



Week 11

GRASSHOPPER PLUG-INS

This we will be gaining knowledge of available Grasshopper plug-ins. It is more of a surface approach on what are available out there, to inform your decisions in your future use of this parametric design software.



Outline

01

The use of plug-ins

What do we gain from the use of plug-ins of the plug-in (Grasshopper)?

02

Available plug-ins

A list of commonly used Grasshopper's plug-ins.

03

Discussion of 4 specific plug-ins with their unique functions

Ladybug, Kangaroo, Galapagos and Ivy.

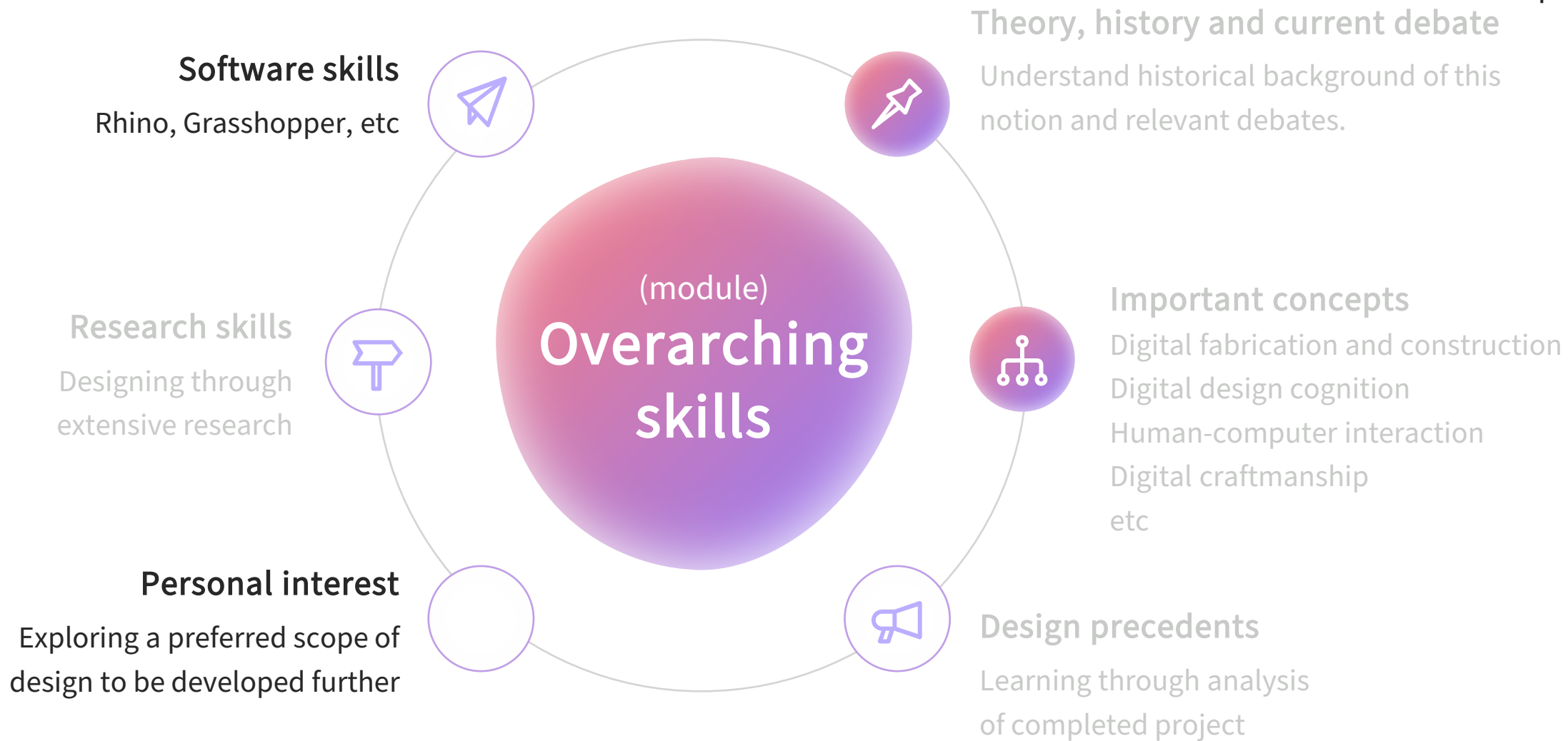
Aims and objectives

- To elicit **purposes** of additional plug-ins
- To contextualise **the use** of plug-ins in parametric design thinking
- To enumerate **available plug-ins** and their common use
- To illustrate kinds of **analysis** and **data** obtained from selected plug-ins
- To inform how can plug-ins be **useful** for future use in design

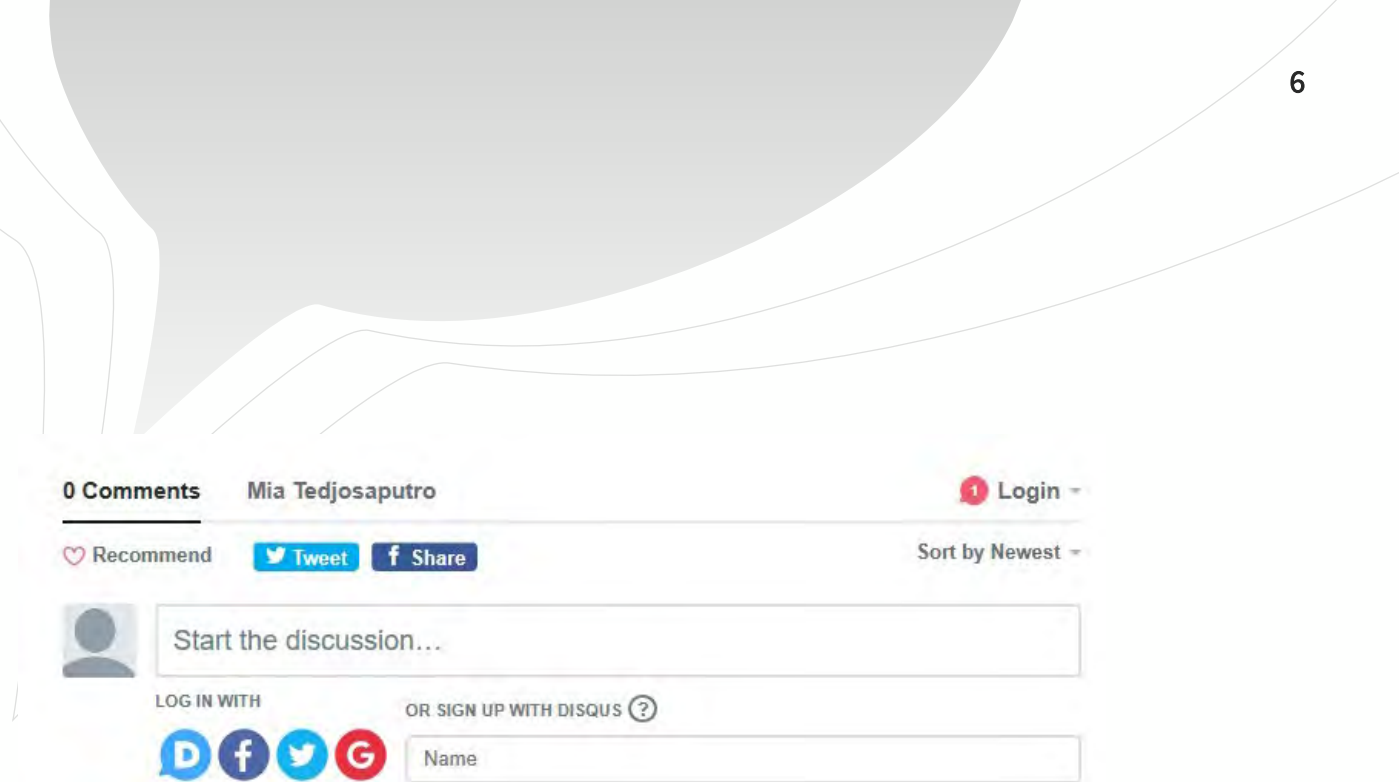
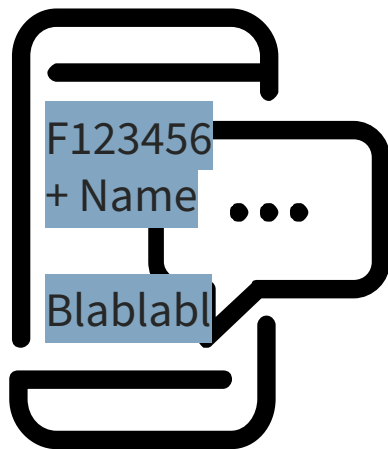
Learning outcomes

Students will be able to..

- 01** Gain understanding on how to incorporate GH plug-ins for future use.
—
- 02** Gain understanding how the GH plug-ins can bring positive impacts on design decisions and processes.
—
- 03** Choose which GH plug-ins they will decide to learn first.



Discussion

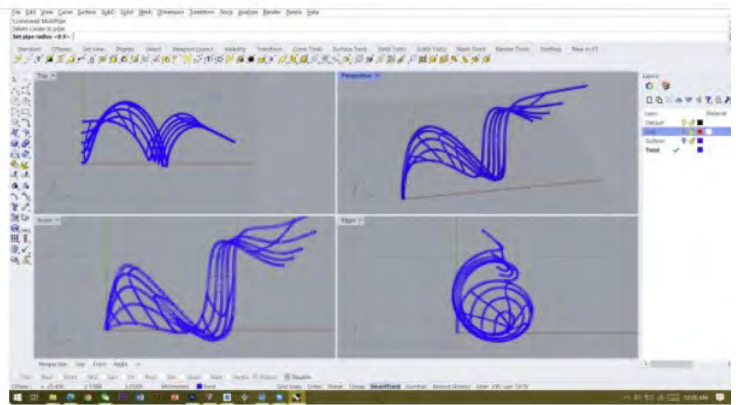


Choose one from listed plug-ins in this lecture material and do an online research on it. How does the plug-in contribute to design phases, in ways that we could not achieve without parametric software system?

Write down 200 words of reflection on this

<https://miatedjosaputro.com/2022/04/02/dg-week-11-2/>

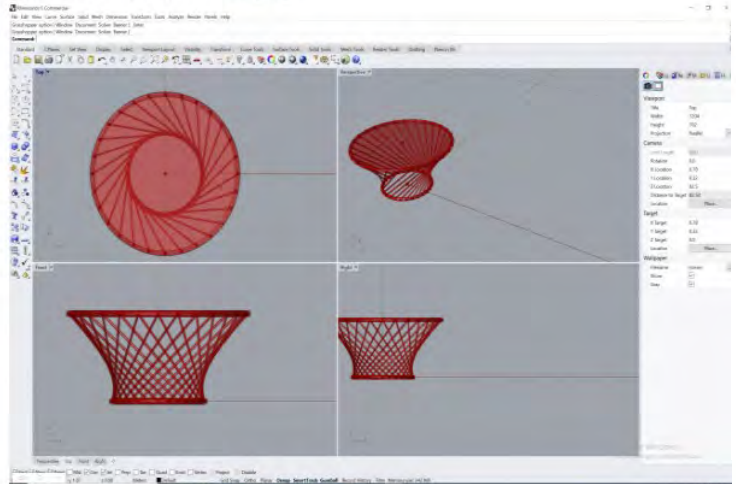
Previously in Week 8 - Rhino Week 9 - GH



