Week 5
Parametric Design

This week we will be looking at parametric design, its relation with computational design, parametricism and parametricism 2.0, parametric design thinking and how designers use parameters.

Photo by Christian Perner on Unsplash

Outline

01

Introduction to Parametric Design

02

Brief historical account

03

Parametricism

04

Parametric Design Thinking

05

Characteristics of Parametric Design System

06

How Designers Use Parameter
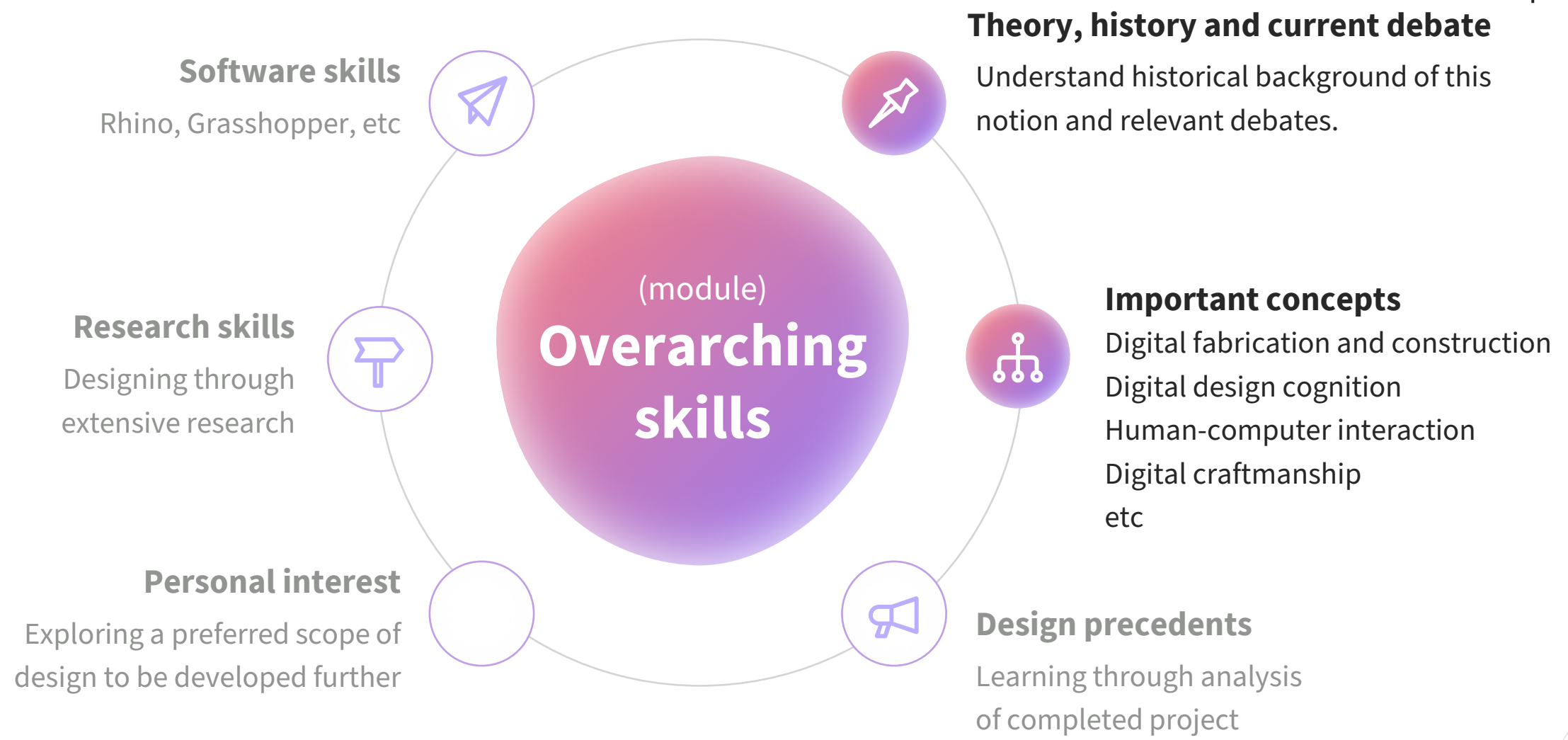
Photo by Clark Van Der Beken on Unsplash

Aims and objectives

- To **introduce** the concept of parametric design
- To **contextualise** parametric design within the umbrella of **computational design field**
- To infer **parametric design thinking**
- To provide illustration on **how designers can use the concept** in their practices

Learning outcomes

Students will be able to..

01 Summarise **what is** parametric design and **its key differences** with non-parametric design

02 To infer **main potentials** of parametric design

03 Critically **inform their design practice** with regards to parametric design

Software skills

Rhino, Grasshopper, etc

Research skills

Designing through
extensive research

Personal interest

Exploring a preferred scope of
design to be developed further

(module)
Overarching skills

Theory, history and current debate

Understand historical background of this
notion and relevant debates.

