UNI

PARAMETRIC COMPLEXITIES

INSTALLATION WORKSHOP

ALGORITHMS AND PARAMETRIC FABRICATION IN DESIGN USING SCRIPTING AND INTERACTION

**BRIEF**

**Are you interested in gaining Parametric competency to push your design skills to the next level?**

**Are you ready to learn a very exciting and powerful tool that will take your ideas and concepts to a whole new realm?**

# COURSE DESCRIPTION \ \

The **FOUR**-day **INCLUSIVE** workshop of parametric design with digital fabrication and interactive design technology, integrated within the algorithmic modelling. The entire workshop is divided into three parts - Rhinoceros3D, Grasshopper and Arduino. The first part focuses on to investigate new formal solutions optimized for the architecture and design. It will also include a lecture and presentations on the subject of complexity in our design methodology and how to incorporate it as a design tool.he workshop will explore algorithmic strategies and the main techniques of form finding using the basic and intermediate level tools in Rhinoceros. The techniques will be applied at different scales, from architecture (surface modelling) to product level design. The model will further explore the fabrication methodologies in architecture and design.

The second part workshop will introduce the basics of grasshopper with visual scripting. It will discuss methods of parametric design, algorithmic modelling techniques and advanced data management for the generation and control of complex shapes using python/grasshopper. Workshop will be focused to cover up several modules along with the introduction of various fractal geometries based over mathematical platforms like grasshopper for Rhinoceros. Tools like processing, Mandelbulb 3d, Apophysis, Python scripting related to generation of fractal geometries and methodology of programming will also be discussed and experimented in the module. It will cover the most important aspect of the visual programming software that will include lectures and guided practical exercises.

The third part of the workshop goes into establishing physical and digital connections leveraging operational flexibility and fluidity using Grasshopper.

The workshop will strive to highlight intelligence in systems and pose the problem of multiple contradicting parameters in digital design. The workshop will focus in creating physical interactive prototypes responding to certain parameters or information. Grasshopper and plugin Firefly paired with Arduino Board's computing platform will be introduced to participants as possible tools for experimentation.

# STRUCTURE \ \

Program has been structured into three parts :
1. To teach participants the use of Rhino and associated plugins that help in achieving parametric fabrications, with a real design exercise. Participants will learn how to build and manage parametric data structures (from basic simple lists to complex data Structures) and to develop data driven geometry and envelops. This will help them in understanding and taking the data visualization to next level. On second day an overview on how to do framing for architectural renders in VRAY for Rhino.
2. Participants will learn to generate their form with polygonal modelling technique in Rhino. This form will be taken into Grasshopper environment where it will be used to analyse and to develop their design. The workflow will be demonstrated through exercises that deal with different design challenges, interrogating the aesthetic potential of Topological Optimization. Each topic will be presented with both theoretical introduction and practical application. In the afternoon of the second day, participants will split into groups to develop their own projects, with direct supervision from tutor, and towards their third day evening presentation.
3. Participant will get to experiment upon sensors and actuators with the help of Arduino board and visual programming in Grasshopper. A 3D form created using Rhinoceros and Grasshopper will be used to emulate the data taken from sensors. Each topic will be presented with both theoretical introduction and practical application. In the afternoon of the fourth day, participants will split into groups to develop their own projects, with direct supervision by the tutors, and towards their last day evening presentation.

## DAY 1     SATURDAY (8 HOURS)

*BRIEF INTRODUCTION ABOUT RHINO + GRASSHOPPER + ARDUINO*

1. USER INTERFACE
2. COMPONENTS OF RHINOCEROS
3. NURBS AND POLYGON MESHES,POLYGONAL MODELLING IN RHINOCEROS
4. BASIC EXERCISE OF SURFACE CREATION, SUBDIVISION AND MODELLING TECHNIQUES.
5. GEOMETRY TESSELATION
6. VRAY BASICS
7. SUBDIVISION USING PANELLING TOOLS.
8. MORPHING
9. APPLICATION OF THE LEARNED TECHNIQUES IN A PARAMETRIC DESIGN EXERCISE.
10. VRAY SCENE RENDERING
11. BASICS OF LASER CUTTING.
12. FABRICATION TOOLS AND PLUGINS TO REALIZE YOUR PARAMETRIC DESIGNS USING THE LASER CUTTING MACHINE.
13. UNDERSTANDING GENERATIVE ALGORITHMS FOR FRACTAL USING MADLEBULB3D & APOPHYSIS
14. GRASSHOPPER VISUAL INTERFACE
15. GRASSHOPPER COMPONENTS
16. DATA AND LIST MANAGEMENT IN GRASSHOPPER
17. PYTHON SCRIPTING BASICS WITH RHINOCEROS
18. DESIGN PROJECT ASSIGNMENT
19. VECTORIAL FIELDS
20. MESH TESSELLATION AND SUBDIVISION TOOLS [DELAUNAY, SUBSTRATE, VORONOI, OCTREE, LUNCHBOX & PANELLING TOOL]
21. LISTS & DATA MANAGEMENT, MANIPULATION, VISUALIZATION
22. APPLICATION OF THE LEARNED TECHNIQUES IN A PARAMETRIC DESIGN EXERCISE.