Reply Share



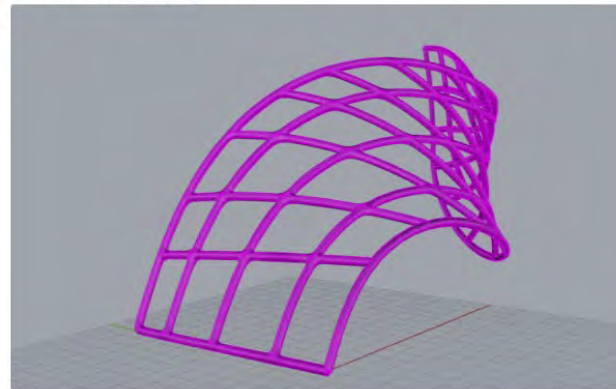
Feissal Hassan F17411030 · 12 days ago



Reply Share



Gellia- F17411022 · 13 days ago

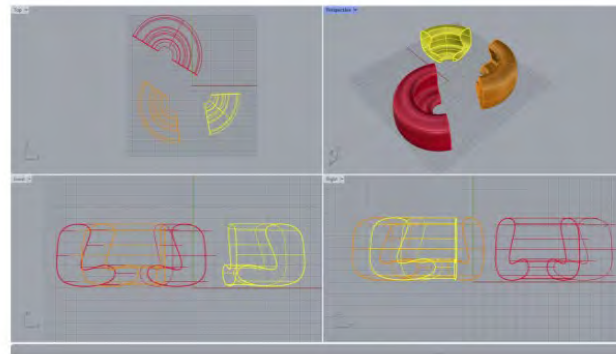


see more

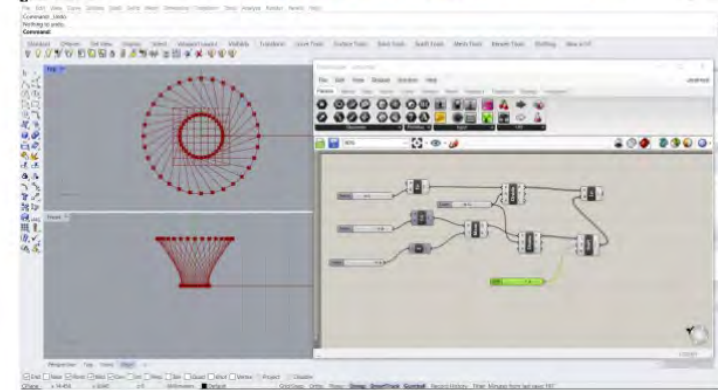
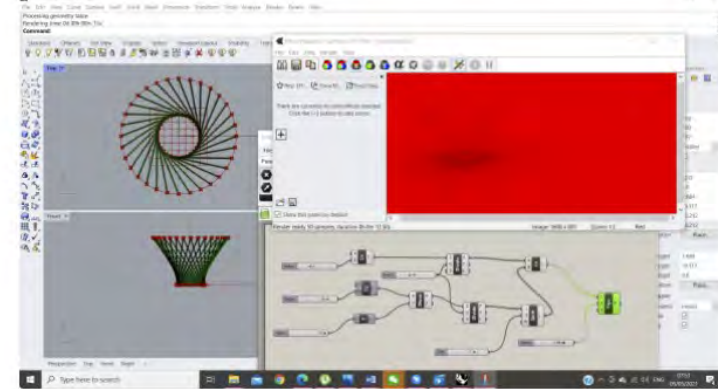
Reply Share



Mia Tedjosaputro **Mod** · 14 days ago
Week8+ F17411036-Patricia



Tusankine F17411024 · 5 days ago · edited
incredible! extremely interesting and quick to work with. Definitely worth doing deeper exploration for parametric designs.



Reply Share

Previously in Week 9..

Other parametric plug-ins: Bridging architecture with other disciplines

ENVIRONMENTAL ANALYSIS:

Ladybug

Honeybee

Geco

Heliotrope-Solar

STRUCTURAL ANALYSIS:

Kangaroo Physics

Karamba

BullAnt

Hummingbird

Mantis

<https://www.arch2o.com/10-parametric-plugins-every-architect-should-know/>

GH Plug-ins

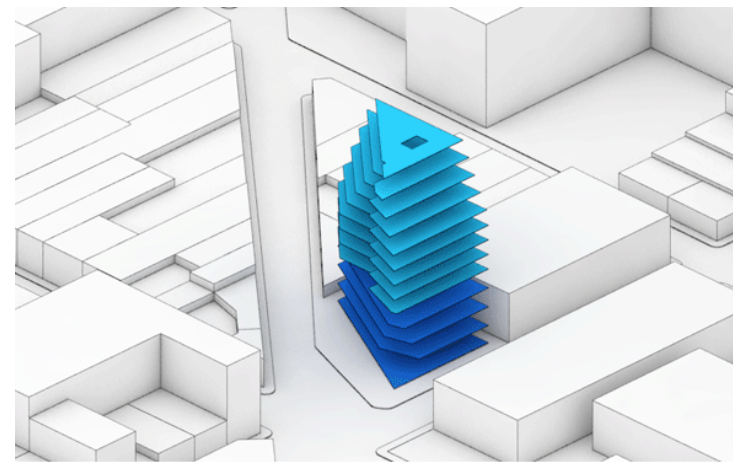
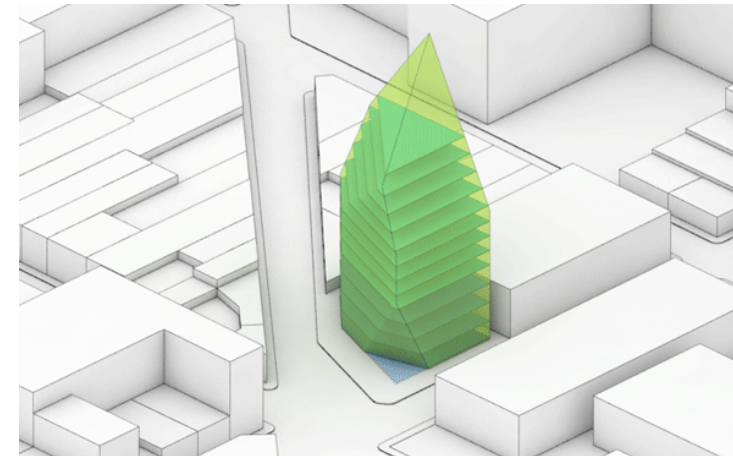
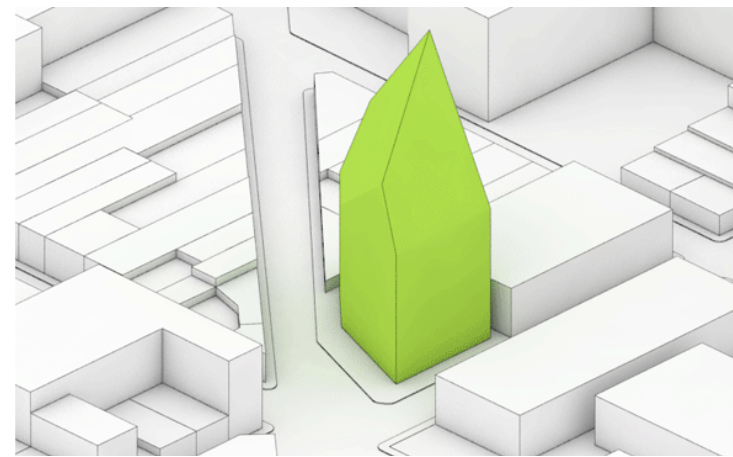
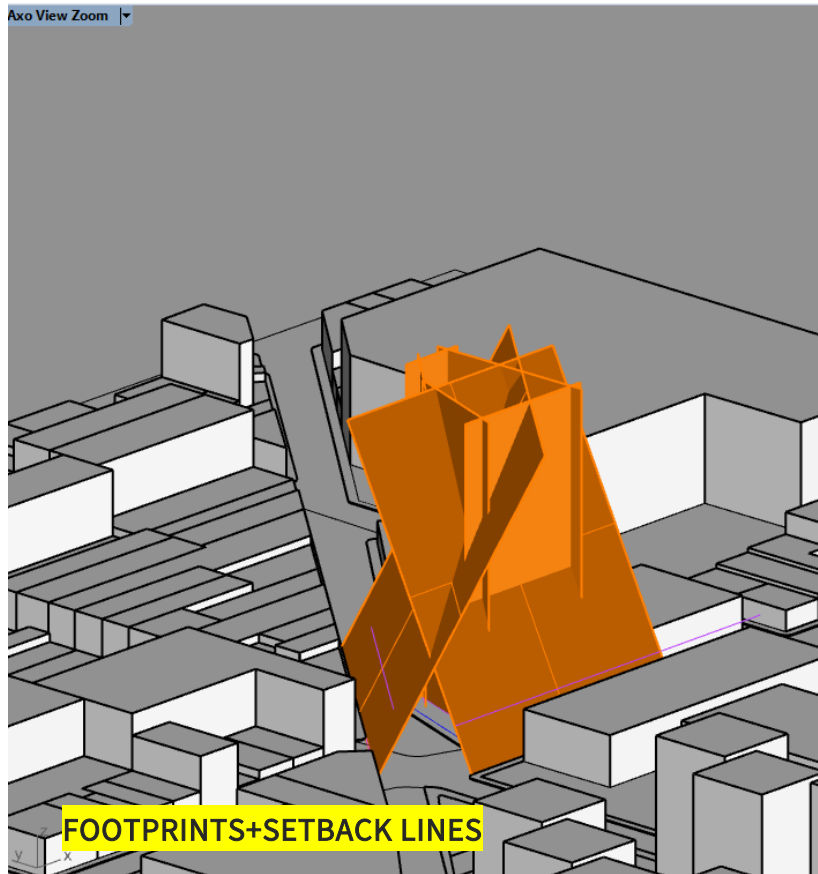
<https://www.grasshopper3d.com/forum/topics/gh-s-origin>

This week I do not expect you to learn individual plug-ins. You have the whole summer for finding out which one works for you. But I would like you to stay informed on what available out there and reflect on how can these tools be useful for your future design projects.



Example use of GH in early design stage:

<http://designplaygrounds.com/blog/creating-models-for-development-analysis-with-grasshopper/>



What do we
gain from using
plug-ins?
How to choose
from hundreds
of them?

- Open source library
- Incorporating design strategies such as optimisation, structural, environmental in early design stage.
- Ability to simulate strategies in real time
- Align decisions with what your design strategy is, look for design precedents using the same plug-in, choose with plenty of tutorials
- Learn how to interpret data

Popular GH plug-ins

<https://www.food4rhino.com/>



Search

Sort by
Downloads

TYPE
 App (390)
 Resource (0)

LICENSE
 Free (365)
 Trial (25)

PLATFORM
 Grasshopper (390)
 Windows (390)
 Version 4&5 (281)
 Version 6 (209)
 Version 7 WIP (8)
 Mac (47)
 Version 5 (37)
 Version 6 (19)
 Rhino (30)
 Windows (29)
 Version 6 (25)
 Version 5 (17)
 Version 7 WIP (4)
 Version 4 (0)
 Mac (7)
 Version 5 (5)
 Version 6 (4)
 Rhino.Inside (2)

BROWSE

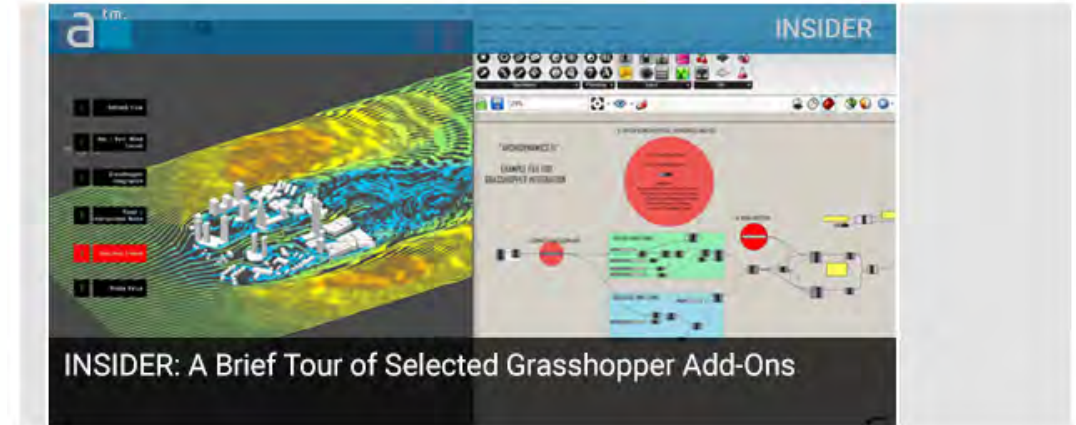
- Kangaroo Physics**
Kangaroo is a Live Physics engine for interactive simulation, form-finding, optimisation and constraint solving.
4 (346 votes)
- LunchBox**
LunchBox is a plug-in for Grasshopper for exploring machine learning, mathematical shapes, paneling, structures, and workflow.
3.6 (386 votes)
- Ladybug Tools**
Ladybug and Honeybee are open source environmental plugins for Grasshopper to help designers create an environmentally-conscious architecture.
4 (333 votes)
- GhPython**
Use the same flexible language everywhere: GhPython is the Python interpreter component for GH that allows to execute dynamic scripts.
3.6 (194 votes)
- Elk**
Elk is a set of tools to generate map and topographical surfaces using open source data from OpenStreetMap.org and USGS.
OpenStreetMap.or
3.5 (229 votes)
- PanelingTools for Rhino and Grasshopper**
Paneling solutions from concept to fabrication. Generate 2D and 3D cellular patterns over rectangular grids.
3.8 (87 votes)

Review of 35 GH plug-ins

<https://architosh.com/2020/03/insider-a-brief-tour-of-select-grasshopper-add-ons/>

INSIDER: A Brief Tour of Select Grasshopper Add-Ons

by Anthony Frausto-Robledo, AIA, NCARB, LEED AP



We look at 35 Grasshopper plugins that add additional capabilities and superpowers to the number one AAD tool in the market used in AEC. Importantly, there are quite a few GH plugins working for the Mac version of Rhino + Grasshopper—a growing reality that is good for the market.

Grasshopper Plugins

In this brief article, we briefly discuss 35 Grasshopper plugins and what they essentially provide to the Rhino + Grasshopper user community. They are organized by category and we provide information on which plugins say, or we could confirm, work on both the Windows and Mac versions of Rhino + Grasshopper. Importantly, many entries in the Food4Rhino page can be incorrect in which plugins do or do not work on the Mac versions of

Review of GH plug-ins based on category

<http://james-ramsden.com/resources/list-of-grasshopper-components/>

A mix of favourite and interesting plugins for Grasshopper.

