

**Grasshopper Level 1 Course:**  
Improving your workflow using parametric tools



**Rhino**ceros®



authorised training centre

Simply Rhino Limited  
+44 (0)208 498 9900  
[www.simplyrhino.co.uk](http://www.simplyrhino.co.uk)  
[training@simplyrhino.co.uk](mailto:training@simplyrhino.co.uk)

# Introduction

---

## **Instructors:**

Arthur Mamou-Mani AAdip, ARB/RIBA, FRSA  
Carmen Hu

## **Objectives:**

The aim of this course is to improve your workflow with Grasshopper3D and to give you an overall understanding of parametric thinking. We will explore all the native tools of Grasshopper and their relationship to Rhinoceros as well as their data structure and general concepts such as data types, data matching and lists. Grasshopper being a visual programming platform, the course will take you on a journey through mathematics, algorithms and computer science and explain applied examples of concepts such as vector geometry and trigonometry. We will show examples from the real world and try to reproduce them to confront you with real-life scenarios.

## **Audience-Friendly Class:**

Although the Grasshopper Level 1 (GHL1) and Grasshopper Level 2 (GHL2) classes are based on a pre-defined schedule, they are always different depending on the audience and requests happening throughout. We will make sure that the class matches your expectation and ambitions with the software. Most importantly, we want you to leave the class inspired and ready to use and create with the software at all stages of design. Please refer to the next page for more details about day by day course breakdown but feel free to contact us for more bespoke training or to give us a heads up on what you would like to learn.

## **Prerequisites:**

The class is aimed at complete beginners in Grasshopper and parametric thinking but it is preferable to have an intermediate level in Rhinoceros. Although Grasshopper is mostly used for design, the class is about parametric thinking and workflow and therefore is not addressed at a specific profession. Over the past several years of delivering GHL1 we had architects, engineers, industrial designers, jewelry designers, contractors, project managers and artists attending the class.

## **Software & Plug-in:**

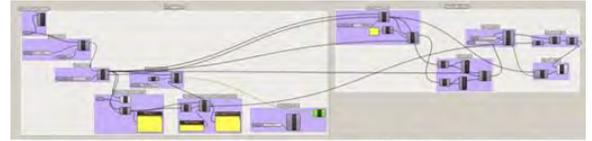
Rhino 7.0 / Grasshopper3D

# Overview - 7 Weeks Workshop

---

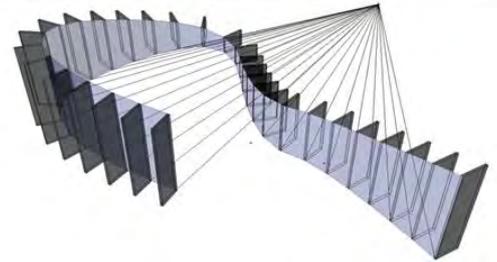
## Week 1 - Introduction to Grasshopper

1. Parametric thinking and modelling introduction
2. Grasshopper interface, tools and basic setup
3. Workflow between Rhino and Grasshopper (referenced, internalised and baked)



## Week 2 - Introduction to Grasshopper

4. Data Types and their parameters
5. Transformation Methods and Vector Geometry
6. List, Data Tree Structure and Data Matching



## Week 3 - Data Tree Structure & Geometry

7. Number Sequences (Series, Range, Random)
8. Mathematical Expressions
9. Data Dynamic Remapping (Graph Mapper)
10. Curves, surfaces and points and their properties (domain, parameters)



## Week 4 - Data Tree Structure & Geometry

11. Data Tree, Path, Items, Index and Matrix
12. Proximity Based Transformation (attractors)
13. Grids, Image Sampling



## Week 5 - Surface Panelling & Information

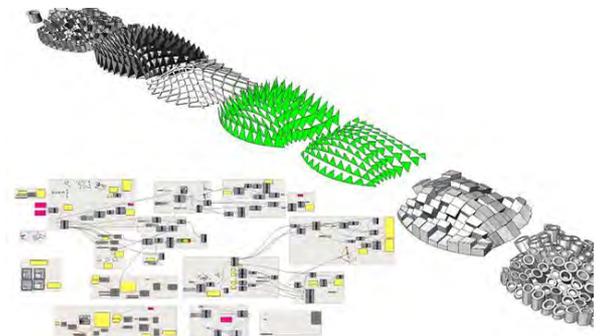
14. Introduction to panelling for surfaces
15. Surface Mapping, Isotrim and box morph

## Week 6 - Surface Panelling & Information

16. Mesh Modelling and Topology
17. Data Visualization (Tags, Gradient Colours)

## Week 7 - Surface Panelling & Information

18. Communicating with Excel through CSV file
19. Introduction to Galapagos (genetic algorithm)
20. Q&A and Level 1 course recap



# Weeks 1 & 2 - Introduction to Grasshopper

---

## 1. Parametric thinking and modelling introduction

This course will begin with an introduction to parametric design with several examples of projects built using Grasshopper. We'll introduce you to the key resources and community around the plugin for Rhino3D.

