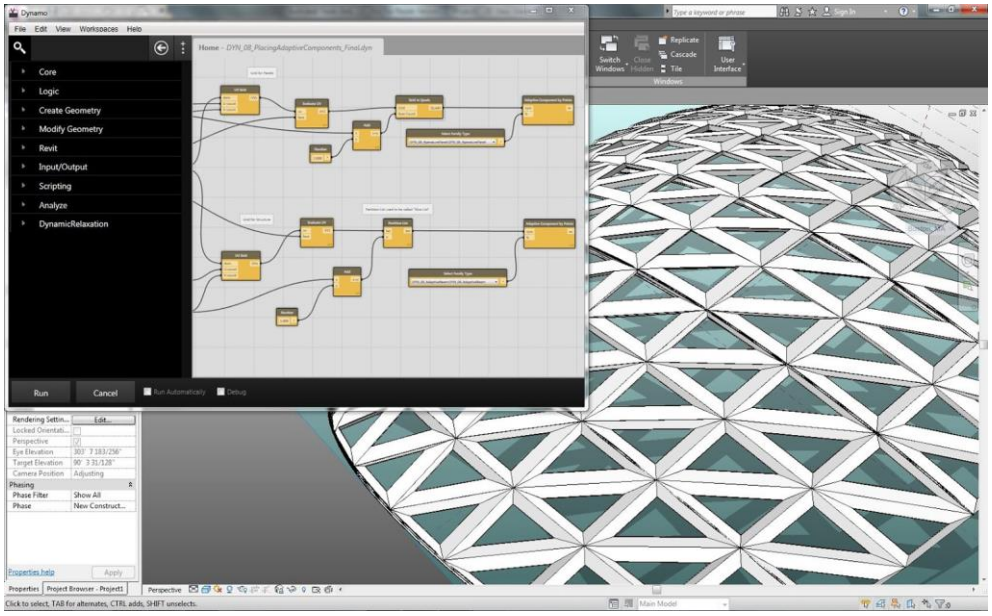
- http://www.geometrydepth.com/weaverbird-in-30-minutes/

Dynamo

General Info

Company	Autodesk
Official Site	http://autodeskvasari.com/dynamo
Type	Plug-in
Target	Computational Design

Screencapture



Description / Features

Dynamo is a visual programming environment for Building Information Modeling, which allows designers and architects to explore new shapes using generative algorithms. Dynamo is a plug-in that extends the parametric capabilities of Revit and Vasari with a simplified environment of a graphical algorithm editor.

References

Tutorials

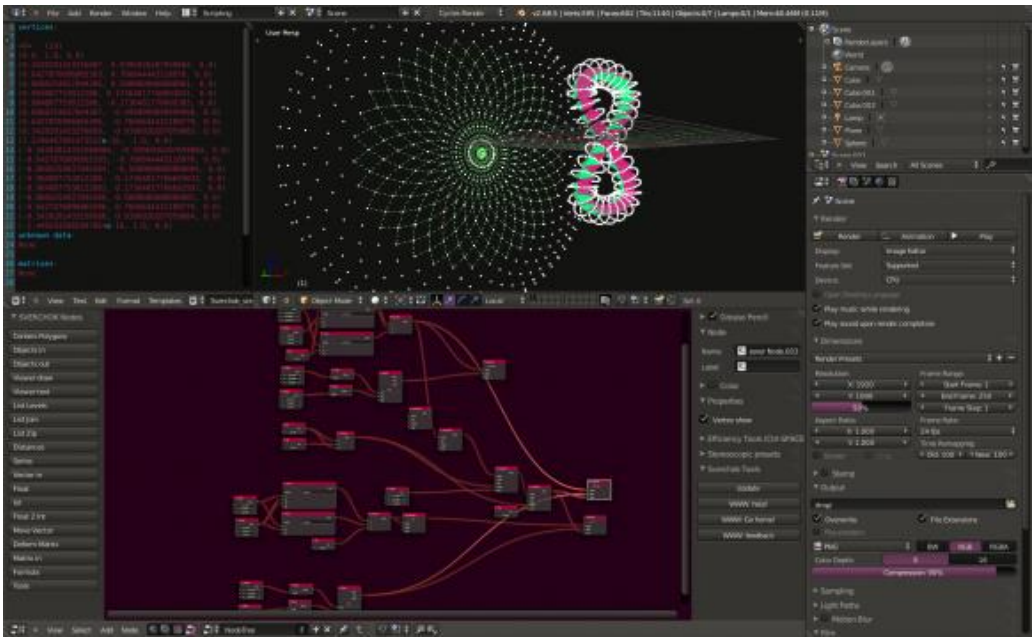
- http://www.youtube.com/watch?v=Ek8kTNU0Imw

Sverchok

General Info

Company	Alexander Nedovzin and Nikita Gorodetskiy
Official Site	http://nikitron.cc.ua/blend_scripts.html
Type	Plug-in
Target	Computational Design

Screencapture



Description / Features

Sverchok is an add-on for Blender which aims to create a node based programming interface for modelling. Directly inspired by Grasshopper, this add-on has the clear difference that it is opensource, while it is still in development.

References

Tutorials

- http://www.youtube.com/watch?feature=player_embedded&v=MkgoHZowtTU

Projects

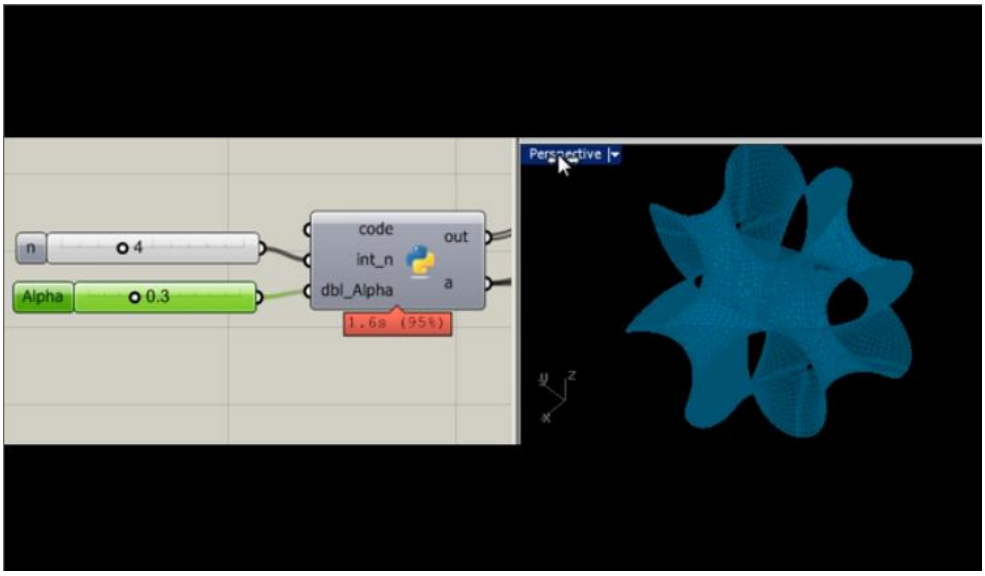
- http://www.blenderartists.org/forum/showthread.php?272679-Addon-WIP-Sverchok-parametric-tool-for-architects

Calabi Yau Manifold

General Info

Company	Dimitry Demin
Official Site	http://www.food4rhino.com/project/calabi-yau-manifold
Type	Plug-in for Grasshopper (mesh menu)
Target	Computational Design

Screencapture



Description / Features

A Calabi-Yau space is a mathematical construction used by physicists to describe parts of nature that are too small to see with the human eye.
Although the definition can be generalized to any dimension, they are usually considered to have three complex dimensions. Since their complex structure may vary, it is convenient to think of them as having six real dimensions and a fixed smooth structure. One interesting property is the symmetry in the numbers forming the Hodge diamond of a compact Calabi-Yau manifold. It is surprising that these symmetries, called mirror symmetry, can be realized by another Calabi-Yau manifold, the so-called mirror of the original Calabi-Yau manifold. The two manifolds together form a mirror pair. Some of the symmetries of the geometry of mirror pairs have been object of recent research.

References

Projects

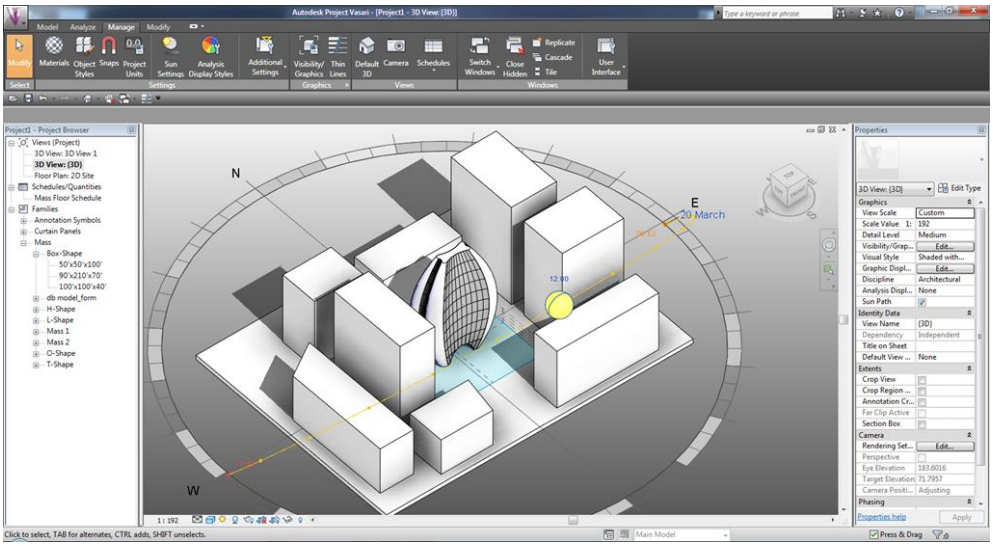
- Calabi Yau Manifold Crystal: http://www.youtube.com/watch?v=5aWQEWoUy1E

Vasari

General Info

Company	Autodesk
Official Site	http://autodeskvasari.com
Type	Stand-alone application
Target	Advanced Modeling

Screencapture



Description / Features

Vasari is a building design and analysis tool that lets you focus on the conceptual design phase. It supports performance-based design via integrated energy modeling/ analysis, solar radiation analysis, and more.
Conceptual building models created with Vasari can be used in Autodesk Revit.
Vasari is focused on conceptual building design using both geometric and parametric modeling.
Many plugins expand the software capabilities, like the Dynamo (algorithmic design) or Python (scripting) and other more specific add-ins like Parameters from Image (W.I.P.)