ENERGY AND BUILDING SIMULATION

Ladybug and Honeybee	Import EPW files, solar radiation analysis, daylight calculations, thermal calculations
Diva for Rhino	Daylight calculations
mr comfy	Thermal and daylight calculations

GEOMETRY

Jackalope	Rhino morph operations
Lunchbox	Convert surfaces to panels
MeshEdit	Essential mesh manipulation tools

WORKFLOW

Octopus	Multi-objective optimisation
Lunchbox	Read and write to Excel
GeometryGym	Move geometry between different BIM/analysis file formats
Firefly	Arduino control and internet data control
Mosquito	Facebook, Twitter and Google Maps queries

VISUALISATION

Giulo	
Piacentino's renderAnimation	Generate frames for animation
Horster	Control Rhino camera

MAPPING

Elk	Process OpenStreetMap OSM data and USGS HGT height data
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...and of course there is the [Food4Rhino directory](#) for the full list of the most popular component

Plug-in 1: Ladybug

For environmentally
conscious design
decisions using local
weather data

By: Mostapha
Sadeghipour Roudsari



Ladybug

Ladybug performs detailed analysis of climate data to produce customized, interactive visualizations for environmentally-informed design.



Plug-in 1: Ladybug

Download the plug-in here

<https://www.food4rhino.com/app/ladybug-tools>

Interview with both co-founders (**Mostapha** and **Chris Mackey**) about how it came into existence:

<https://architosh.com/2020/03/insider-ladybug-tools-aim-to-take-environmental-analysis-to-wider-audience/>

Getting started with Ladybug with **Chris Mackey**, the co-founder

https://www.youtube.com/playlist?list=PLruLh1AdY-Sj_XGz3kzHUoWmpWDXNep1O

Resources:

FORUM: <https://discourse.ladybug.tools/>

SHARING PLATFORM: <http://hydrashare.github.io/hydra/>

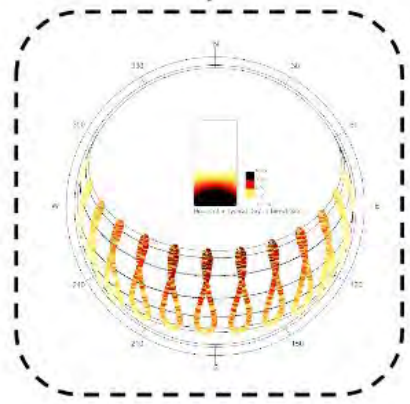
Plug-in 1: Ladybug

Ladybug Analysis Tools



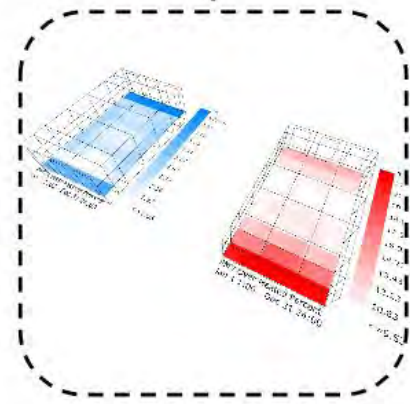
Ladybug

Climate Visualization
+ Analysis



Honeybee

Building Energy, Daylight
+ Comfort Modelling



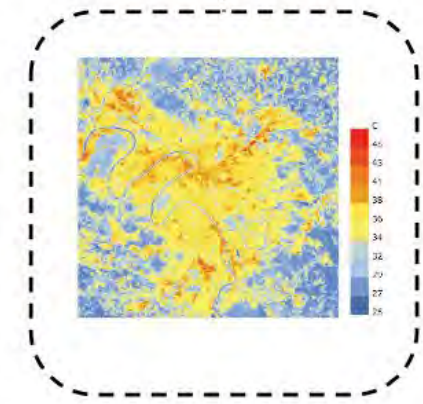
Butterfly

Airflow Modelling
(CFD)



Dragonfly

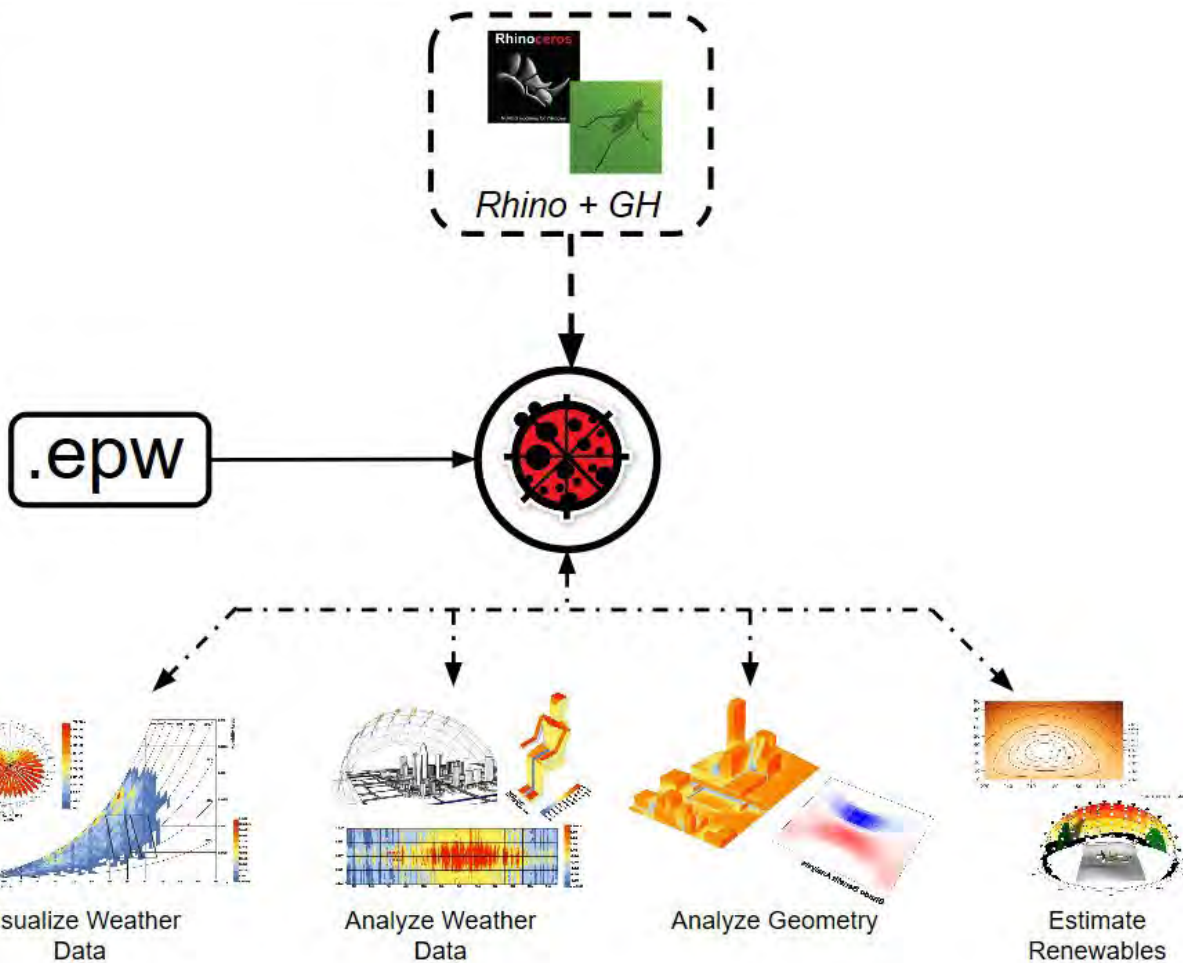
Climate Modelling
(heat island, climate change)



- 1. Introduction
- 2. Project Context
- 3. Ladybug Analysis Tools
- 4. Ladybug Analysis Tools (BETA)
- 5. Ladybug Analysis Tools (BETA)
- 6. Ladybug Analysis Tools (BETA)
- 7. Ladybug
- 8. Honeybee
- 9. What Attracted Me to the Ladybug Project
- 10. Environmental design needs, energy efficiency, occupant comfort, approval, long-term resilience.

Plug-in 1: Ladybug

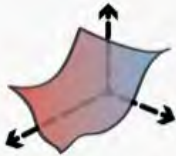






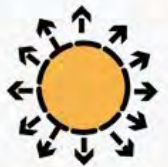










.epw files



- 1 Performance Newtwork Presentation1
- 2 Performance Newtwork Presentation1
- 3 Ladybug Analysis Tools
- 4 Ladybug Analysis Tools
- 5 Ladybug Analysis Tools
- 6 Ladybug Analysis Tools
- 7 Ladybug
- 8 Ladybug
- 9 What Attracted Me to the Ladybug Project
- 10 If environmental design saves energy money, increases comfort, and provides long term economic

Plug-in 1: Ladybug

Instantaneous
feedback and
evaluation

 <p>CLIMATE DATA PLOTS</p>	 <p>SUNPATH GRAPHICS</p>	 <p>SHADOW STUDIES</p>	 <p>VIEW FROM SUN</p>	 <p>SOLAR ACCESS STUDIES</p>	 <p>SOLAR ENVELOPE</p>
 <p>SOLAR FAN</p>	 <p>RADIATION STUDIES</p>	 <p>VIEW STUDIES</p>	 <p>PSYCHROMETRIC CHARTS</p>	 <p>ADAPTIVE COMFORT CHARTS</p>	 <p>OUTDOOR COMFORT STUDIES</p>
 <p>LOCAL THERMAL COMFORT STUDIES</p>	 <p>SHADE BENEFIT ANALYSIS</p>	 <p>GENERATIVE SHADE DESIGN</p>	 <p>RAYTRACING</p>	 <p>SHADOW MASKS</p>	 <p>RENEWABLES</p>

Plug-in 1: Ladybug

Potential use:

Weather data Visualisation

Basic and advanced sun path study

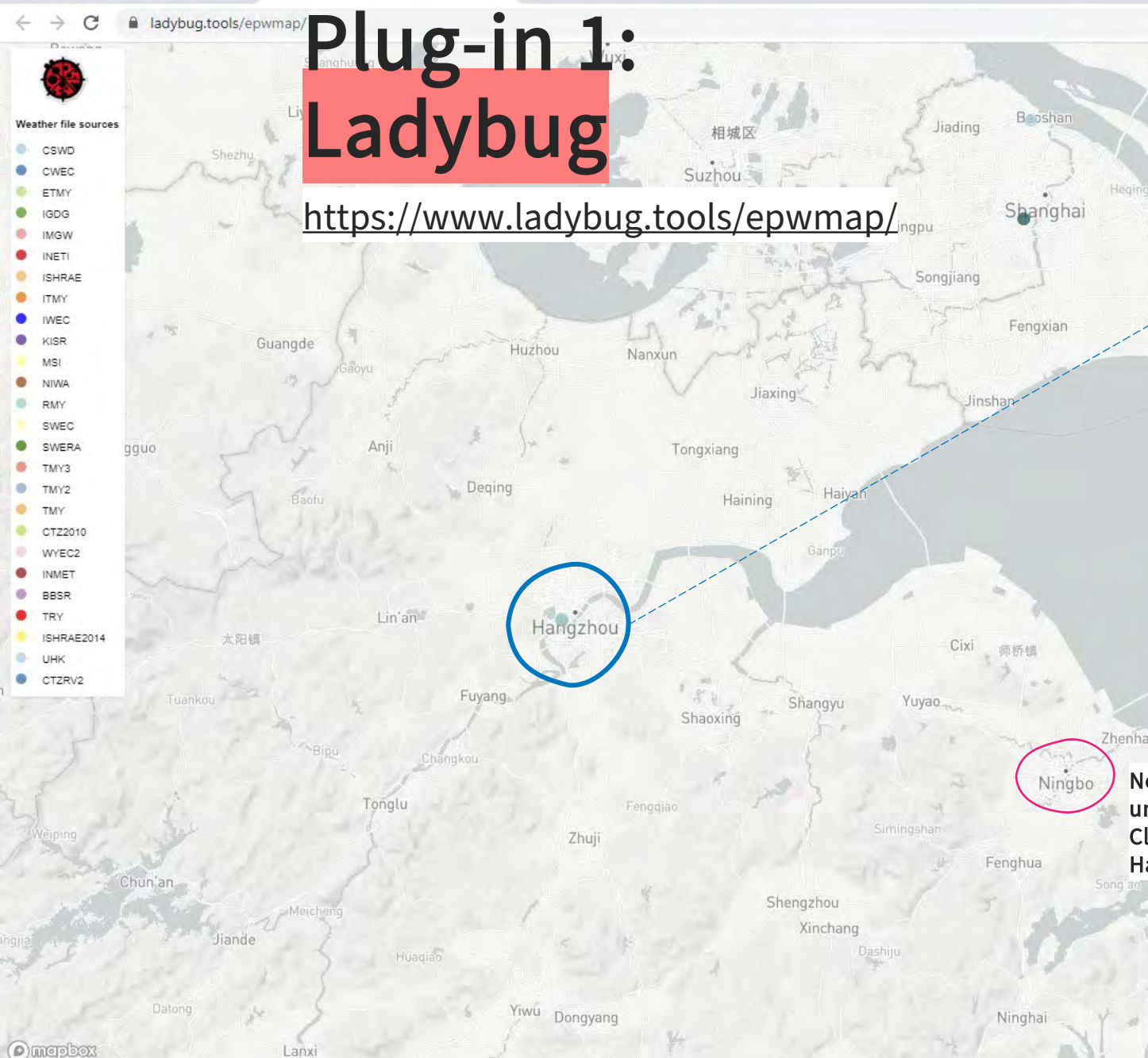
Sunlight hours study

Outdoor comfort study

Solar radiation study

Plug-in 1: Ladybug

<https://www.ladybug.tools/epwmap/>



```
{0}
0 ladybug.CHN_Zhejiang.Hangzhou.584570_
0 CSWD.CHN_Zhejiang.Hangzhou.584570_CSWD.epw
```