## 2. Grasshopper Interface, tools and Basic Setup

A detailed introduction to Grasshopper's unique visual programming interface will be given including the canvas, tabs and menus.

## 3. Workflow between Rhino and Grasshopper

How to import geometry from Rhino and understanding the key vocabulary such as list, items, branches, path. We will see how to link the two platforms through referenced geometry and unlink them through internalising geometry.

## 4. Data Types and their parameters

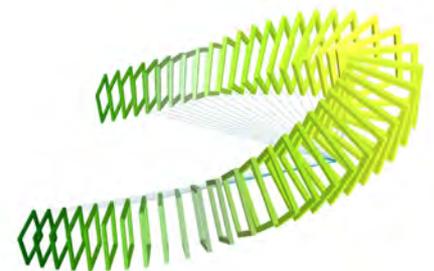
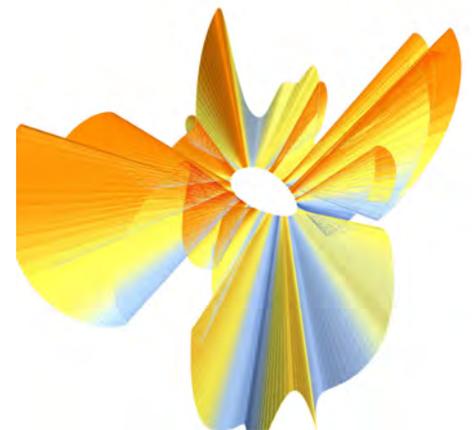
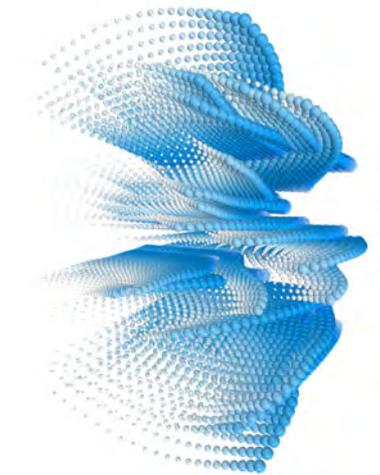
Understanding the way Grasshopper reads data is crucial to using each components. We will look at inputs, outputs, data manipulation through flatten, graft, simplify, reverse.

## 5. Transformation Methods and Vector Geometry

Moving, rotating, orienting, using planes or points require an understanding of vectors. We will see how vectors are being read and used in mathematics and within Grasshopper.

## 6. List, Data Tree Structure and Data Matching

Understanding the logic of data structure is essential for mastering Grasshopper. Students will start getting themselves to be familiar with basic data handling methods and matching techniques. We will cover the concept of Tree and List, as well as data visualization function.

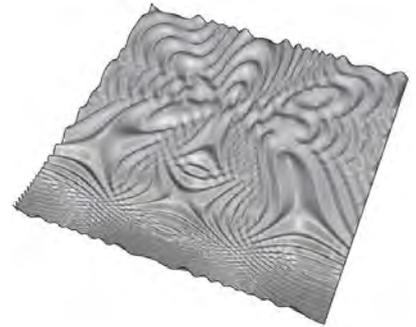


# Weeks 3 & 4 - Data Tree Structure & Geometry

---

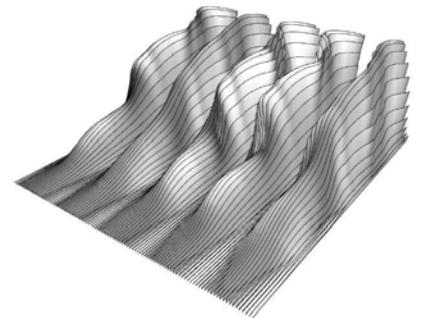
## 7. Number Sequences (Series, Range, Random)

Being able to replicate operations, using a sequence of number, allows Grasshopper to generate multiple geometry at once. We will look at numbers in relation to lists and data matching.



## 8. Mathematical Expressions

Grasshopper uses mathematical concepts in most of its operations, we will show you how to use the mathematical expression editor to manipulate the data and create mathematical graphs.

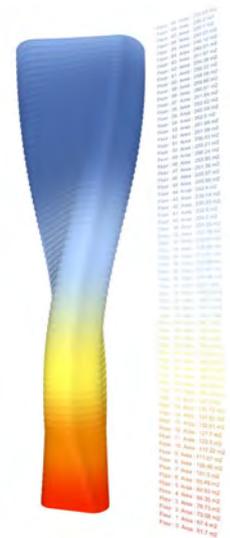


## 9. Data Dynamic Remapping (graph mapper)

Number can be manipulated, scaled and remapped in a linear or non-linear way using the graph mapper tool. We will show you how to use mathematical graphs to alter geometry through rotation, scaling and movement.

## 10. Curves, surfaces and points and their properties (domain, parameters)

Curves, surfaces and points share properties but need to be understood in the context of 1D, 2D and 3D Space. We will look at the properties of NURBS curves and surfaces, their domain and reparameterization.