References

Tutorials

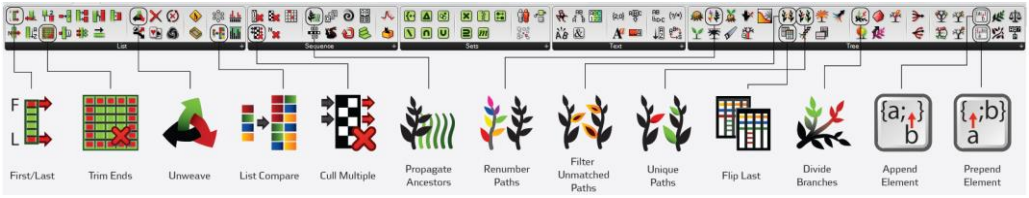
- http://autodeskvasari.com/video/video/listTagged?tag=tutorial
- http://www.youtube.com/watch?v=AuNZXyXxpWc
- Scripting in vasari with Python: http://www.youtube.com/watch?v=EBAhA5IHTRQ
- Vasari vs. Dynamo: http://www.youtube.com/watch?v=gclsKawNsMw

TreeSloth

General Info

Company	David Stasiuk
Official Site	http://www.grasshopper3d.com/group/milkbox/forum/topics/tree-sloth
Type	Components for Grasshopper
Target	Computational Design

Screencapture



Description / Features

TreeSloth is a set of components which add functionality to lists management in Grasshopper. Of particular relevance, is the component “Propagate Ancestors” which eases the interrelation of data in non-matching length lists.

References

Manual

- http://www.grasshopper3d.com/group/milkbox/forum/topics/tree-sloth

Download

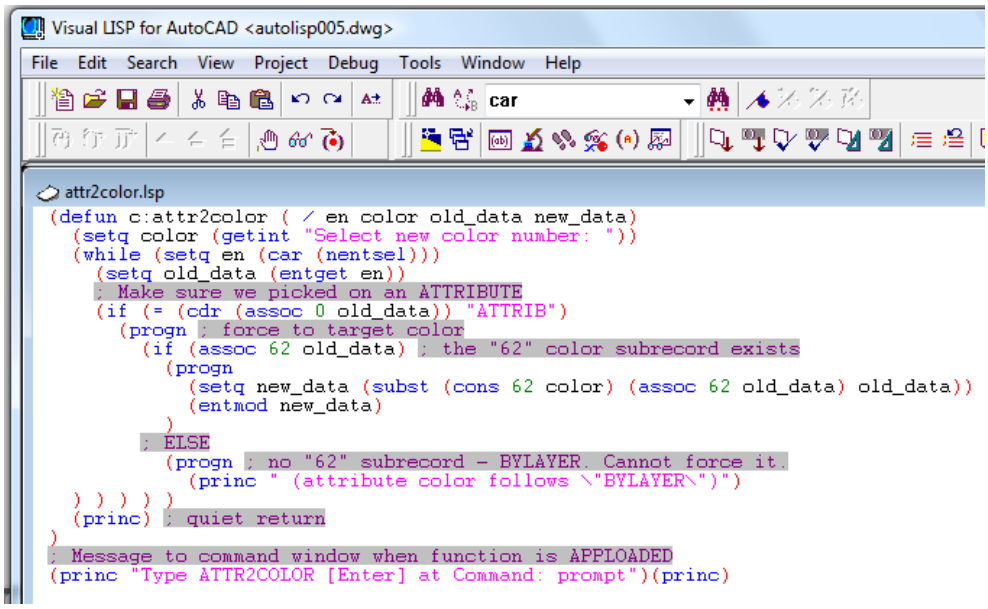
- http://api.ning.com/files/uvilscSDxx*BXWnHdxtN4HRa8XYuTBaVSGapYef-upFcHh4Fm6AfriP0lb08rddXiwdbyv3uWREpNcHN7iAwGBrwSvVApYXV/tree_sloth_1.0.gha

AutoLISP

General Info

Company	Autodesk
Official Site	http://usa.autodesk.com/adsk/servlet/index?siteID=123112&id=770237
Type	Scripting language
Target	Programming Languages

Screencapture



Description / Features

AutoLISP is a programming language invented in 1958, being one of the oldest in use today. One of its main advantages was dealing with complex data tree structures. Its popularity is mainly derived for its use in AutoCAD, the most popular CAD package in the last years.

References

Manual

- http://docs.autodesk.com/ACDMAC/2013/ENU/PDFs/acdmac_2013_autolisp_developers_guide.pdf

Tutorials

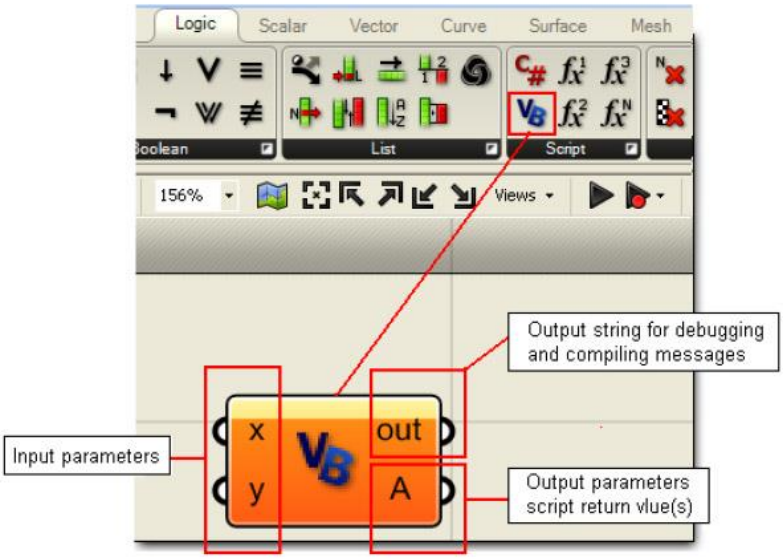
- http://www.cadtutor.net/tutorials/autolisp/quick-start.php

Visual Basic .NET

General Info

Company	Microsoft
Official Site	http://msdn.microsoft.com/en-us/vstudio/hh388573.aspx
Type	Programming and scripting language
Target	Programming Languages

Screencapture



Description / Features

Visual Basic is a language created by Microsoft with ease of use in mind. It featured a full-fledged graphical GUI editor, making it a favorite for early programmers. In 2002 Microsoft integrated Visual Basic into its .NET framework, making it one of the languages used along with C#. With a historical background on first-approach to programming within the Windows environment, and full support within Rhino, it has been a popular choice for scripting in this software.

References

Manual

- http://wiki.mcneel.com/developer/dotnetplugins

Tutorials

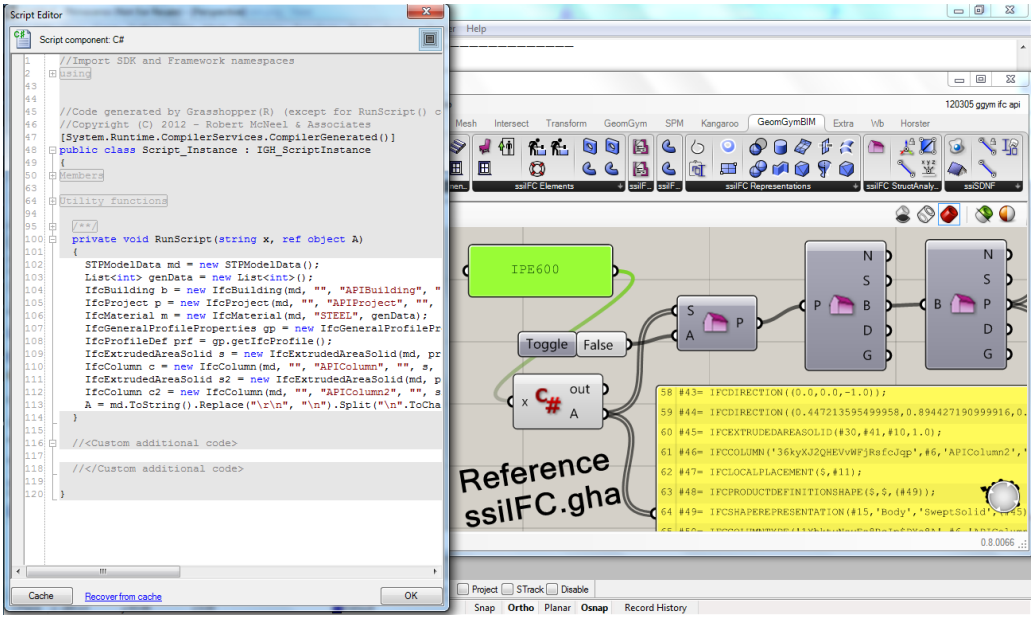
- http://wiki.mcneel.com/developer/simplevbplugin

C#

General Info

Company	Bjarne Stroustrup
Official Site	http://www.open-std.org/JTC1/SC22/WG21/
Type	Programming language
Target	General Purpose

Screencapture



Description / Features

C# is a general purpose programming language. It was created by Microsoft to make part of its Common Language Interface (CLI) in an effort to create a machine independent way to code. It evolved from C++, which in its turn evolved from C, arguably the most popular programming language of all time. The major difference of C++ to C, is the implementation of object orientation features.
Due to this nesting nature, writing C or C++ in a C# environment is possible with few exceptions. McNeel chose to implement C# within the .NET initiative, making it also available in Grasshopper.