Important concepts

Digital fabrication and construction
Digital design cognition
Human-computer interaction
Digital craftmanship
etc

Design precedents

Learning through analysis
of completed project

Previously on Week 4

==PARAMETRICS==

An approach to digital design founded upon: ==relational or associative modelling==

It operates under conditions of ==**constraints**==, to exploit parametric ==**modifications**== as means to ==**generate variability**== of an object (or a system) under design.

Introduction to Parametric Design

What is Parametric Design?

- Parametric Design is a process **based on algorithmic thinking.** *

- Enables the expression of **parameters** and **rules** that together; **define, encode and clarify** the relationship between **design intent** and **design response**. *

- A parametric design system is defined by its: **input, algorithm and output.** *

- Focus mainly on **geometry and topology.** *

*Jabi, W. (2013). *Parametric design for architecture,* Laurence King Publishing.

Photo by Pierre Châtel-Innocenti on Unsplash

Podcasts

PS: You need to crank your volume up!

Podcast 1:
https://youtu.be/K_2H5I-enGM

Podcast 2:
https://youtu.be/C-04o4TtgAs

Podcast 3:
https://youtu.be/xz0PUmj09Bc

Introduction to Parametric Design: Podcast 1 of 3
PODCAST 1

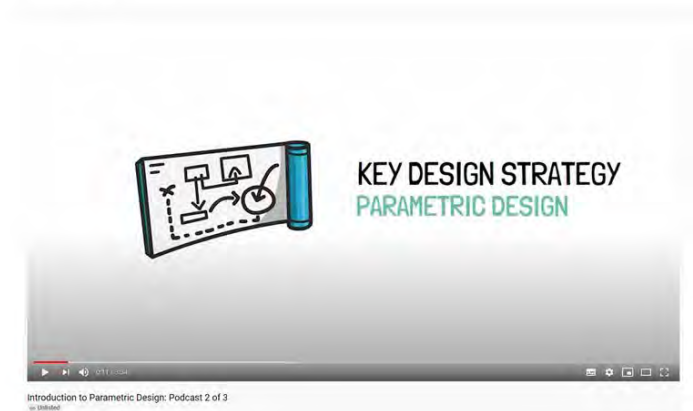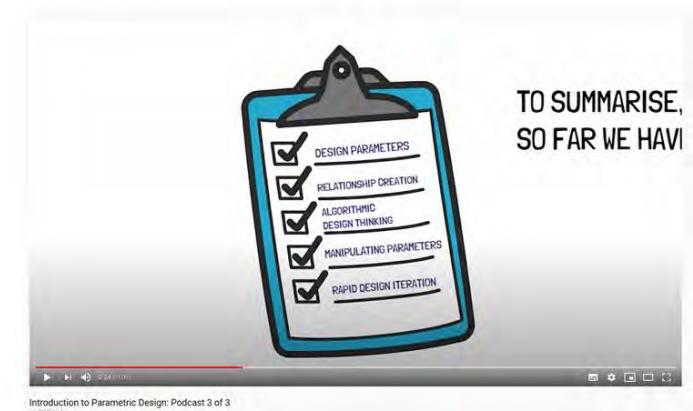Introduction to Parametric Design: Podcast 2 of 3
PODCAST 2

Introduction to Parametric Design: Podcast 3 of 3
PODCAST 3

Podcasts

P1 What is parametric design

Definition and example
Algorithmic thinking
Parametric design system

P2 Key strategy

Key design strategy
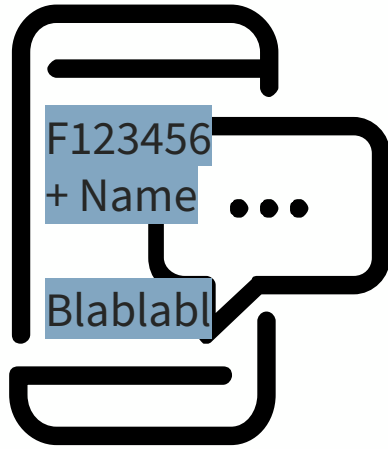How designers use parameters
An example of parametric exploration

P3 Summary

Recap of explored concepts
Link to short quiz
Three topics
Before classroom to-do-list

NOTE FOR THE THIRD PODCAST:
For this Digital Architecture class, please ignore the short quiz link *(as you will upload it to the forum)* and ignore the 'before classroom to-do-list'.

QUIZ

F123456
+ Name

Blablabl

0 Comments   Mia Tedjosaputro   🔴 Login ▾

♡ Recommend   🐦 Tweet   f Share   Sort by Newest ▾

Start the discussion…

LOG IN WITH   OR SIGN UP WITH DISQUS ❓

Name

Question:

1. How does parametric design differ with non-parametric design?
2. From your observation, what are the advantages of parametric design?
3. What are the concepts we have explored in the three podcasts?