## 11. Data Tree, Path, Items, Index and Matrix

Data Tree structure is at the core of Grasshopper3D. We will show how trees can be manipulated through components such as Flip Matrix, List item and shift list.

## 12. Proximity Based Transformation (attractors)

We will use external geometry to influence the dimension of a series of objects in space based on distance.



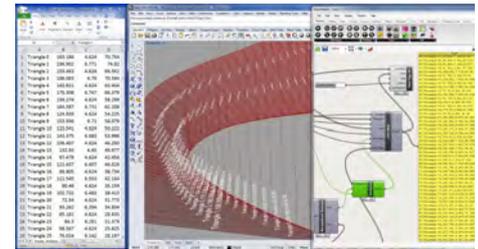
## 13. Grids, Image Sampling

Using Data matching and grafting operations, we will create 2d and 3d grids and link them with images to create informed patterns.

# Weeks 5, 6 & 7 - Surface Panelling & Information

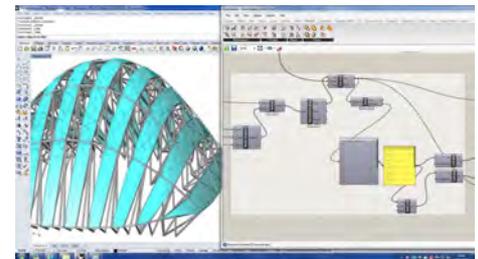
## 14. Introduction to Panelling for Surfaces

Surfaces can be subdivided into smaller panels and volumes. They can also be populated with components of all form through a process called replication using data trees. We will look at different ways of paneling a surface and controlling this process.



## 15. Surface Mapping, Isotrim and box morph

We will look at the properties of a surface and explain patterning principles on a surface. From a 3D freeform truss to a pyramidal hood reacting to curvature, we will explore several components geometry and the way they can be differentiated.



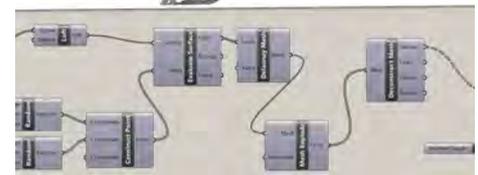
## 16. Mesh Modelling and Topology

Introduction to mesh modelling. Looking at the meshes properties such as their face topology we will look at the workflow behind mesh constructions in Grasshopper, comparing them with NURBS surfaces.



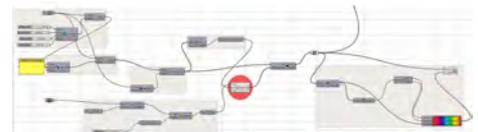
## 17. Data Visualization (Tags, Gradient Colours)

We will extract information from our models such as colour gradients, text tags defining dimensions and other properties.



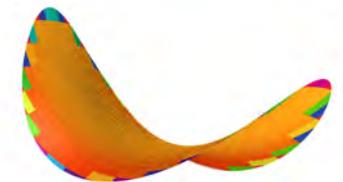
## 18. Communicating with Excel through CSV file

The information behind our parametric model will be formatted and exported as a CSV file to Excel. To do so, we will look at string operations such as concatenation.



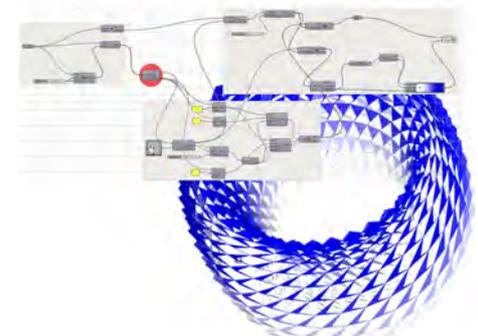
## 19. Introduction to Galapagos (genetic algorithm)

This will be our first iterative, or generative step within Grasshopper, we will look at how this evolutionary solver can solve geometrical problems based on a fitness criteria and genomes.



## 20. Q&A and Level 1 course recap

We will finish with a general question and answer session, going through all examples and reflecting together on how you will be able to use the tool for your own workflow.





## Arthur Mamou-Mani (AA dip.)

Arthur is an Architect, director of [Mamou-Mani](#) and [Fab.Pub](#) and a lecturer at the University of Westminster and UCL-Bartlett. He has been working with Simply Rhino for the past nine years, giving Grasshopper3D workshops to prestigious engineering companies including, Heatherwick Studio and Foster + Partners. Arthur also gave numerous talks including the TEDx, 3DPrintShow, Shape to Fabrication and the Develop3D Conferences.



## Carmen Hu

Carmen is a computational designer from Canada. She holds an MSc in Emergent Technologies and Design from the AA. Her interests include computational design and analysis of complex geometries, parametric modeling, and material fabrication using robotics. She previously attended the Pratt Institute in New York and received a BA in Interior Architecture from California College of the Arts, San Francisco. Prior to her current position she worked at Woods Bagot, SF and at an interior design practice in Hong Kong.