References

Manual

- http://wiki.mcneel.com/developer/dotnetplugins

Tutorials

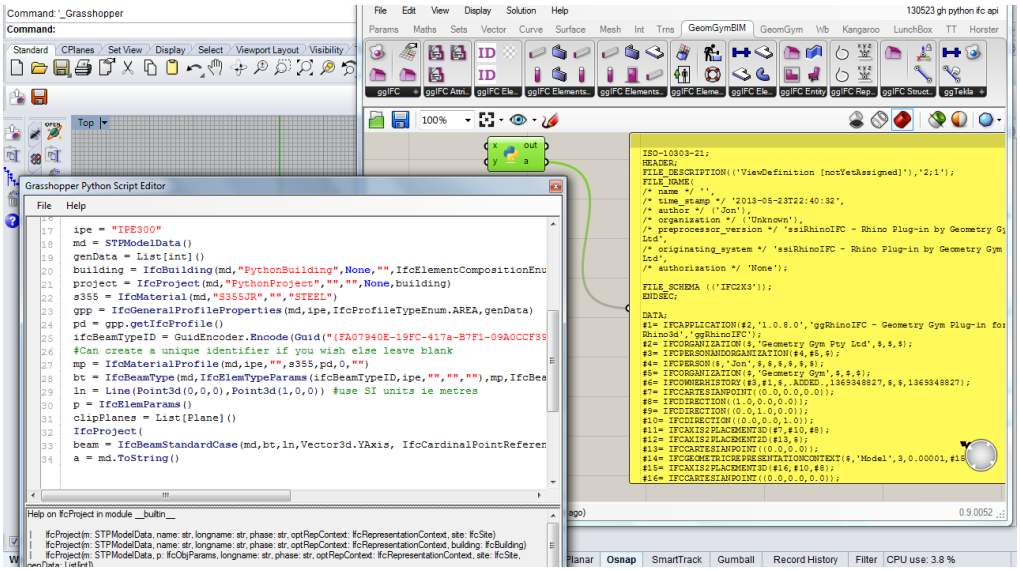
- http://msdn.microsoft.com/en-us/library/aa288436(v=vs.71).aspx

Python

General Info

Company	Guido van Rossum
Official Site	http://www.python.org/
Type	Programming language
Target	General Purpose / Scripting

Screencapture



Description / Features

Python is a language designed from the ground-up with very clear objectives, being the most visible its ease of use and learning, quick and clean writing, and english readability and aesthetics. It is somewhat based in C and ABC, and borrows Icon's clear synthax paradigms. In the last 5 years, Python has seen great adherence as a side-car language: a great majority of scriptable software packages are supporting this language, including Rhino and Grasshopper.

References

Manual

- http://www.rhino3d.com/download/IronPython/5.0/RhinoPython101

Tutorials

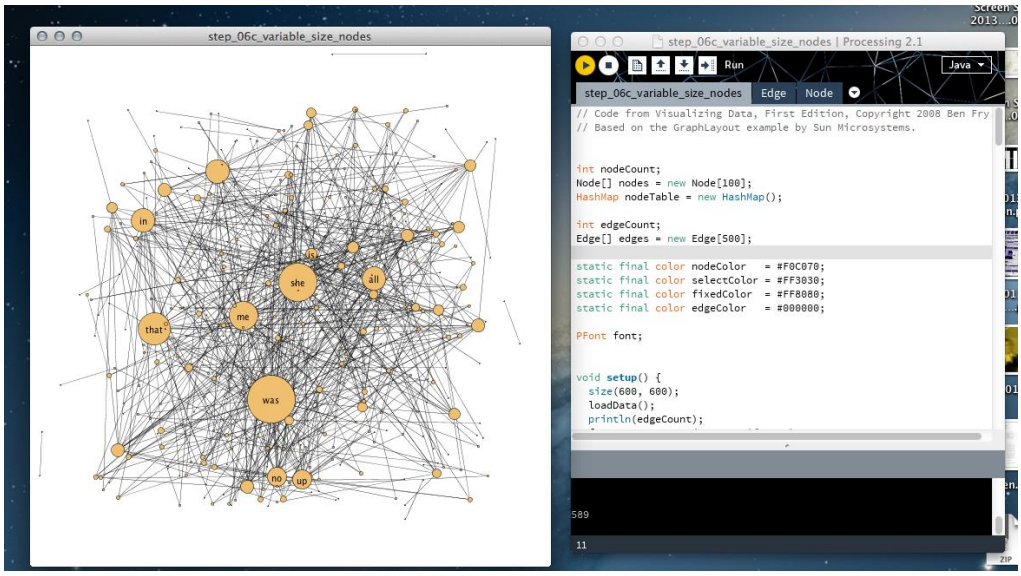
- http://docs.python.org/2.7/tutorial/index.html
- http://www.codecademy.com/pt/tracks/python

Processing

General Info

Company	Casey Reas and Benjamin Fry
Official Site	http://processing.org/
Type	Programming language
Target	Graphics

Screencapture



Description / Features

Processing was developed as a programming language with which people with no or few programming experience could experiment and create art projects. Its runs within its own application, it is open source, and runs on various platforms. It is very popular as an interface between various sources of information, being a favourite among data visualizers such as infographic creators.

References

Manual

- http://www.processing.org/reference/

Tutorials

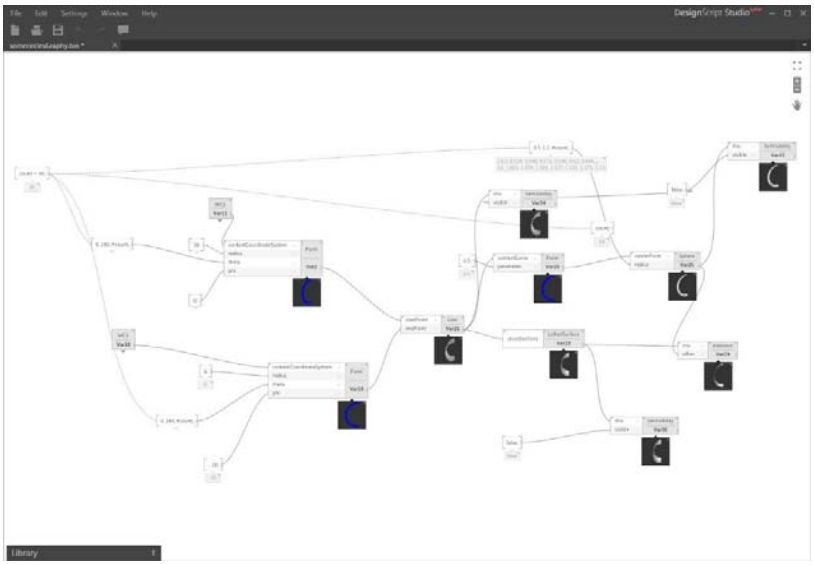
- http://www.processing.org/tutorials/

DesignScript

General Info

Company	Autodesk
Official Site	http:// labs.autodesk.com/utilities/designscript/
Type	Scripting language
Target	General Purpose

Screencapture



Description / Features

Designscript is a new language still being evolved by Autodesk which intends to be the answer to Grasshopper or Generative Components. Its interface has some advantages, like previews in each node, or visualizing the correspondent code for each node.

References

Tutorials

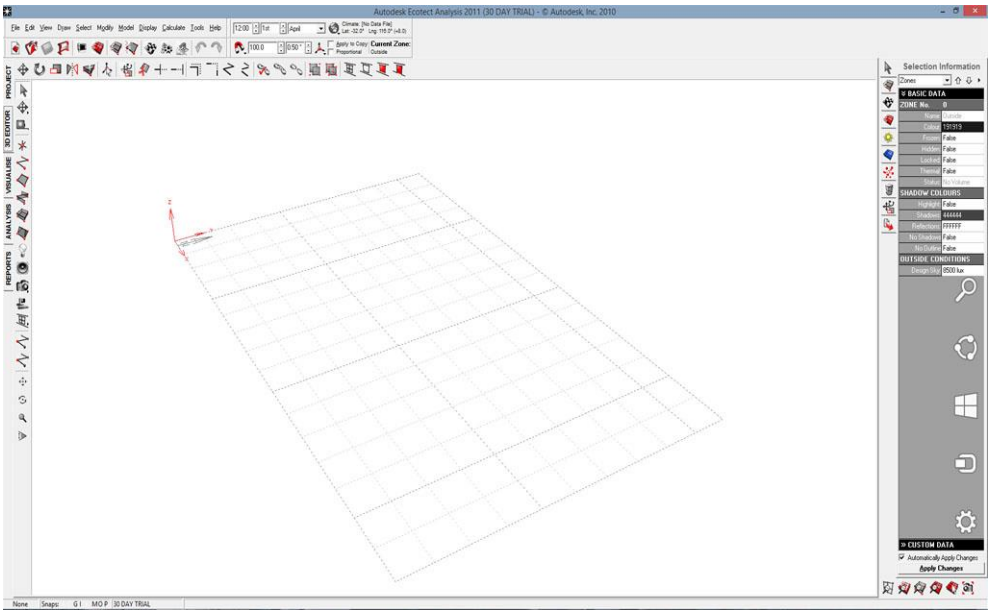
- http://designscript.ning.com/

Ecotect Analysis

General Info

Company	Autodesk
Official Site	www.usa.autodesk.com/ecotect-analysis
Type	Stand-alone application
Target	Performative Analysis