ImportEPW

readMe!
latitude
location
dryBulbTemperature
dewPointTemperature
relativeHumidity
windSpeed
windDirection
directNormalRadiation
diffuseHorizontalRadiation
globalHorizontalRadiation
horizontalInfraredRadiation
directNormalIlluminance
diffuseHorizontalIlluminance
globalHorizontalIlluminance
totalSkyCover
barometricPressure
modelYear
VER 0.0.68
JAN_01_2020

```
{0;0}
key:location/data
Type/units/frequency/startsAt/endsAt
0 Hangzhou_Zhejiang_CHN
1 Dry Bulb Temperature
2 C
3 Hourly
4 (1, 1, 1)
5 (12, 31, 24)
6 4.8
7 0.2
8 -0.2
9 -0.7
10 -1.1
11 -1.5
12 -1.4
13 -1.8
14 -1.4
15 0.1
16 2.2
17 3.5
```

No Ningbo data unfortunately,
Closest stations are Hangzhou or Zhoushan

Download from ONEBUILDING
[Copy link to clipboard](#)

Ladybug

How to install Ladybug (unusual step-by-step):

<https://youtu.be/Zya7ir2Rwls>

An example of Environmental Analysis with Ladybug:

<https://youtu.be/RYVkBqVee1w>

Duration: 15 minutes

The screenshot displays a Grasshopper workspace with a complex workflow for environmental analysis. Key components include:

- Ladybug_Import epw**: A green component that reads weather data from an EPW file. Its output list includes: Output, latitude, location, dryBulbTemperature, dewpointTemperature, relativeHumidity, windSpeed, windDirection, directNormalRadiation, diffuseHorizontalRadiation, globalHorizontalRadiation, horizontalPlaneIrradiance, directNormalIncidence, diffuseHorizontalIncidence, globalHorizontalIncidence, radiationViewFactor, barometricPressure, monthIndex, YER 0.0.66, and JAN_20_2018.
- Ladybug_SunPath**: A component that generates sun paths based on input parameters. Its output list includes: north, out, location, sunVectors, sunAltitudes, sunAzimuths, hour, day, month, timeStep, sunSphereMesh, sunPathCrvs, compassCrvs, altitudeCrvs, centerPt, sunPathScale, legend, sunScale, legendBasePts, title, projection, titleBasePt, annualHourlyData, conditionalStatement, legendPar, sunPathCenPts, sunPositions, sunPositionsInfo, sunPositionsCty, solarOrStandardTime, hourlyData, YER 0.0.66, and JAN_20_2018.
- Ladybug_Analysis Period**: A component that defines the analysis period. Its output list includes: fromMonth, fromDay, fromHour, toMonth, toDay, toHour, YER 0.0.66, and JAN_20_2018.

The background shows a 3D model of a building with a red wireframe sun path visualization, indicating the sun's trajectory over time.

Environmental Analysis with Ladybug Simplified

7,852 views • 9 Nov 2020

301 1 SHARE SAVE ...



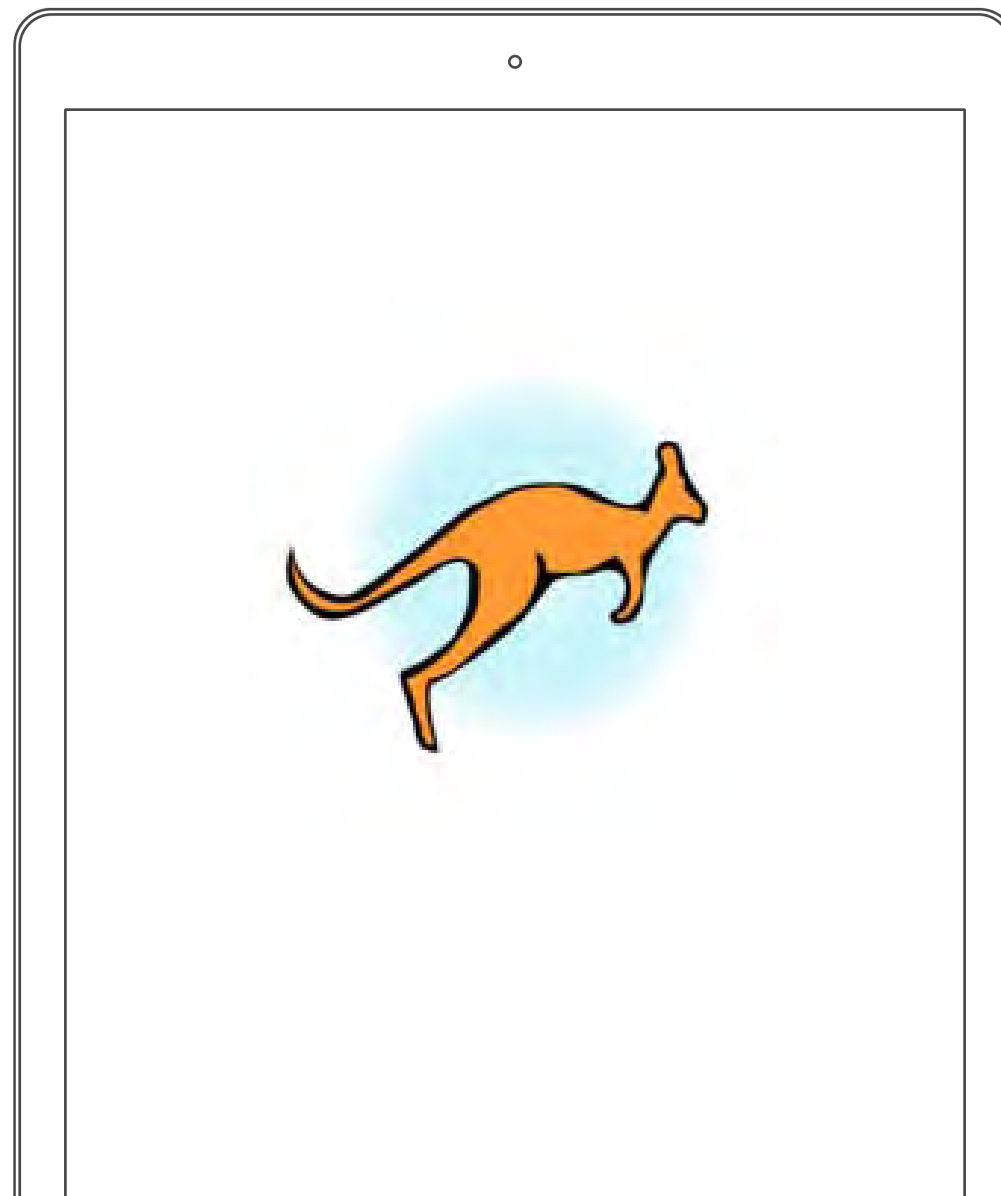
How to Rhino
31.8K subscribers

SUBSCRIBE

Plug-in 2: Kangaroo

Physics engine
and form finding
platform for
Grasshopper

By: Daniel Piker



Plug-in 2: Kangaroo

Kangaroo2 comes with Rhino 6 onwards, no need to download or install separately.

<http://kangaroo3d.com/>

Download link if you need it:

<https://www.food4rhino.com/app/kangaroo-physics>

RESOURCES:

<https://discourse.mcneel.com/c/grasshopper/kangaroo>

Kangaroo for tensile structure

Useful example:


<https://youtu.be/f0DiTj3Gx1A>



Rhino Grasshopper - Tensile Structure Pavilion - Easy Kangaroo 2 & Weaverbird tutorial

9,856 views · 11 May 2020

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 **ARKIM7 STUDIO**
887 subscribers

SUBSCRIBE



Kangaroo for form finding

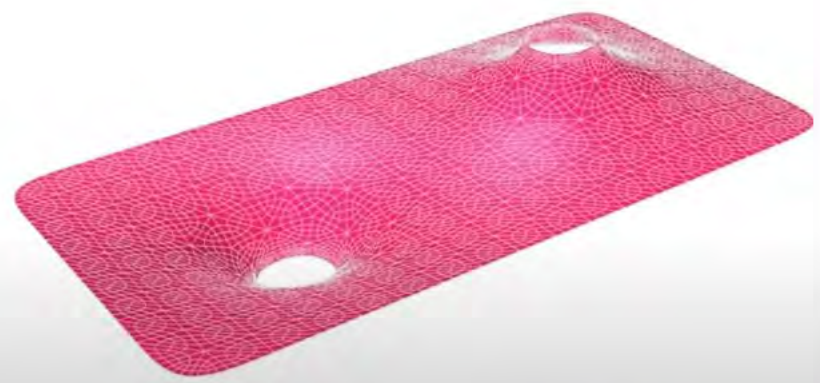
<https://youtu.be/o0aIMd4m9N8>



Form Finding With Kangaroo II

Computational Design Basics,
Summer Term 2020

On Camera: Samim Mehdizadeh



DIGITAL D
PROF. DR.-ING. OLIVER

Grasshopper - Form Finding with Kangaroo Pt. 1

7,633 views • 23 Jun 2020

186 0 SHARE SAVE ...

Digital Design Unit - TU Darmstadt
2.21K subscribers

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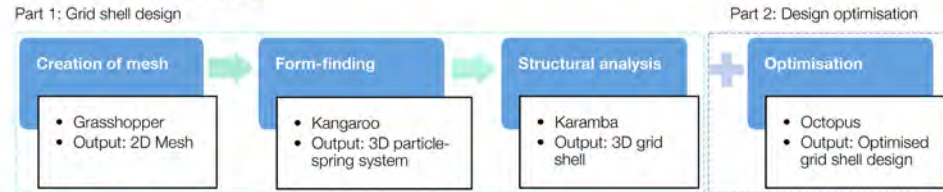


Clara Torres Gómez, Supervisor: Dr C. Málaga-Chuquitaype. Department of Civil and Environmental Engineering, Imperial College London, UK.

INTRODUCTION

Grid shell structures offer multiple structural and architectural advantages such as optimal use of materials, quick construction process and the possibility to achieve architecturally interesting building forms. Nevertheless, their design is challenging as it involves the use of multiple slender elements. This thesis focuses on the development and testing of a design tool for form-finding and structural verification through optimisation of timber grid shells. The design tool is implemented using the algorithm editor Grasshopper [1].

PROJECT OUTLINE



THE PROJECT

PART 1: GRID SHELL DESIGN

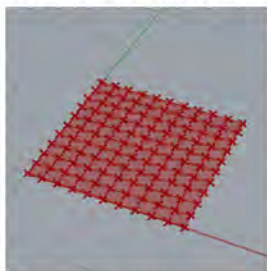


FIGURE 3: 2D MESH

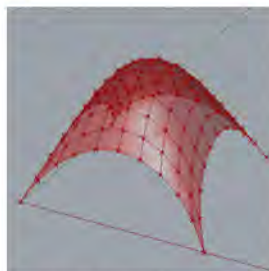


FIGURE 4: 3D PARTICLE-SPRING SYSTEM

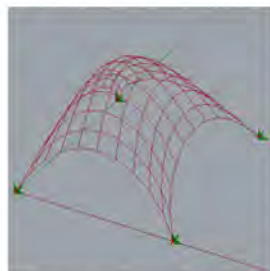


FIGURE 5: 3D GRID SHELL

TABLE 1: 3D GH RESULTS AND % DIFFERENCE WITH OPENSEES RESULTS

	Near supports		Top	
Axial forces (kN/m)	-3.51	-2.5%	-0.05	-8.8%
Shear forces (kN/m ²)	0.05	-	0.05	-
Bending moment (kNm)	0.02	-	0.01	-
Displacement in x,y (mm)	-0.06	-	0.00	-
Displacement in z (mm)	-0.04	-63.7%	-0.09	-3.0%

Grasshopper (GH) is a graphical algorithm editor integrated with the modelling tools of Rhino3D. A timber grid shell is designed parametrically using GH. The grid shell is initially a 10mx10m flat mesh discretised into quadrilateral elements 1mx1m in size (FIGURE 3).