## DAY 2     SUNDAY (8 HOURS)

*FABRICATION + DESIGN*

1. UNDERSTANDING USE OF SENSORS IN MAKING INTERACTIVE STRUCTURES.
2. UNDERSTANDING SENSORS, ACTUATORS,
3. FABRICATION TOOLS AND PLUGINS TO MAKE A SMALL PROTOTYPE AND ARDUINO BASICS
4. MICROCONTROLLERS AND MICROPROCESSORS.
5. READING AND TRANSLATION OF DIGITAL SIGNALS USING ARDUINO
6. PROGRAMMING ARDUINO BOARDS THROUGH VISUAL PROGRAMMIG
7. USE OF EMULATOR TO EMULATE ARDUINO BOARDS
8. OPEN SOUND CONTROL (OSC) AND USER DA-TAGRAM PROTOCOL (UDP) TO COMMUNICATE THROUGH DEVICES.

## DAY 3     MONDAY (8 HOURS)

*FABRICATION*

1. EXCERCISE TO CREATE AN INTERACTIVE INSTALLATION USING VISUAL PROGRAMMING IN GRASSHOPPER.
2. MODEL PROTOTYPING AND FABRICATION.
3. INSTALLING THE ARDUINO AND CONNECTING TO THE INTERNET.

## DAY 4     TUESDAY (8 HOURS)

*FABRICATION*

# REQUIREMENTS \\

- There are no prerequisites, anyone from the design background or an enthusiast in the field of design are invited for this workshop.
- Participants should bring their own computer with above mentioned software installed. More details will be sent to the registered participants.
- In order to experiment on your own Arduino kit an extra amount of **50 USD** for Arduino kit has to be paid.
- Link to the respective software for download will be sent to the registered participants separately.

# TAKE AWAYS \\

- Basic understanding of the Rhino interface
- How to navigate around your scene and select objects
- Distinguishing the different Rhino objects and their use
- How to create and edit 2D and 3D geometric objects
- How to transform your objects
- How to organize your model efficiently
- Helpful tips and tricks to work fast and efficient
- How to render and prepare presentations using V-RAY Plugin for Rhino.
- Understanding Parametric Design main characteristics
- How the Grasshopper Interface works
- How information is organized and managed in Grasshopper
- How to create parametric models
- Take home with you your own parametrically designed hand-on model.
- Understanding how sensors and microcontrollers can be used to make an interactive installation.
- How to visually programme arduino to create a working prototype.

# T O O L S \ \

All the participants should have following tools installed on their workstations:

1.  **Rhinoceros 5** SR12 or Higher (30 day Trial version can be downloaded from https://www.rhino3d.com/download)
2.  **PanellingTools** for Rhino (https://wiki.mcneel.com/labs/panelingtools)
3.  **T Splines** for Rhino (http://www.tsplines.com/latest-version)
4.  **Vray for Rhino** (https://www.chaosgroup.com/vray/rhino)
5.  **Grasshopper for Rhino** (http://www.grasshopper3d.com/page/download-1)
6.  **MadleBulb3D** and **Apophysis**
7.  **Python** (Framework can be installed before workshop)
8.  **Firefly for Grasshopper** (http://www.food4rhino.com/app/firefly)
9.  **Arduino IDE 1.6.0** (https://www.arduino.cc/en/Main/OldSoftwareReleases)
10. **Lunchbox for Grasshopper** (http://www.food4rhino.com/app/lunchbox)
11. **AutoCAD**
12. **Adobe Suite**

# R E G I S T R A T I O N \ \

A total of **15 seats** are available for the workshop per workshop coordinator. Registration will close 3 days prior to the workshop or till the seats last.

Please follow the link to complete the registration:

**1 PASS** permits **1 PARTICIPANT** in **1 WORKSHOP**

Refer to the **eduPass** Section to learn more about the Professional/Student/Group/Multiple registration.
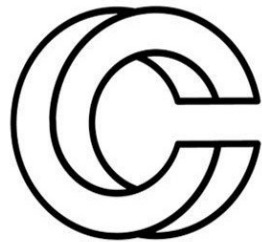
# CLASSROOM
## COMPETITIONS

**Classroom competitions** are a part of this series of workshops and is meant for all the designers who want to explore their way with hands on experience to gain skills and create real world projects. Under this series you participate in workshops at one of these Micro-studio and get awareded a trophy.

In association with **UNI**, we are now expanding our vision of creating these micro-studios globally with a fusion of online design community and offline classrooms.

This fusion will help us in combining different ideologies and diverse methodologies, to create a continuum which links ideas such as exploration, debate and collaboration at a global level to understand and create **'Architecture of Everything'**

# **EDU**PASS

EDUpass is a pass which can be used to participate in any workshop in this series (registration to be done 3 days prior the commencement of the workshop). Multiple EDUpasses can be purchased and used in a group to attend a single workshop or a single participant can register for multiple workshops.

For example, If you had purchased 6 passes, you can register to 6 different workshops or bring along 5 other friends/colleague with you to a attend a single workshop of your choice.

## **HOW** DOES IT **WORK?**

A Participant can purchase as many passes as he/she wants and 1 PASS permits entry to any 1 workshop and classroom competition of his/her choice.

# SPARRO