Screencapture



Description / Features

Autodesk Ecotect Analysis is Software used as sustainable building design tool. Ecotect Analysis performs different kinds of building energy analysis in order to improve performance in all types of buildings, such as:

- Whole-building energy analysis
- Thermal performance
- Water usage and cost evaluation
- Solar radiation
- Shadows and reflections

References

Manuals

- http://www.gsd.harvard.edu/research/gsdsquare/Publications/GettingStartedwithEcotectRadianceDaysim.pdf

Tutorials

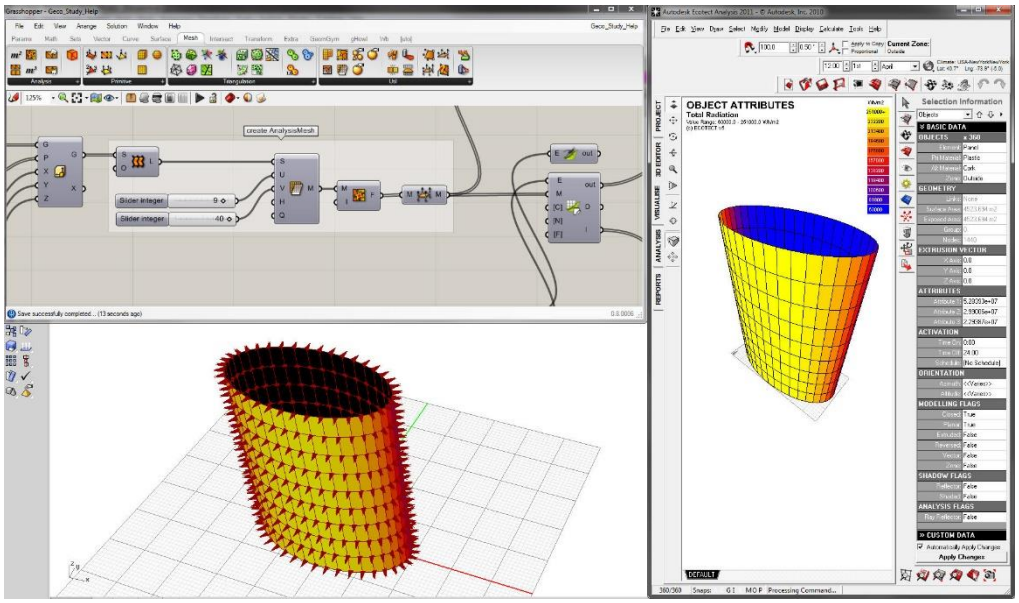
- http://www.youtube.com/watch?v=pkcWGmznjQc
- http://www.youtube.com/watch?v=hpdFU7a9Z1A
- http://www.youtube.com/watch?v=fEJgG4mqXmA
- http://www.youtube.com/watch?v=XSYbfoQZG7k

Geco

General Info

Company	UTO
Official Site	http://utos.blogspot.com/
Type	Plug-in
Target	Performative Analysis

Screencapture



Description / Features

Geco offers a direct link between Rhino/Grasshopper models and Ecotect.
The Plug-in allows you to export complex geometries very quickly, evaluate your design in Ecotect and access the performances data, to import the results as feedback to Grasshopper.

References

Tutorials

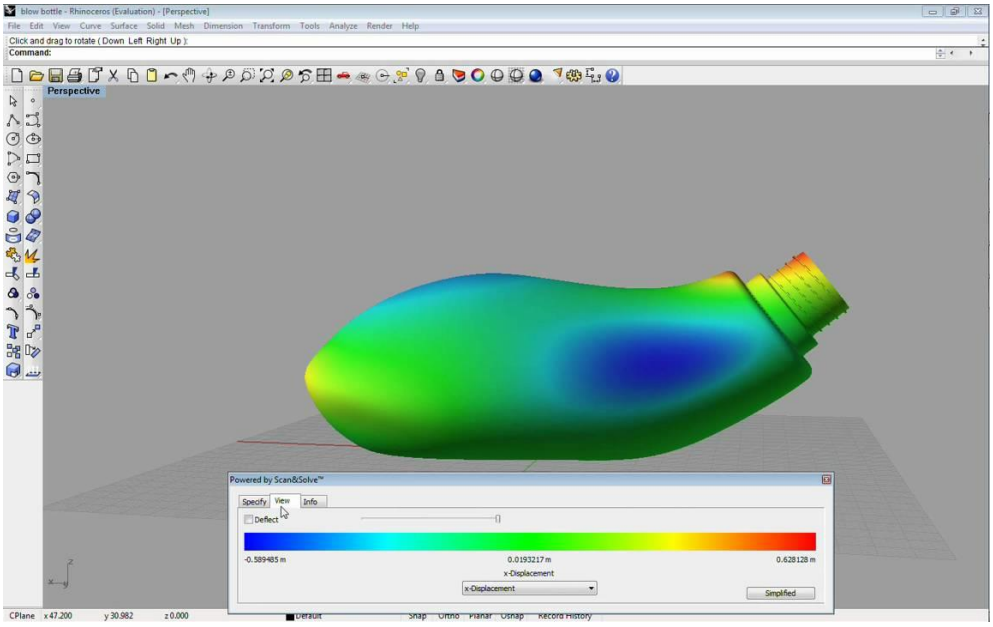
- http://www.youtube.com/watch?v=eEhna0AFfsY

Scan&Solve

General Info

Company	Intact Solutions, LLC
Official Site	http://www.scan-and-solve.com http://www.intact-solutions.com/scanandsolve/
Type	plug-in
Target	Performative Analysis

Screencapture



Description / Features

Scan&Solve for Rhino completely automates basic structural simulation of Rhino solids. Scan&SolveTM software for engineering analysis from Intact Solutions is based on a patented meshfree technology that liberates Finite Element Analysis (FEA) from the dependence on and limitations of meshing. The salient feature of the technology is separate handling and controls of geometric and physical computational models that are seamlessly combined at solution run time.

References

Tutorials

- http://www.youtube.com/watch?v=fOeBaVkaVeU
- http://www.youtube.com/watch?v=IaFvKEbp9k4

Projects

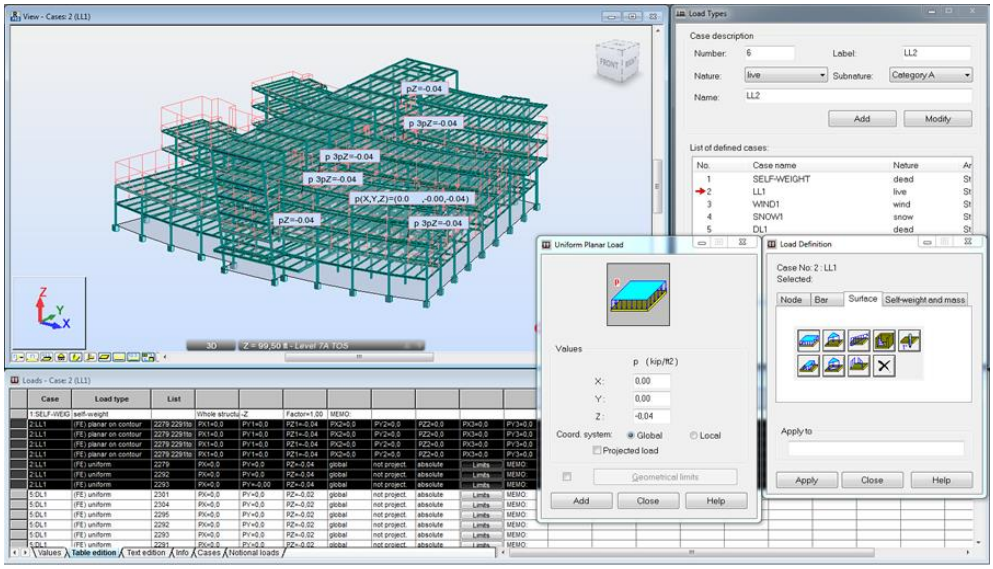
- http://www.youtube.com/watch?v=oa4q9DyFTZg

Robot Structural Analysis

General Info

Company	Autodesk
Official Site	http://www.autodesk.com/products/autodesk-simulation-family/features/robot-structural-analysis/all/gallery-view
Type	Stand-alone application
Target	Performative Analysis

Screencapture



Description / Features

Autodesk ® Robot ™ Structural Analysis Professional makes available to designers a complete set of tools for modeling and design of structures of any size and complexity.