The form-finding process is carried out using the Kangaroo add-on. The mesh is discretised into a particle-spring system, and subsequently the Dynamic Relaxation method is applied to the system. Kangaroo essentially performs a virtual hanging-chain model of the structure in order to find the most efficient shape to carry the applied vertical loads (FIGURE 4).

The particle-spring system is then converted into a real structure and analysed using Karamba, a Finite Element program, fully embedded in the parametric environment of GH (FIGURE 5). TABLE 1 shows that the results from GH are validated using OpenSees [2]. The percentage difference is missing for the shear forces, bending moments and displacements in x- and y- directions. This is because the values are very small in both cases, this is what is expected in terms of grid shell behaviour.

ACKNOWLEDGEMENT

The author Dr C. Málaga-Chuquitaype for his dedication in making this project an engaging and rewarding experience. The author would also like to thank Arthur Mamou-Mani for his valuable help with Grasshopper.

GRID SHELL STRUCTURES

A grid shell is a shell structure discretised by means of a grid pattern. It derives its strength from its double curvature.



FIGURE 1: 'GRID SHELL IN THE PARK', SAN ANTONIO, USA

Advantages

- Minimal use of material
- Quick construction process
- Architecturally interesting shapes can be achieved

Disadvantages

- Complex design



FIGURE 2: THE WEALD AND DOWNLAND MUSEUM, SURREY, UK

PART 2: DESIGN OPTIMISATION

The dimensions of the cross-section of the timber laths is optimised to reduce the amount of material used and ensure that bending moments occurring in the grid shell are minimised. This is achieved using the evolutionary solver Octopus, which is an add-on for GH. The results are presented in TABLE 2. The two grid shells are shown on FIGURE 6. The implementation of the optimisation in the grid shell design tool presented in Part 1 is illustrated in FIGURE 7.

TABLE 2: COMPARISON OF INITIAL AND OPTIMISED RESULTS

Section	Initial	Optimised	% Reduction
Volume of material (m ³)	4.33	1.23	72%
Sum of bending moments (kNm)	2.44	0.67	73%
Max. bending moment (kNm)	0.05	0.02	60%

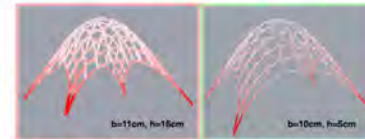


FIGURE 6: INITIAL AND OPTIMISED GRID SHELLS

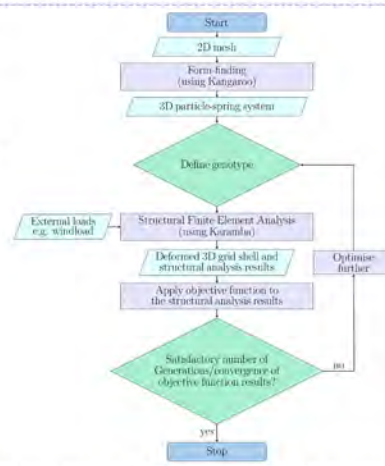


FIGURE 7: TOOL FOR GRID SHELL DESIGN AND OPTIMISATION

CONCLUSION

Form-finding and structural analysis of a timber grid shell can be successfully combined in a Grasshopper model. The analysis results are verified using the finite element framework OpenSees. It is also shown that the parametric environment of Grasshopper allows for an easy parametrisation of the design problem into objective functions, variables and constraints. The inclusion of an evolutionary solver in the Grasshopper model allows for an optimised structural design.

REFERENCES

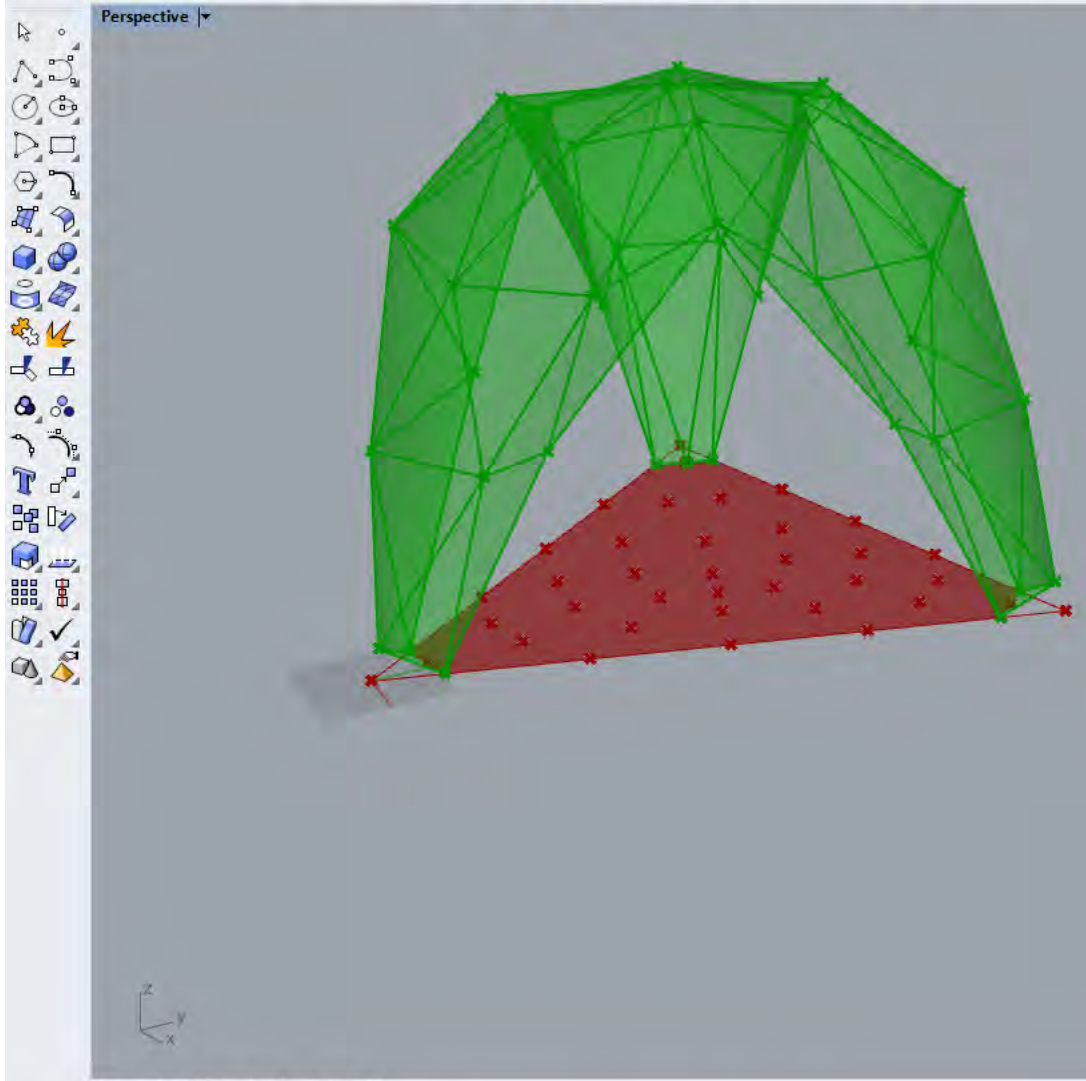
[1] Akos, G., & Parsons, R. 2014. Foundations - the grasshopper primer third edition. Available at http://md.uai.cl/workshop/wp-content/uploads/2016_files/Instructors.pdf (Accessed 28 March 2015).
 [2] McKenna, F., Ferver, G. L., Scott, M. H., and Jeremic, B., (2000). Open System for Earthquake Engineering Simulation (OpenSees). Pacific Earthquake Engineering Research Center, University of California, Berkeley, CA.

Point to move from (vertical=100)

Point to move to

1 mesh added to selection.

Command:



Name	Material
Default	
Layer 01	
Layer 02	
Layer 03	
Layer 04	
Layer 05	

Grasshopper - 20210507_kangaroo trial*

File Edit View Display Solution Help 20210507_kangaroo trial*

Params Maths Sets Vector Curve Surface Mesh Int Trns Dis Ladybug Wb Kangaroo2 Human LunchBox NGon Horster

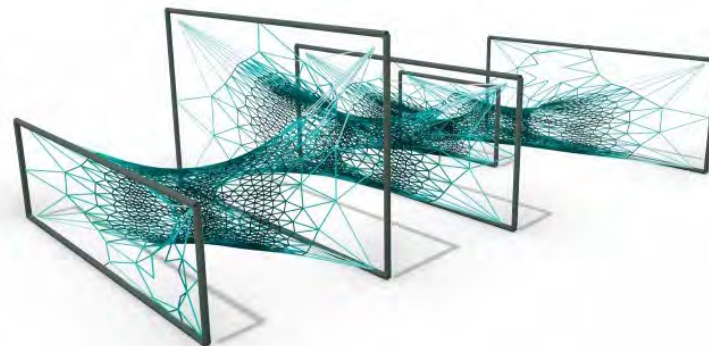
Geometry Primitive Input Util

118%

Autosave complete (210 seconds ago) 1.0.0007

Kangaroo + Weaverbird

[FORCE OF NATURE – IAAC Blog](#)



Process:



Set Frame (Contour)



Set Height



Set Opening (Pop20)



Create Basic Mesh (Loft)



Kangaroo Damping Solver



Subdivision Mesh (Weaverbird)



Plug-in 2: Kangaroo

Potential use:

Simulate physical interaction between object

Simulate objects' properties through time

Creating unique shapes (*catenary curves, catenary vault systems, tensile membrane systems, dome and tensile structure*) we could not do using hands by

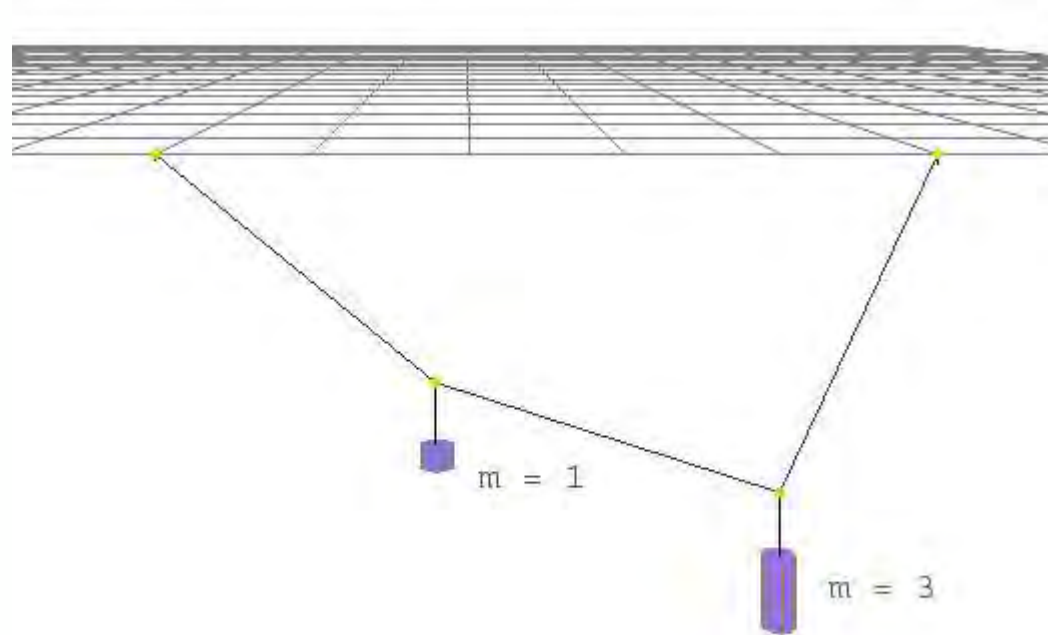
Modelling different forces

Plug-in 2: Kangaroo

Based on *particle-spring systems*

” Particle-spring systems are based on lumped masses, called particles, which are connected by linear elastic springs”

Kilian, A. & Ochsendorf, J. (2005). Particle-spring systems for structural form finding. *Journal of the international association for shell and spatial structures*, 46, 77-84.