- Two-way communication with Autodesk Revit Structure
- A wide range of analysis capabilities
- Enhanced partitioning into finite elements (“auto-meshing”)
- Application of state standards / design codes
- Integrated modules for the calculation of structures

References

Manuals

- http://images.autodesk.com/adsk/files/robot_2010_training_manual_metric.pdf
- http://images.autodesk.com/adsk/files/robot_getting_started_guide_eng_2011_metric_2.pdf

Tutorials

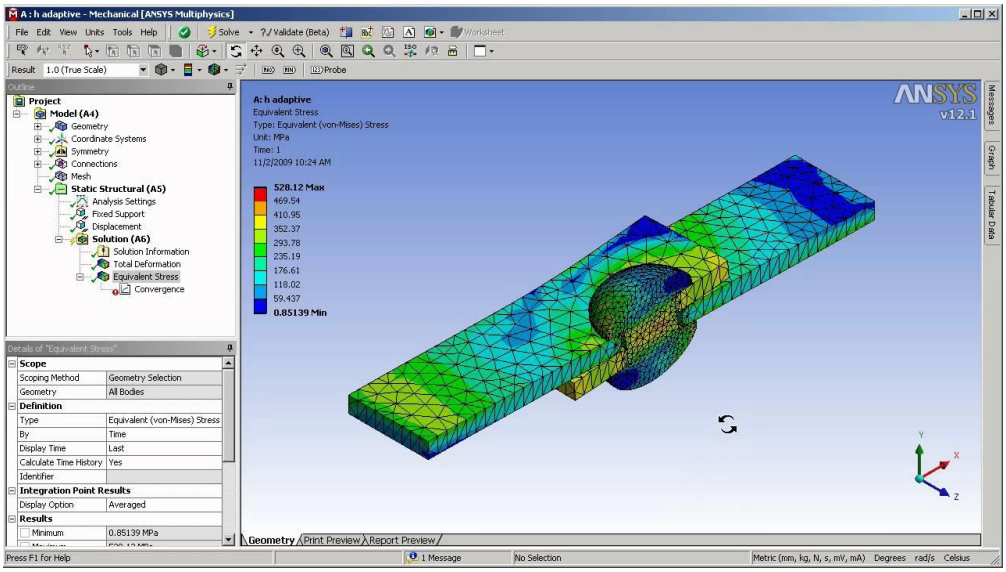
- http://aec-projects.com/autodesk-robot-structural-analysis-professional/
- http://www.youtube.com/watch?annotation_id=annotation_3668951835&feature=iv&src_vid=PWrPXcT7lOA&v=ylwnB4S2lX0

Ansys

General Info

Company	ANSYS, Inc
Official Site	http://www.ansys.com/
Type	Software stand-alone
Target	Performative Analysis

Screencapture



Description / Features

Ansys provides various solutions for FEA analysis, ranging through structural, fluid, magnetic and even life cycle.

References

Manual

- http://research.me.udel.edu/~lwang/teaching/MEx81/ansys56manual.pdf

Tutorials

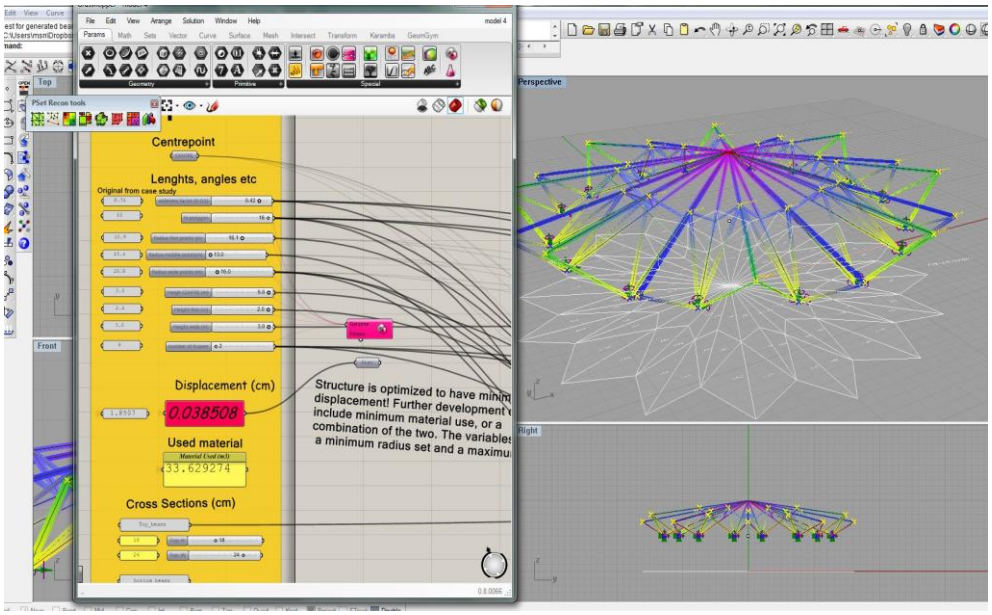
- http://www.ansys.com/Industries/Academic/Tools/Curriculum+Resources/Tutorials,+Examples+&+Curriculum

Karamba

General Info

Company	Clemens Preisinger in cooperation with Bollinger-Grohmann-Schneider ZT GmbH Vienna
Official Site	http://www.karamba3d.com
Type	Plug-in for Grasshopper
Target	Computational Design

Screencapture



Description / Features

Karamba is fully embedded in the parametric environment of Grasshopper. This makes it easy to combine parameterized geometric models, finite element calculations and optimization algorithms. It provides accurate analysis of spatial trusses and frames. It calculates and visualizes displacements based on loads, materials (primarily young modulus and shear modulus), cross sections and supports.
Resuming it is an interactive, parametric finite element program that lets you analyze the response of 3-dimensional beam and shell structures under arbitrary loads.

References

Manuals

- http://www.karamba3d.com/wp-content/uploads/gh/Install/Karamba_1_0_4-Manual.pdf
- http://www.karamba3d.com/wp-content/uploads/gh/Install/Karamba_1_0_3-Manual.pdf
- http://www.food4rhino.com/project/karamba
- http://www.grasshopper3d.com/group/karamba/page/new-features-and-bug-fixestW7r7tfC9duICi7XyI9wmPkGQUPIm_8sj7bqMvTXs/edit

Tutorials

- http://www.karamba3d.com/category/tutorials/

Projects

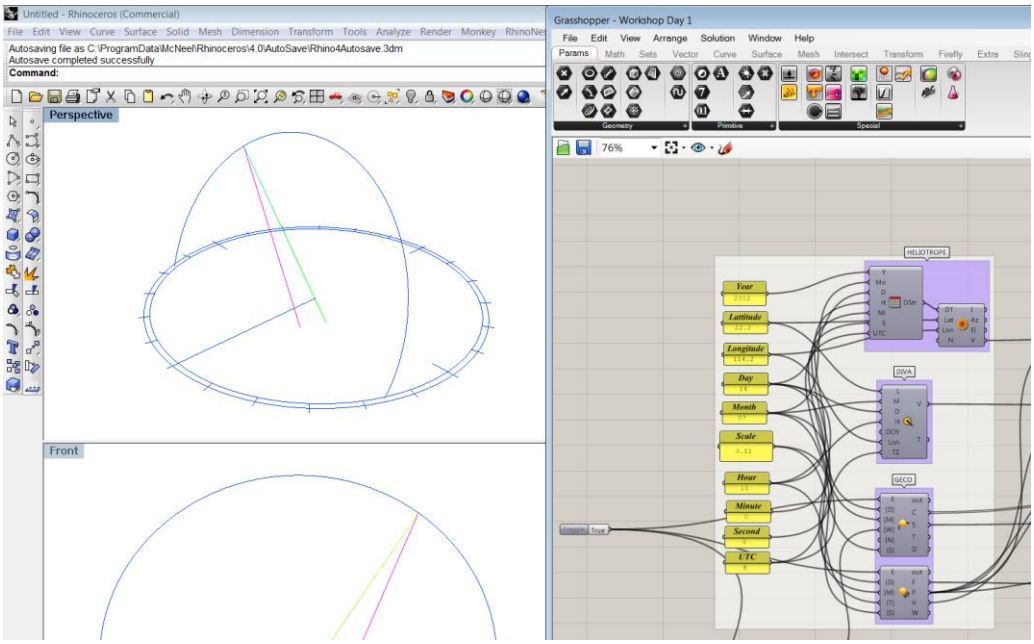
- http://www.karamba3d.com/category/projects/

Heliotrope

General Info

Company	Slate shingle studio
Official Site	http://slateshinglestudio.com/tools
Type	Plug-in
Target	Performative Analysis

Screencapture



Description / Features

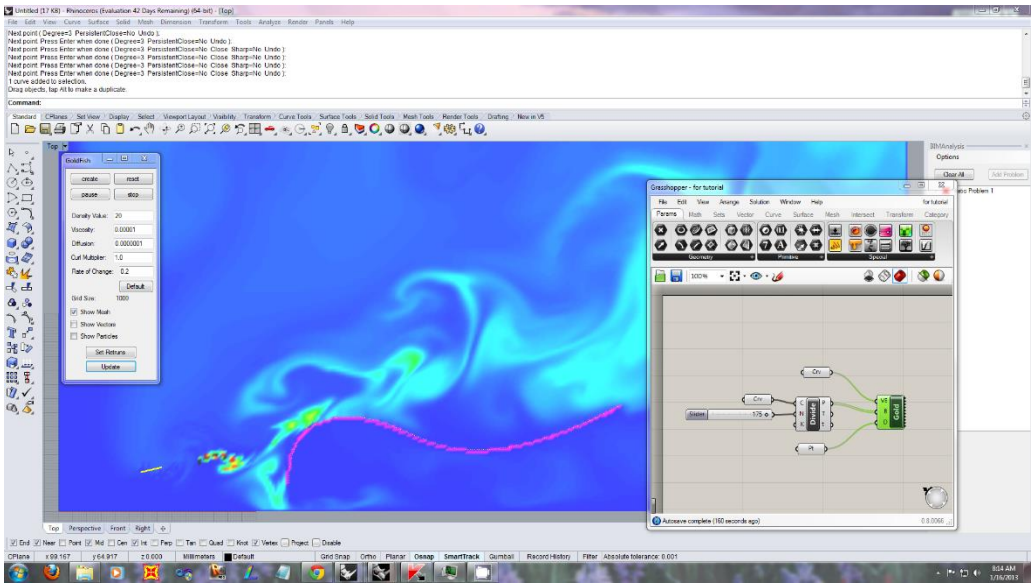
Heliotrope is a plugin that works with Grasshopper or Vasari to design and enhance solar geometry. Heliotrope allows the user to calculate solar position at specific dates and times parametrically. This tool can be used to analyze incident sun on different geometries, to create solar-aware design or even to position rendering lights.

Gold Fish

General Info

Company	ThisPoint
Official Site	http://www.thispointon.com/
Type	Plun In for Grassjopper
Target	Computacional Design

Screencapture



Description / Features

GoldFish is a CFD Solver for Grasshopper written in C++ and C#, fast enough to allow the user to interact with the problem and see updates in real time. Its initial release has limited functionality but there will be more to come.

References

Tutorials

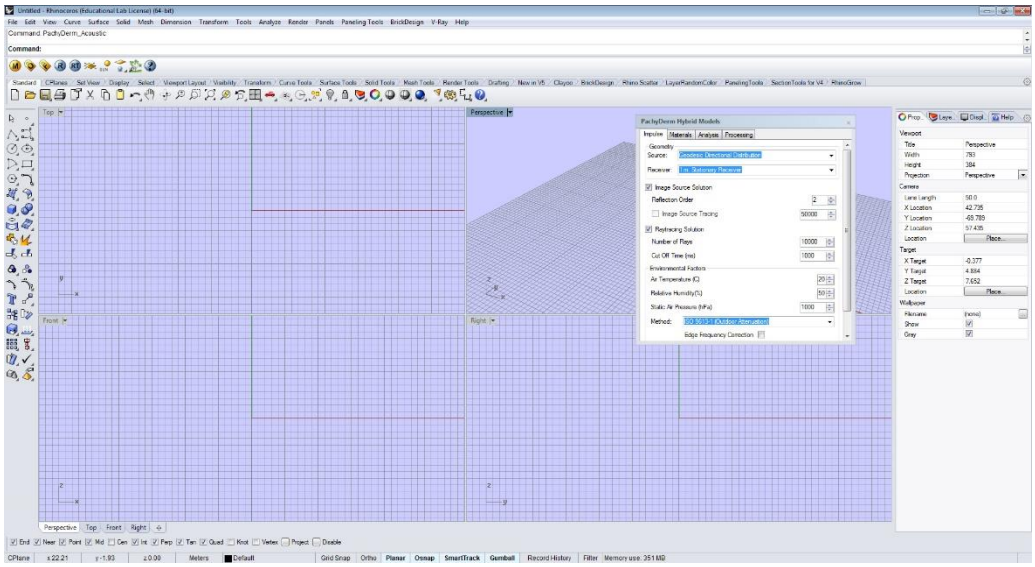
- http://www.thispointon.com/?p=493

Pachyderm Acoustical Analysis

General Info

Company	Arthur van der Harten
Official Site	http://www.perspectivesketch.com/pachyderm/
Type	Plug-In for Rhinoceros
Target	Performative Analysis

Screencapture



Description / Features

Pachyderm enables the use of common geometrical acoustics algorithms within the context of the Rhinoceros geometry system. While this plug-in is not as full featured as some proprietary systems, it enables certain capabilities that have not been available before now.

References

Tutorials

- http://www.perspectivesketch.com/pachyderm/index.php?option=com_content&view=category&id=28&Itemid=59

Projects

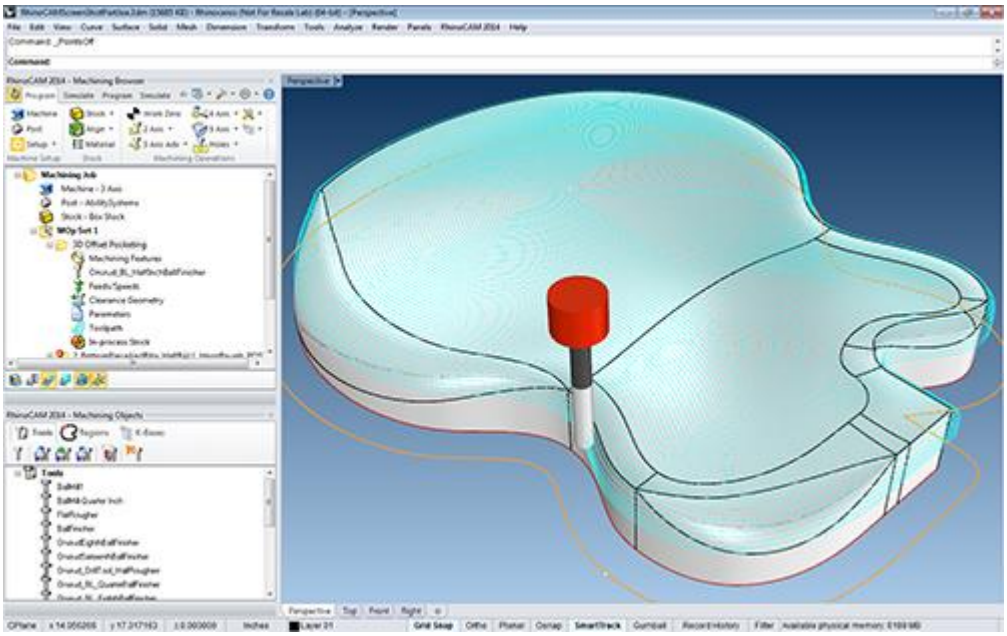
- Hammer Hall Arts Center in Melbourne

Rhino CAM

General Info

Company	Mec Soft Corporation
Official Site	http://rhinocam.com/index.shtml
Type	Plugin for Rhinoceros
Target	Digital Fabricaton

Screencapture



Description / Features

RhinoCam is a Rhinoceros plug-in that runs completely inside of Rhino 5.0. Combining the free-form modeling power of Rhino and machining capabilities of VisualMill, this plug-in offers an easy to use yet powerful general purpose machining program.

References

Manuals

- http://www.mecsoft.com/guest/Training/TrainingManual-RhinoCAM.pdf

Tutorials

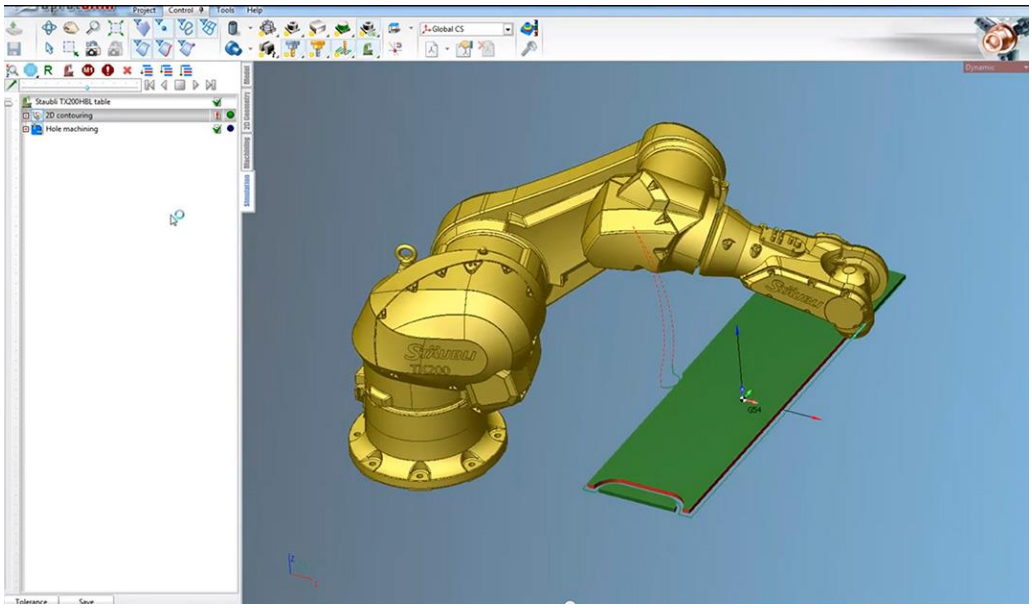
- http://rhinocam.com/Training-Tutorials.shtml

SprutCAM

General Info

Company	Sprut Technology
Official Site	http://www.sprutcam.com
Type	Stand-alone CAM package
Target	Robotics

Screencapture



Description / Features

SprutCAM is a CAM system for Numerical Control program generation for machining using multi-axis milling, turning, turn/mill, Wire EDM numerically controlled machines and machining centers. The system enables the creation of Numerical Control programs for machines with a wide variety of kinematics and can be adjusted to NC equipment of virtually any kind.

- Compatibility and integration with Rhinoceros
- SprutCAM Robot: is a solution allowing the efficient use of Fanuc, Kuka, Staubli, Yaskawa Motoman, Toshiba, Mitsubishi, Nachi, ABB and etc

References

Manual

- http://www.sprutcam.com/files/documentation/SprutCAM8/eng/index.html

Tutorials

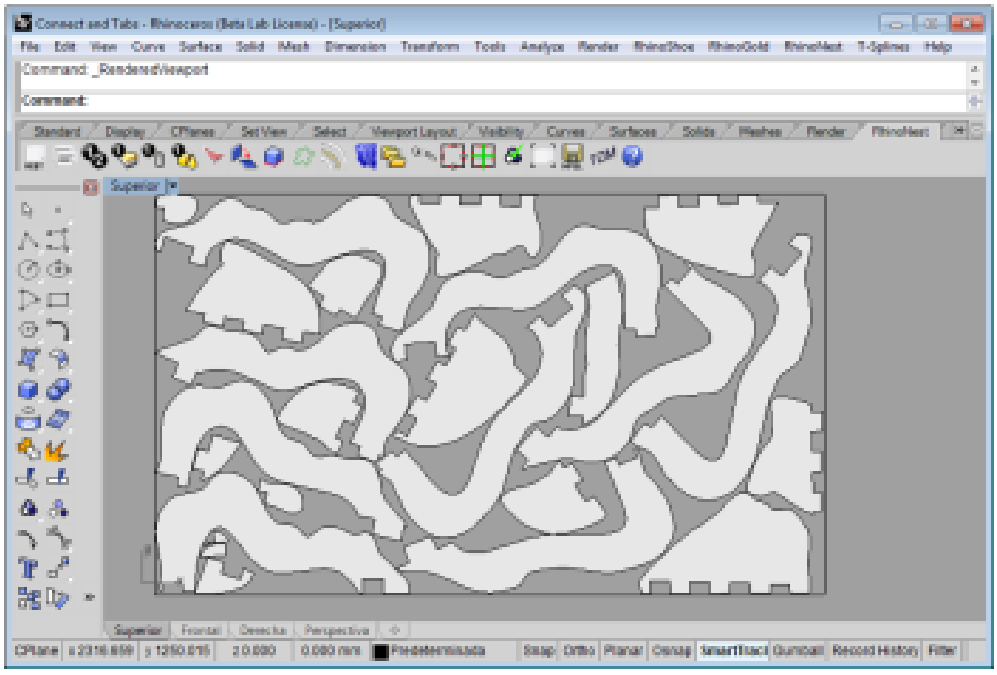
- http://www.youtube.com/user/SprutCAMAmerica/videos

Rhino Nest

General Info

Company	TDM Solutions
Official Site	http://www.rhinonest.com/
Type	Plun In for Rhinoceros
Target	Digital Fabricaton

Screencapture



Description / Features

RhinoNest is a packing software for Rhinoceros. Packing as the optimization and orientation of objects to save material. RhinoNest is fully integrated in Rhinoceros.