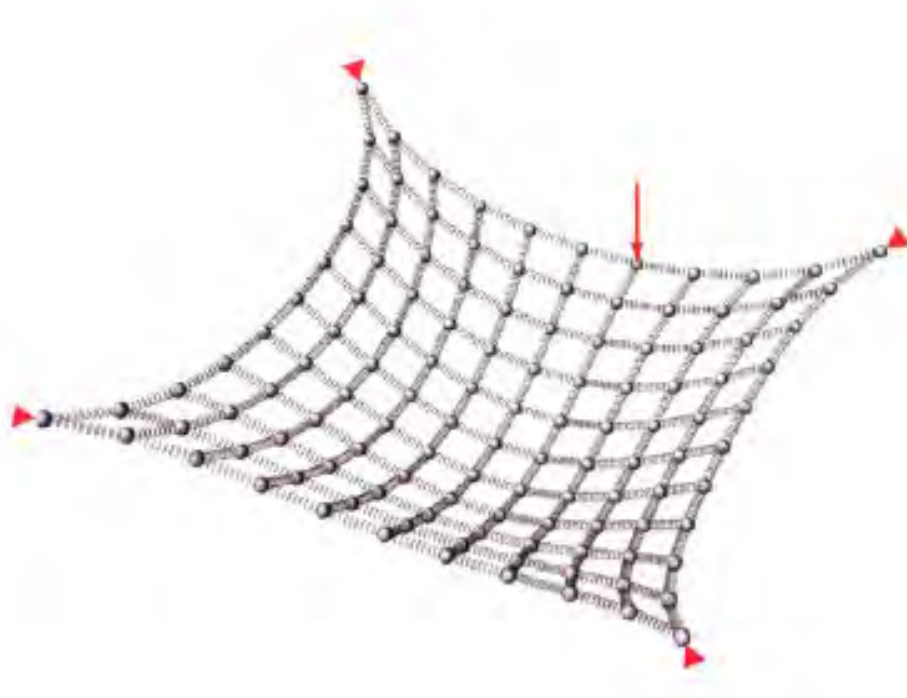
Equilibrium of simple particle spring system (Kilian and Ochsendorf, 2005)

Plug-in 2: Kangaroo

Based on *particle-spring systems*

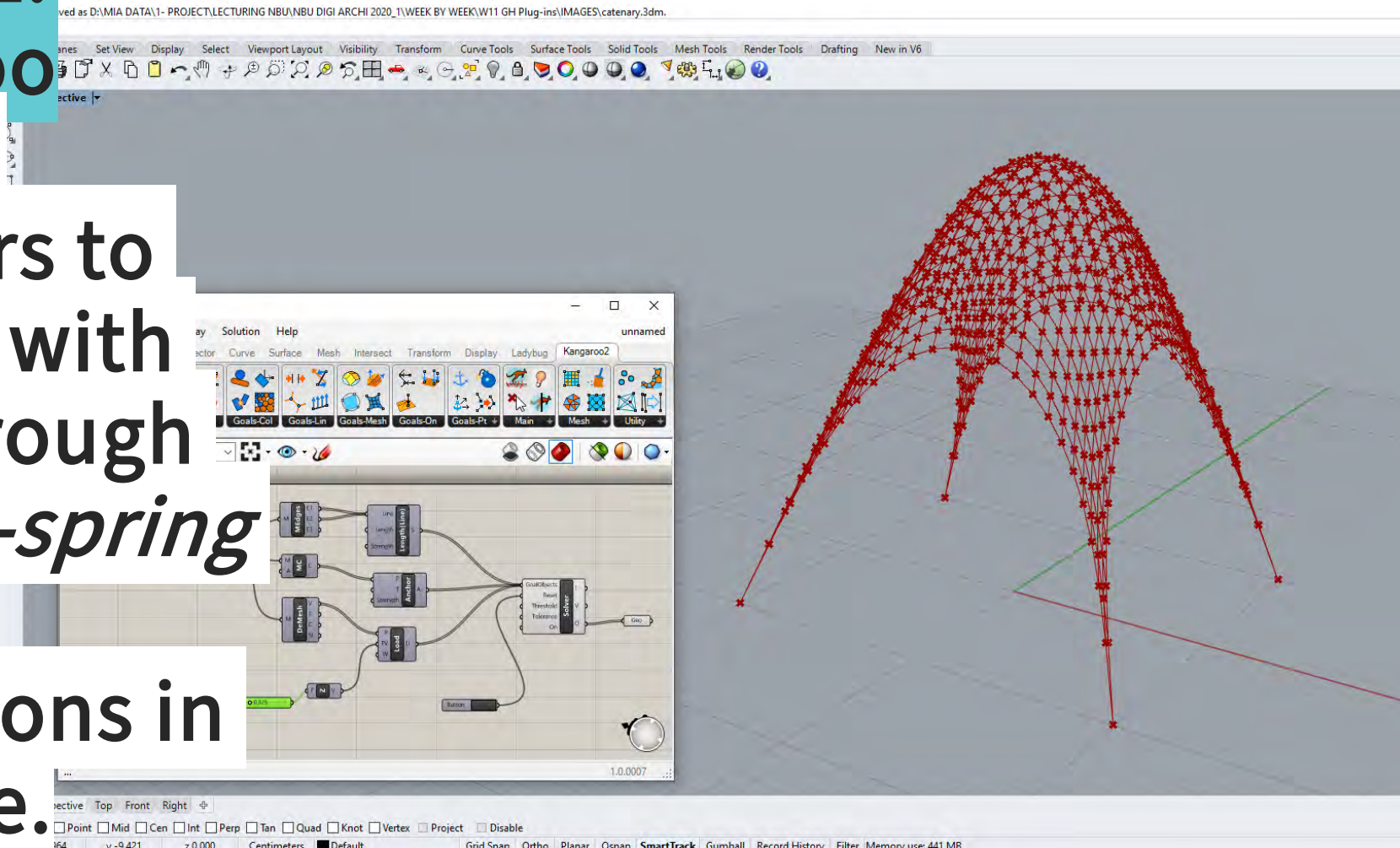
Main components of a particle-spring system are:

1. Particles
2. Springs
3. Forces
4. Anchor point



A particle-spring system that simulates a square membrane anchored at its corner. Force vectors are applied to the particles.

Plug-in 2:
Kangaroo
 enables
 designers to
 interact with
 form through
particle-spring
 system
 simulations in
 real time.



Plug-in 2: Kangaroo

Potential form: Catalan vault

<https://inspiration.detail.de/technology-the-catalan-vault-a-historical-structural-principle-with-a-bright-future-106565.html>



Plug-in 2: Kangaroo

Other applications: The British Museum



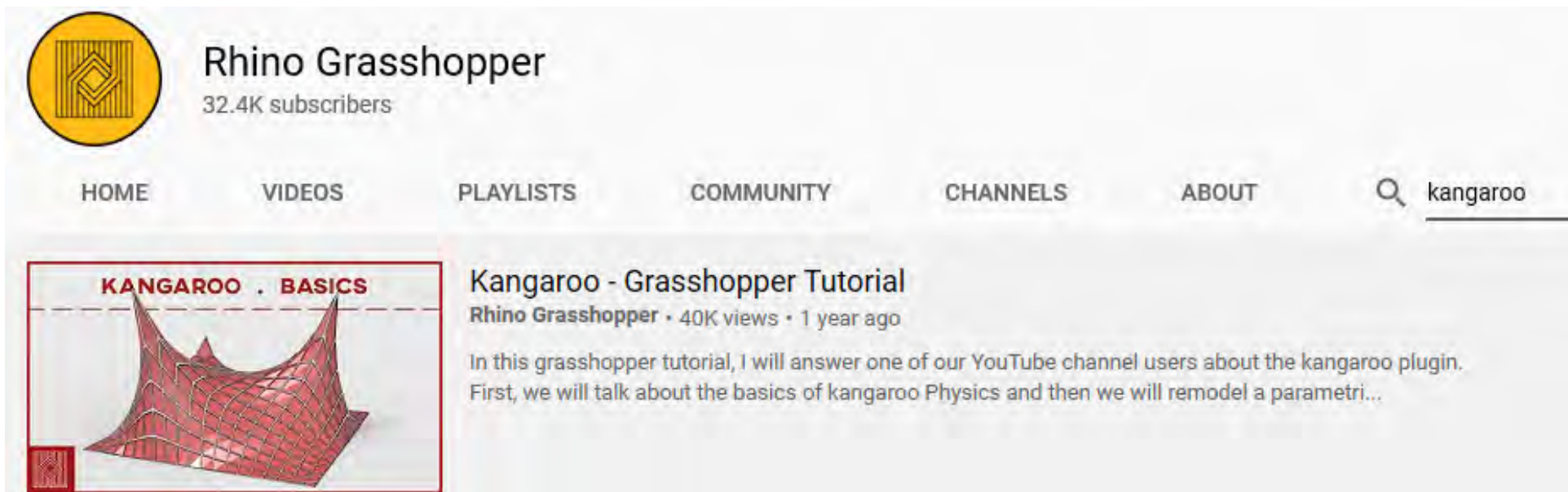
<https://explodebeps.wordpress.com/grasshopper-definitions/kangaroo-british-museum-roof-2/>



<https://www.tripsawy.com/treasures-of-the-british-museum-1661292>

Plug-in 2: Kangaroo Physics and Kangaroo 2 introduction

<https://youtu.be/ToHLIEGvhqA>



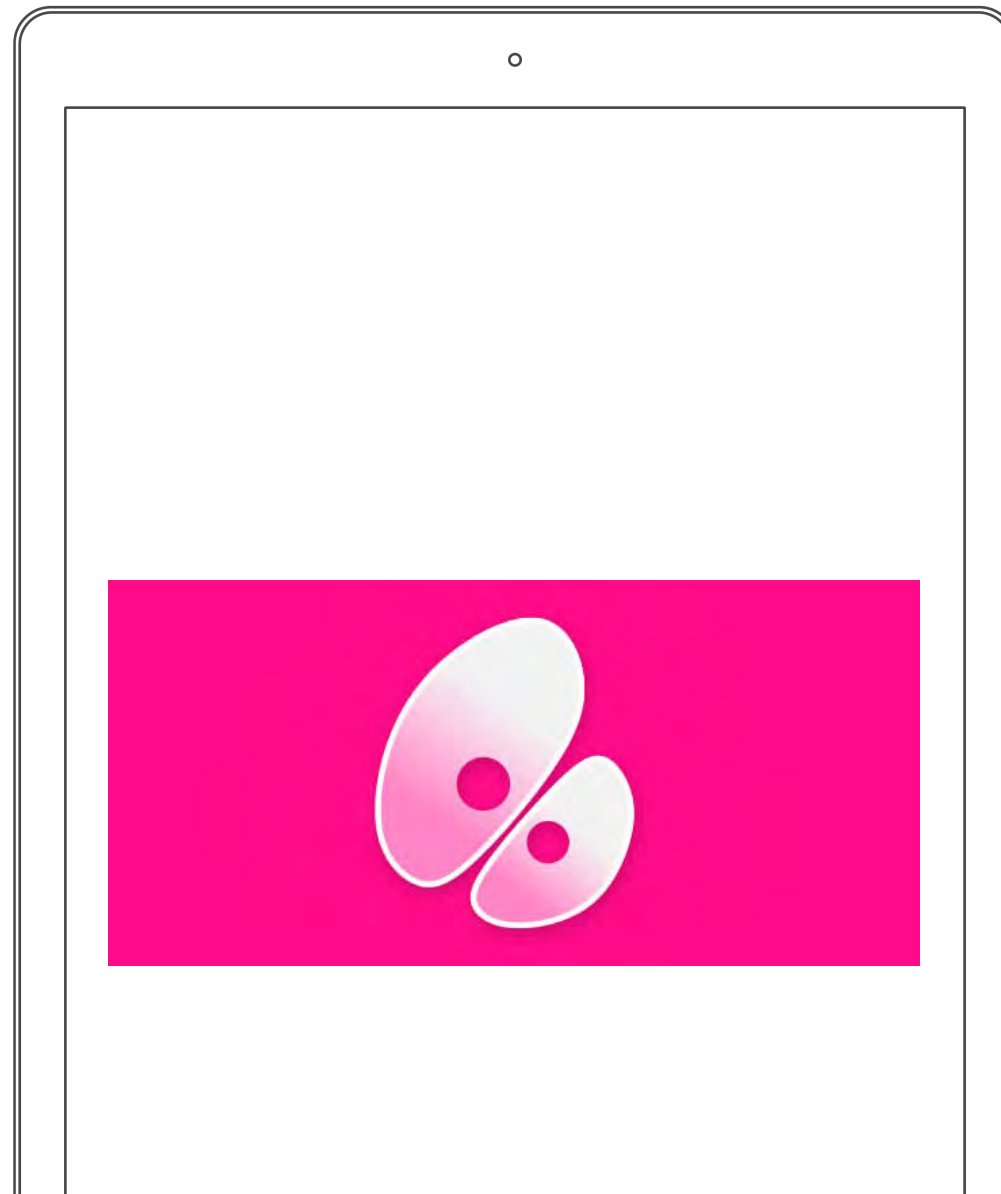
The screenshot shows the YouTube channel page for 'Rhino Grasshopper', which has 32.4K subscribers. The navigation menu includes HOME, VIDEOS, PLAYLISTS, COMMUNITY, CHANNELS, and ABOUT. A search bar on the right contains the text 'kangaroo'. Below the navigation, a video titled 'KANGAROO . BASICS' is displayed, featuring a red wireframe mesh of a kangaroo's head. To the right of the video, the title 'Kangaroo - Grasshopper Tutorial' is shown, along with the channel name 'Rhino Grasshopper', 40K views, and a timestamp of '1 year ago'. The video description begins with: 'In this grasshopper tutorial, I will answer one of our YouTube channel users about the kangaroo plugin. First, we will talk about the basics of kangaroo Physics and then we will remodel a parametri...'

Plug-in 3: Galapagos

Evolutionary
Solving,
Genetic Algorithm
(GA)

By: David Rutten

It is named after the
Galapagos Island



Plug-in 3: Galapagos

Galapagos comes with Grasshopper, under Params tab.