References

Tutorials

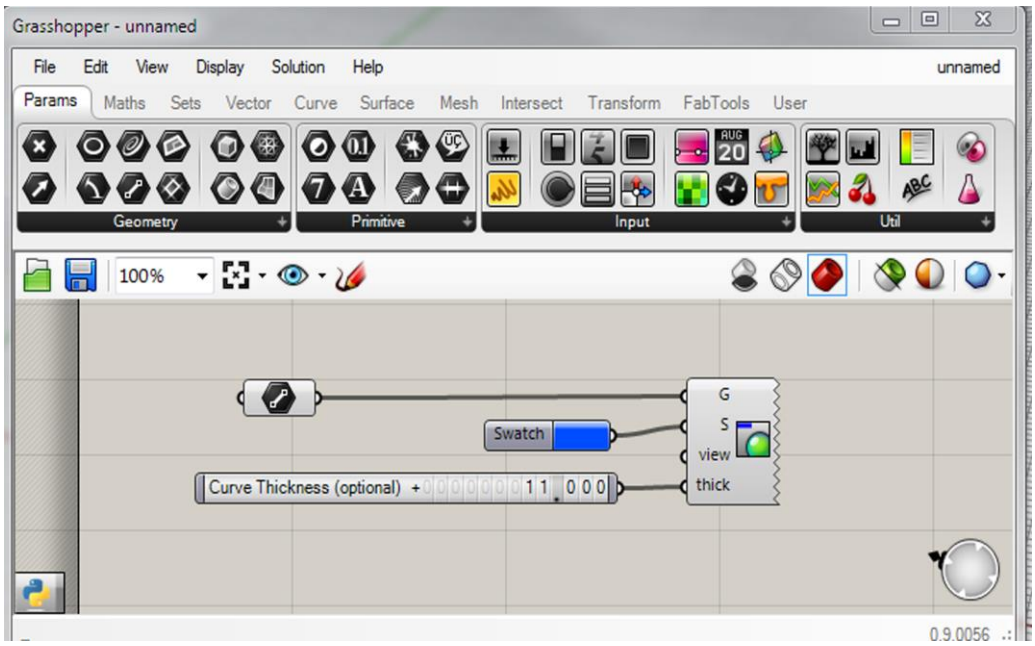
- http://www.youtube.com/watch?v=M6PJN0XtvV4

FabTools

General Info

Company	McNeel Rhinoceros
Official Site	http://fabtools.blickfeld7.com
Type	Plug-in
Target	Digital Fabrication

Screencapture



Description / Features

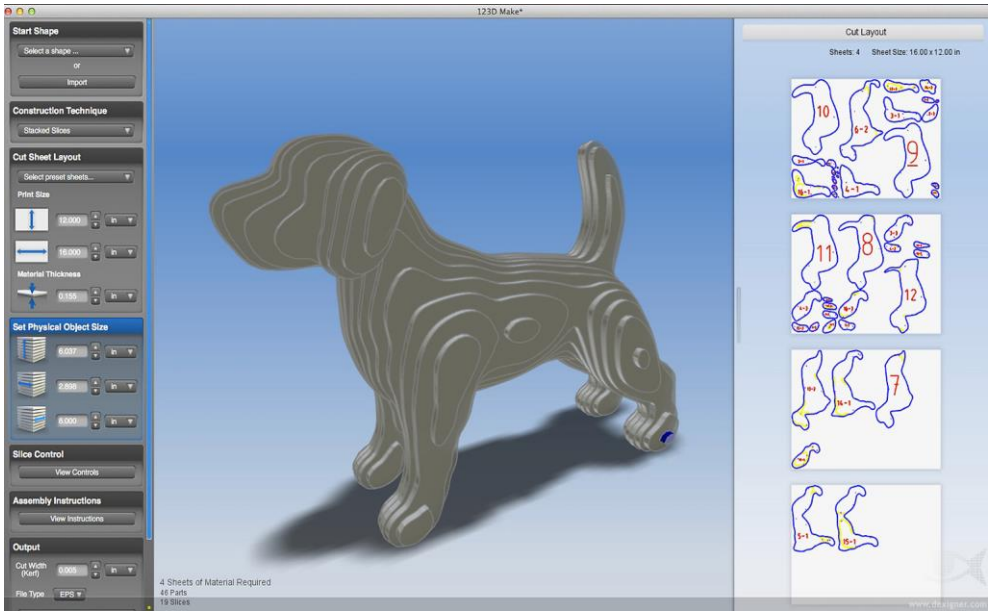
FabTools is a suite of digital fabrication tools that works with Grasshopper providing the user the ability to multi-task. The different tools increase Grasshopper's skills to set properties to geometry, improving speed and workflow when working for production. Tasks like moving objects to layers, baking or unrolling will become easier with FabTools.

Autodesk 123D

General Info

Company	Autodesk
Official Site	http://www.123dapp.com
Type	Stand-alone application
Target	Digital Fabrication

Screencapture



Description / Features

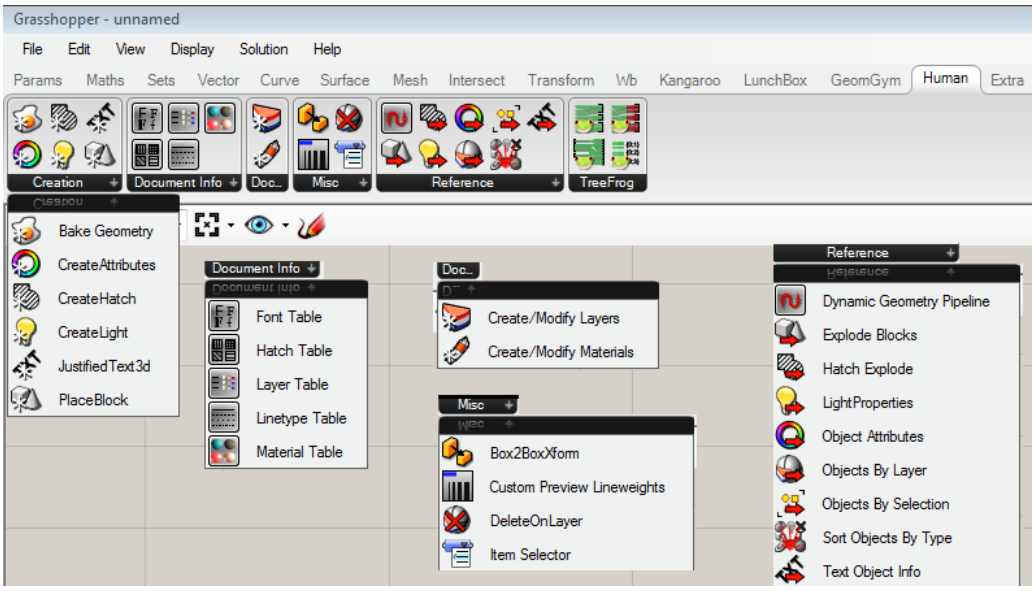
Autodesk 123D is a free software suite created by Autodesk that connects basic 3D modeling tools with fabrication services, which allow people to create, explore and make their own project, due to its ability to transform models into cut patterns and STL export.

Human

General Info

Company	Andrew Heumann
Official Site	http://www.food4rhino.com/project/human
Type	Plug-in
Target	Digital Fabrication

Screencapture



Description / Features

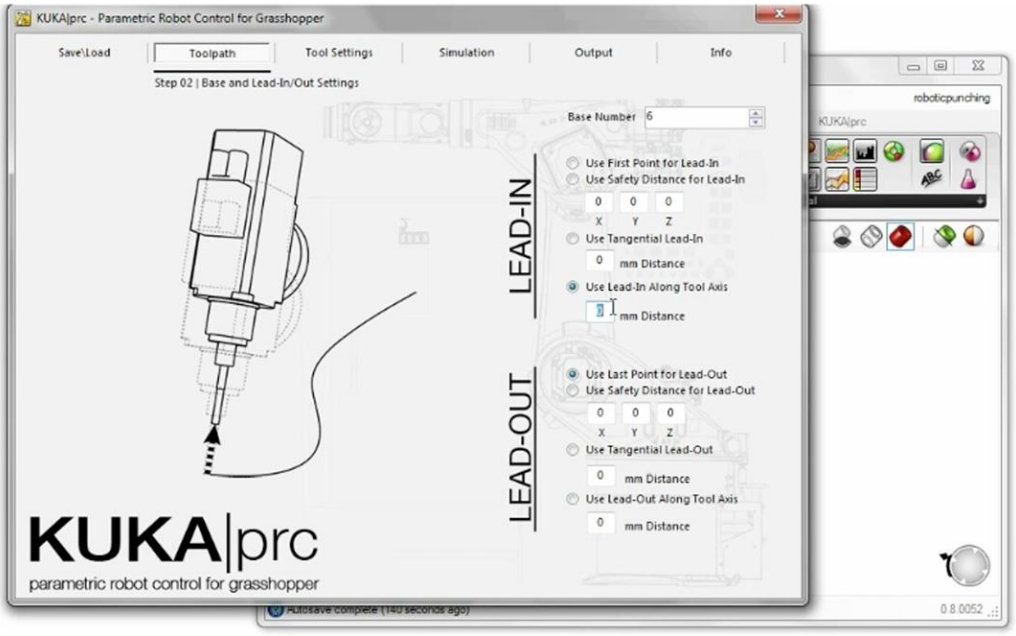
Human aims to fill a gap between the main Rhino viewport and the Grasshopper interface. By creating rules, a user can have objects being automatically selected by a Grasshopper component, by layer, for example. The opposite is also true: Human excels in creating meaningful meta-filled objects into Rhino.

Kuka|prc

General Info

Company	Association for Robots in Architecture
Official Site	http://www.robotsinarchitecture.org/kuka-prc
Type	Plug-In for Grasshopper
Target	Robotics

Screencapture



Description / Features

KUKA|prc is a range of custom components packaged as a plugin for the parametric design software Grasshopper which in turn is a plugin for the NURBS modeller Rhinoceros. KUKA|prc enables you to program industrial robots directly out of the parametric modelling environment, including a full kinematic simulation of the robot. The generated files can be executed at the KUKA robot, without requiring any additional software.

References

Tutorials

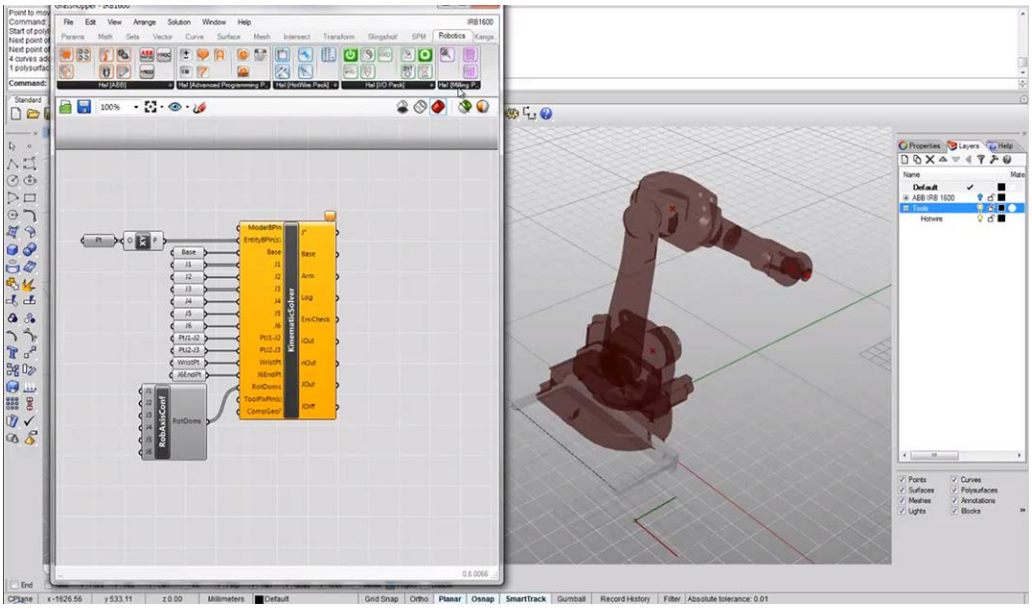
- http://www.robotsinarchitecture.org/wp-content/uploads/2012/04/gh_kukaprc_tutorial.zip

HAL

General Info

Company	Thibault Schwartz
Official Site	http://hal.thibaultschwartz.com
Type	Plug-In for Grasshopper
Target	Robotics

Screencapture



Description / Features

HAL is a Grasshopper plugin for industrial robots programming. HAL allows designers to simulate, program and control complex multi-robots setups in real-time. With its special programming packs covering a large panel of RAPID instructions, HAL facilitates the creation of advanced application structures including I/O management, error handling and multi-tasking. Specific tooling packs, for hotwire cutting, milling and picking, ease the programming process of innovative fabrication strategies.

References

Tutorials

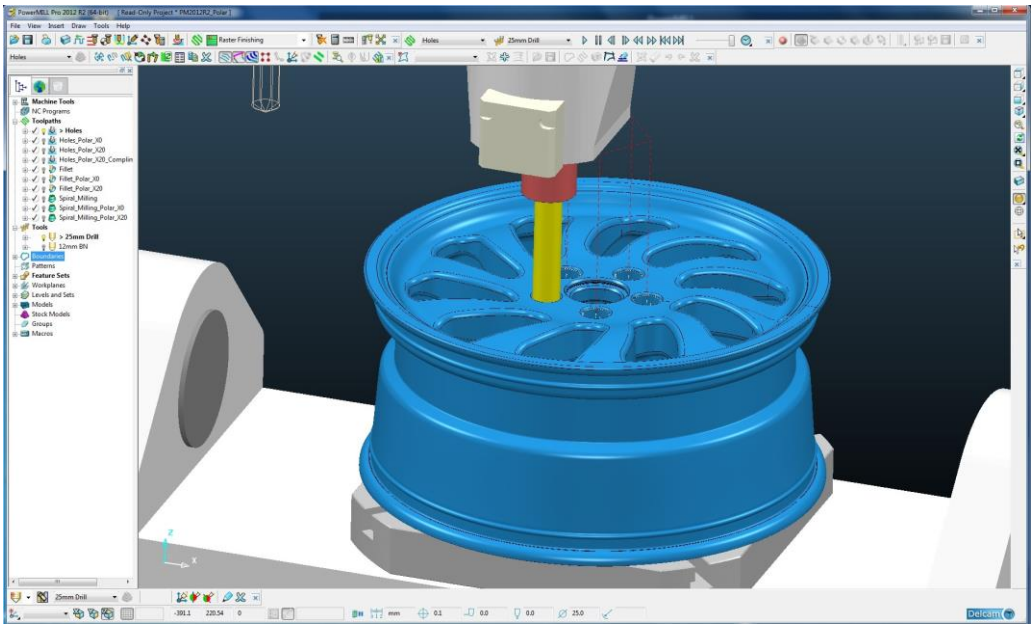
- http://vimeo.com/user14541056/videos/sort:alphabetical/format:thumbnail

PowerMill

General Info

Company	Delcam Advanced Manufacturing Solutions
Official Site	http://www.powermill.com/
Type	Stand-alone software
Target	Robotics

Screencapture



Description / Features

PowerMILL is a software for the programming of tool paths for 2 to 5 axis CNC Milling machines. The software is used in a range of different engineering industries to determine optimal tool paths to reduce time and manufacturing costs as well as reduce tool loads and produce smooth surface finishes.

References

Tutorials

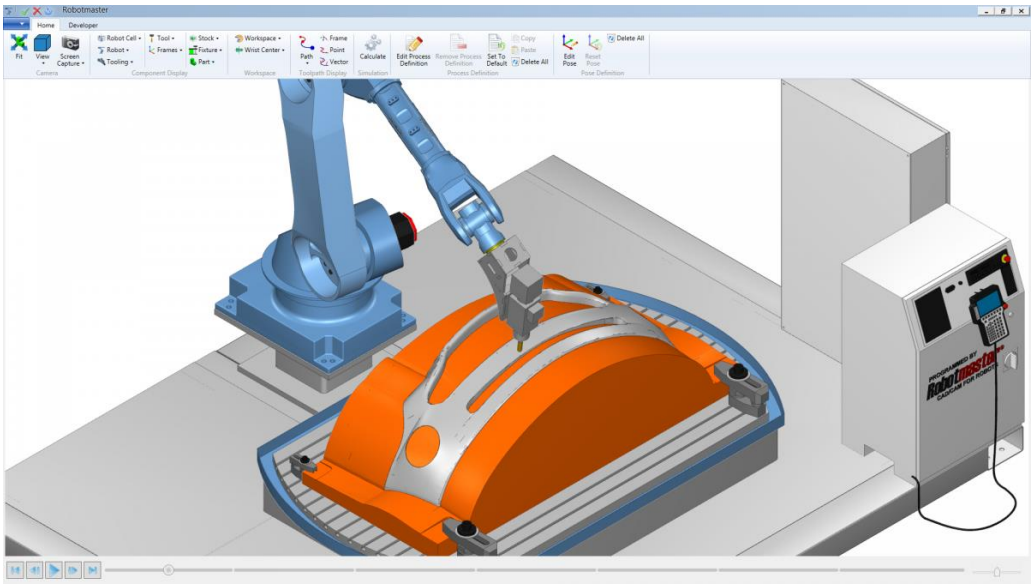
- http://www3.eng.cam.ac.uk/DesignOffice/cad/3rdyear/2012/week34/powermill_11_cad_IIA.pdf

Robot Master

General Info

Company	Jabez Technologies
Official Site	http://www.robotmaster.com//
Type	Stand-alone software
Target	Robotics

Screencapture



Description / Features

Robotmaster seamlessly integrates robot programming, simulation and code generation inside Mastercam, delivering quicker robot programming. Robotmaster is ideal for all applications including trimming, deburring, deflashing, dispensing, grinding, and mold machining. Some features and benefits of Robotmaster are: creation of simple or complex robot trajectories accurately without teaching points; special tools that assist in avoiding singularity and help to work around reach limitations; single solution compatible with multiple robot manufacturers.

References

Manual

- http://support.robotmaster.com/SoftwareDocumentation/Robotmaster%20Quick%20Start%20V5.pdf

Tutorials

- http://isites.harvard.edu/fs/docs/icb.topic554562.files/Robotmaster%20Tutorials%20V3.0.1200.1.pdf