Blog post by David Rutten:

<https://www.grasshopper3d.com/profiles/blogs/evolutionary-principles>

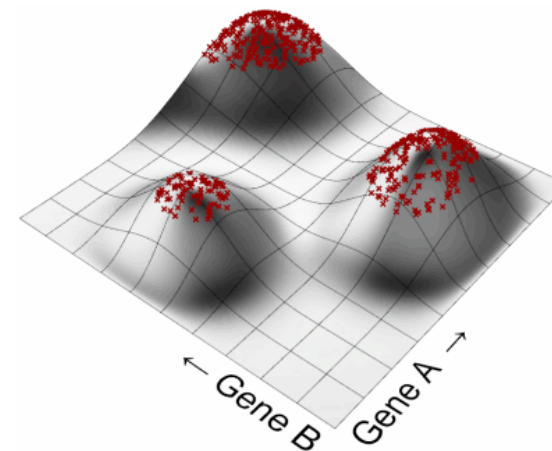
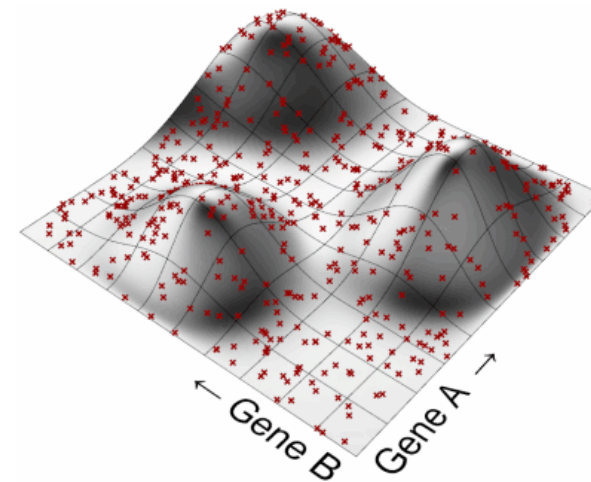
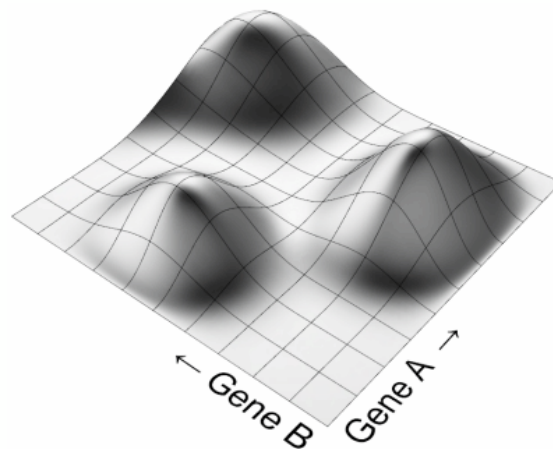
Plug-in 3: Galapagos

Evolutionary computing goes back as early as 1948. Alan Turing proposed the term, “genetical or evolutionary search”.

Plug-in 3: Galapagos

Evolutionary Solver in Galapagos.

<https://www.grasshopper3d.com/profiles/blogs/evolutionary-principles>

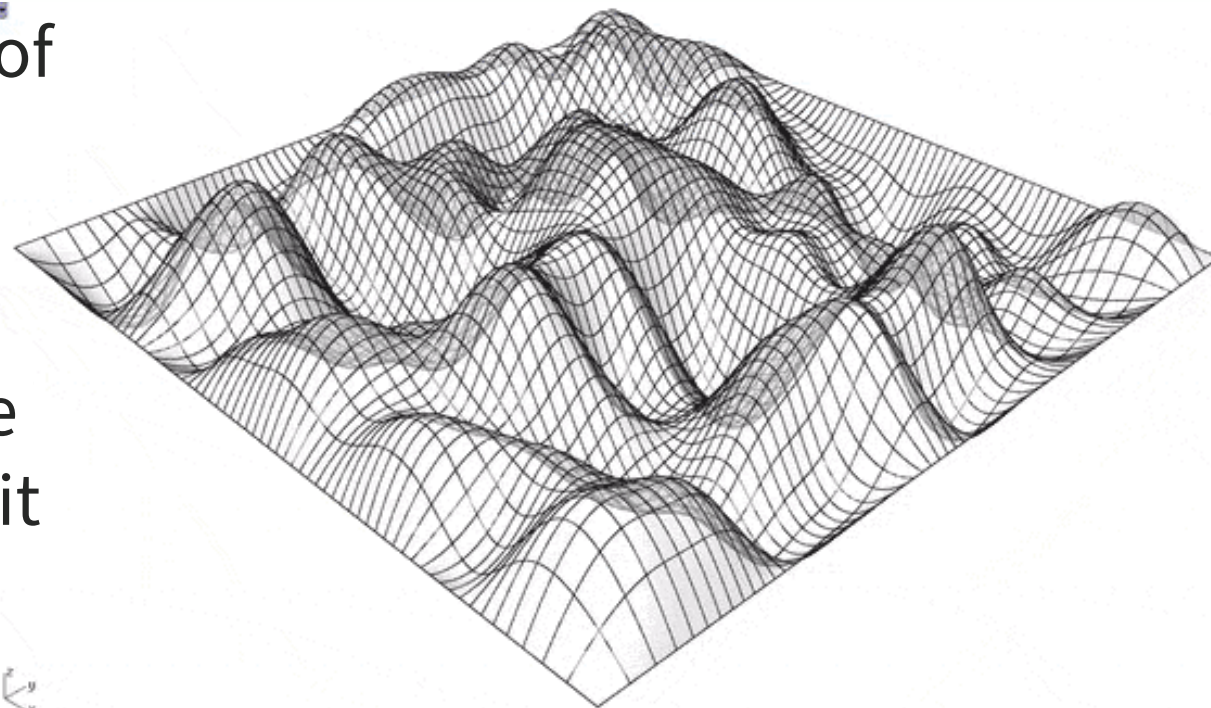


A *Fitness Landscape* of a particular model. The model has two variables (genes), Gene A and B. As Gene A changes, the fitness of entire model also changes. Every combination of A and B results in particular fitness, and it is represented as the **height of fitness landscape**. The solver's job is to find **highest peak in this landscape**. The third picture shows a cluster around three fitness peaks, and the process is repeated until we reach the highest peak.

Plug-in 3: Galapagos

designplaygrounds.com/blog/galapagos-101-fundamentals-course/

So a **peak** represents a range of 'successful' genomes and a **valley** belong to less fit combinations. With every iteration the genomes that are less fit get discarded and the fit enough one will generate offspring and carry on to the next iteration.



Plug-in 3: Galapagos

Evolutionary Solver in Galapagos.

[https://www.grasshopper3d.com/
profiles/blogs/evolutionary-
principles](https://www.grasshopper3d.com/profiles/blogs/evolutionary-principles)

The anatomy of solver requires these 5 interlocking parts:

- Fitness Function
- Selection Mechanism
- Coupling Algorithm
- Coalescence Algorithm
- Mutation Factory

Plug-in 3: Galapagos

Potential use:

Multiple-objective optimisation

Drawbacks according to David Rutten:

Slow and do not guarantee a solution (tend to run on indefinitely unless good-enough value is specified)

Advantages: flexible (wide variety of problems), **forgiving** (happily work on problem that have been under or over constrained) **and high degree of interaction.**

An illustration of Galapagos

<https://youtu.be/0F4UY-Ff2t4>

The screenshot displays a video player interface showing a Grasshopper Galapagos optimization workflow. The main window is titled "Galapagos Editor" and features a "Start Solver" button and a "Stop Solver" button. The editor displays a grid of points and a line graph. Below the grid, a list of values is shown, including 80.510114, 80.510128, 80.52053, 80.523532, 80.523717, 80.528282, 80.532639, 80.533631, 80.53428, and 80.53445. The video player controls at the bottom show a progress bar at 8:28 / 9:06.

Design Optimization, Galapagos, Grasshopper

Command: _SelPt
14 points added to selection.
Command:

Standard CPlanes Set View Display Select View

Perspective

Wall B

Galapagos Editor

Options Solvers Record

Start Solver Stop Solver

Display

Reinstate

X coordinate 8.43

Y coordinate 5.18

80.510114

80.510128

80.52053

80.523532

80.523717

80.528282

80.532639

80.533631

80.53428

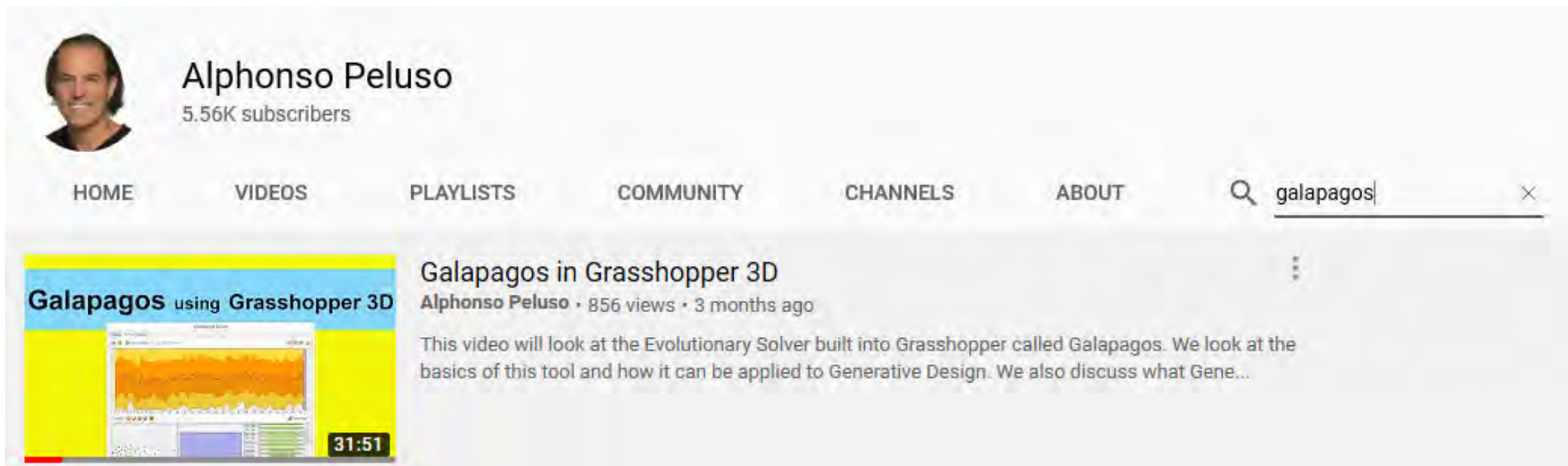
80.53445

Panel 0

8:28 / 9:06

Plug-in 3: Galapagos Introduction

<https://youtu.be/PjGcF7STf7c>



The image shows a screenshot of a YouTube channel page for Alphonso Peluso. The channel name is "Alphonso Peluso" with 5.56K subscribers. The navigation menu includes HOME, VIDEOS, PLAYLISTS, COMMUNITY, CHANNELS, and ABOUT. A search bar contains the text "galapagos". The video "Galapagos in Grasshopper 3D" is featured, with a thumbnail showing a 3D model of a landscape. The video title is "Galapagos in Grasshopper 3D" and it has 856 views and was uploaded 3 months ago. The description reads: "This video will look at the Evolutionary Solver built into Grasshopper called Galapagos. We look at the basics of this tool and how it can be applied to Generative Design. We also discuss what Gene...".

Alphonso Peluso
5.56K subscribers

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

galapagos

Galapagos in Grasshopper 3D
Alphonso Peluso • 856 views • 3 months ago

This video will look at the Evolutionary Solver built into Grasshopper called Galapagos. We look at the basics of this tool and how it can be applied to Generative Design. We also discuss what Gene...

Plug-in 3: Galapagos

Galapagos Editor

Options Solvers Record

Start Solver Stop Solver

12.563115	
12.563115	
12.563083	
12.563073	
12.563069	
12.563066	
12.563033	
12.563007	
12.562989	

Display Reinststate

OK Cancel

Grasshopper - galapagos*

File Edit View Display Solution Help

Params Maths Sets Vector Curve Surface Mesh Intersect Transform Display Ladybug Kangaroo2

X coordinate 0.89877

Y coordinate 0.73248

1.0.0007

End Near Point Mid Cen Int Perp Tan Quad Knot Vertex Project Disable

Solid Tools Mesh Tools Render Tools Drafting New in V6

Vi...
P
1.
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C
K

Plug-in 4: Ivy

Mesh analysis,
Segmentation and
unrolling

By: Andrei Nejur



Plug-in 4:

Ivy

Download the plug-in:

<https://www.food4rhino.com/app/ivy>

Andrei Nejur on Ivy:

<https://vimeo.com/nejur>

Plug-in 4: Ivy Papers on development

Ivy

Bringing a Weighted-Mesh Representation to Bear on Generative Architectural Design Applications

Andrei Nejur
Technical University of
Cluj-Napoca
Kyle Steinfeld
University of California, Berkeley



1

ABSTRACT

Mesh segmentation has become an important and well-researched topic in computational geometry in recent years (Agathos et al. 2008). As a result, a number of new approaches have been devel-

1 The Elephetus project by Anders Holden Deleuran (CITA/KADK) and

Ivy

Progress in Developing Practical Applications for a Weighted-Mesh Representation for Use in Generative Architectural Design

Andrei Nejur
Technical University of
Cluj-Napoca
Kyle Steinfeld
University of California, Berkeley



1

ABSTRACT

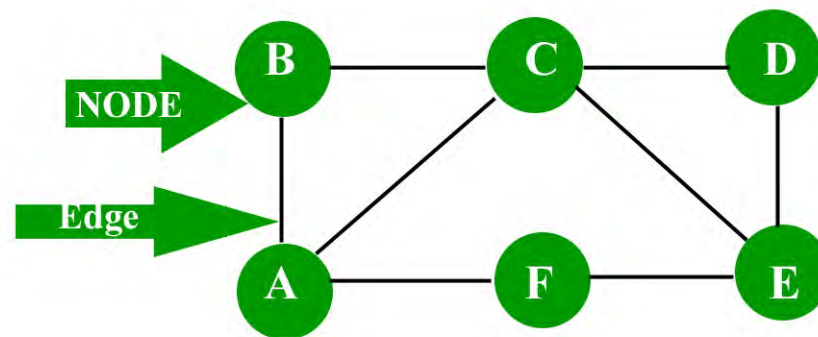
This paper presents progress in the development of practical applications for graph representations of meshes for a variety of problems relevant to generative architectural design (GAD). In previous

1 A papercraft model fabricated using Ivy.

Plug-in 4: Ivy

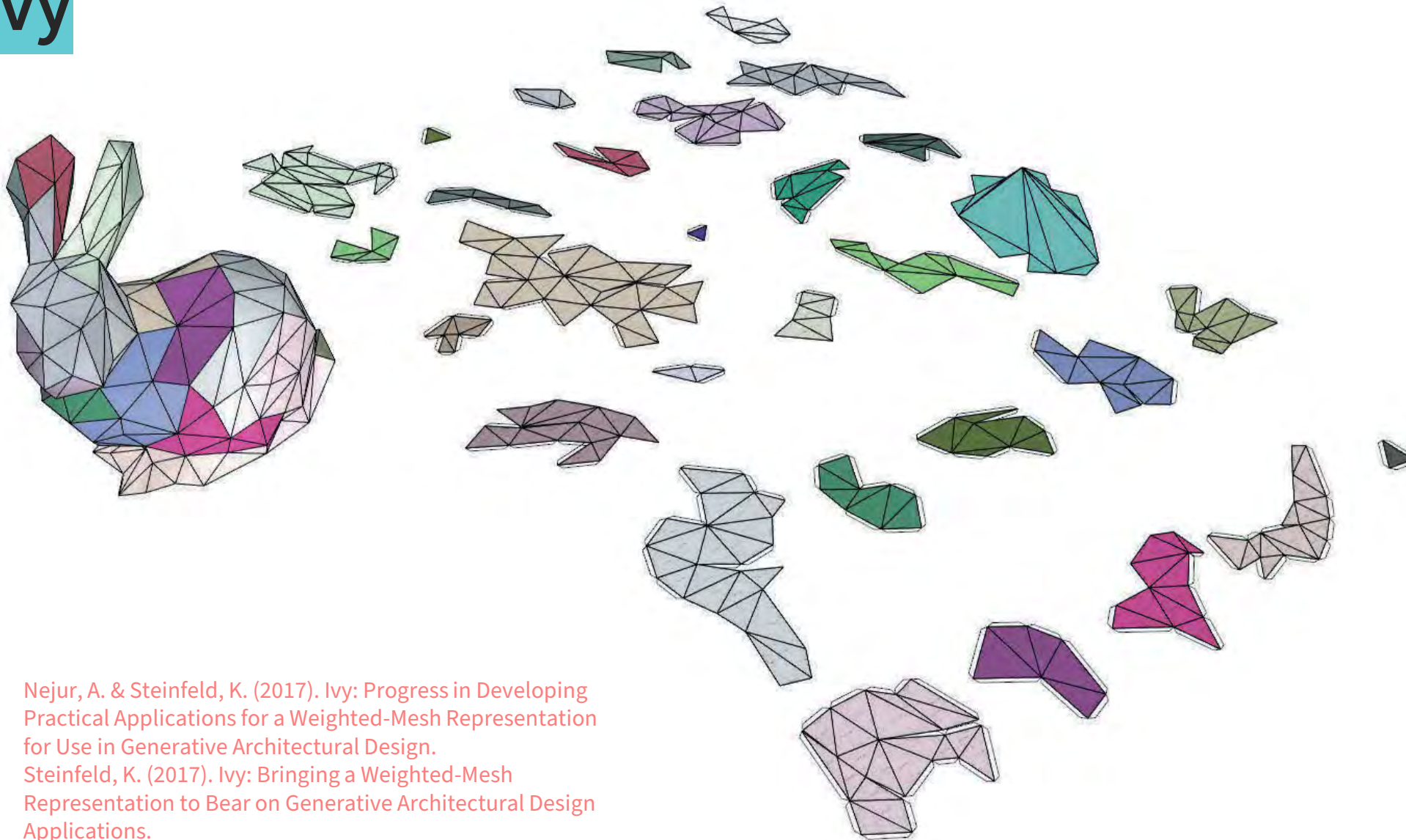
Based on
Graph Theory,

Creating
segmentations and
unroll them, then
send them to
digital fabrication
process



Plug-in 4:

Ivy

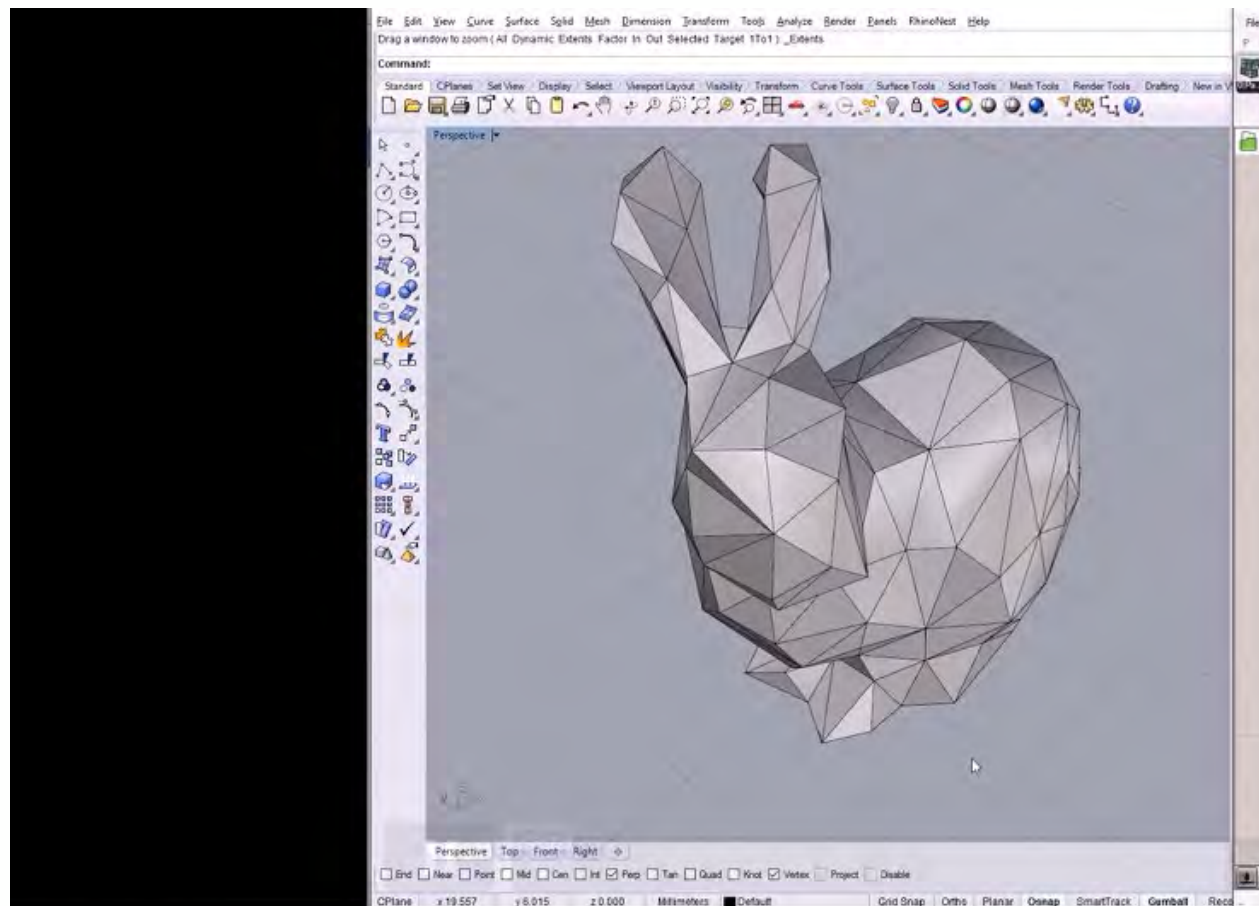


Nejur, A. & Steinfeld, K. (2017). Ivy: Progress in Developing Practical Applications for a Weighted-Mesh Representation for Use in Generative Architectural Design.

Steinfeld, K. (2017). Ivy: Bringing a Weighted-Mesh Representation to Bear on Generative Architectural Design Applications.

Plug-in 4: Ivy Introduction

<https://vimeo.com/nejur/ivy-01>



Ivy for Grasshoper basic mesh unroll

4 years ago | More



Andrei Nejur

+ Follow

Six common techniques:

3- Tiling/ Tessellating

It involves development of objects that when assembled together, forming **a coherent plane without gaps** or overlaps.

Advantages tiling/tessellating in digital fabrication approach:

- Effective time investment
- Provide ways which patterns are generated and optimised (visually and materially sound)
- Optimised for reduction of waste.

Six common techniques:

3- Tiling/ Tessellating

Translating digital information from **mesh to complex 3D form**, using sheet materials through tiling, has made digital fabrication technique become **more apparent** from early design stage.

Tiling/tessellating also affords **greater variation and modulation**, as they provide an inherent economy of means.

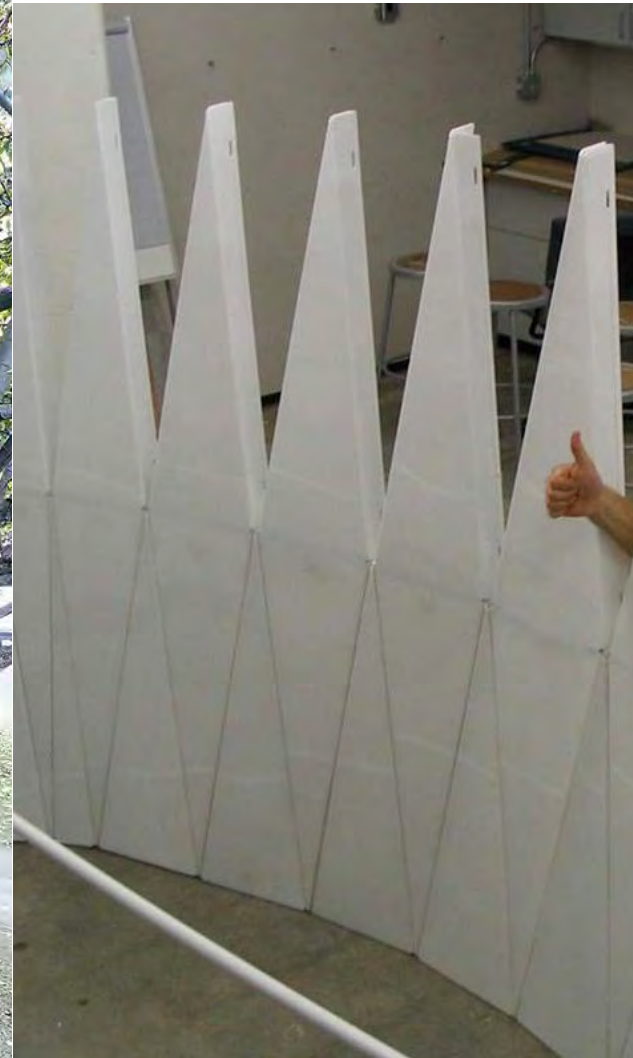
Previously in Week 6, how Ivy can contribute to the process..

Six common techniques: 3- Tiling/ Tessellating

Huyghe + Le Corbusier
Puppet Theater,
MOS
2004



<https://www.mos.nyc/project/puppet-theater>



Re-iterated aims and objectives

- To elicit **purposes** of additional plug-ins
- To contextualise **the use** of plug-ins in parametric design thinking
- To enumerate **available plug-ins** and their common use
- To illustrate kinds of **analysis** and **data** obtained from selected plug-ins
- To inform how can plug-ins be **useful** for future use in design