Upload your answers here <u>at the end of lesson</u>:

https://miatedjosaputro.com/2022/03/23/dg-week-5-2/
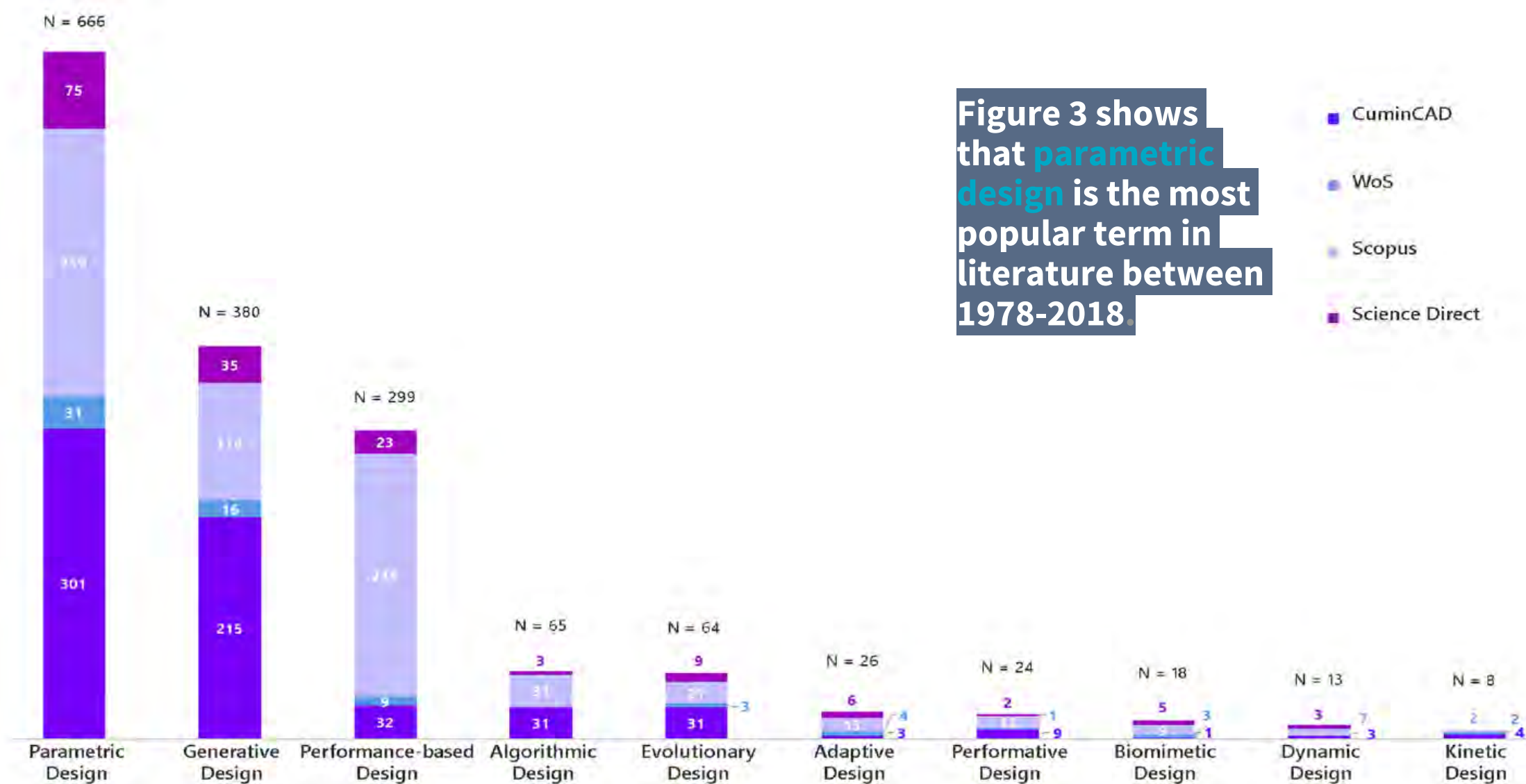
Figure 3 shows that parametric design is the most popular term in literature between 1978-2018.

Legend: CuminCAD, WoS, Scopus, Science Direct

N = 666
75
31
301

N = 380
35
16
215
32

N = 299
23
9
32

N = 65
3
31
31

N = 64
9
31
3

N = 26
6
4
3

N = 24
2
1
9

N = 18
5
3
1

N = 13
3
7
3

N = 8
2 2
4

Parametric Design | Generative Design | Performance-based Design | Algorithmic Design | Evolutionary Design | Adaptive Design | Performative Design | Biomimetic Design | Dynamic Design | Kinetic Design

Fig. 3 Number of times each CD term appeared in the literature between 1978 and 2018.

Caetano, I., Santos, L. & Leitão, A. (2020). Computational design in architecture: Defining parametric, generative, and algorithmic design. *Frontiers of Architectural Research*.

Computational Design:
1. Parametric
2. Generative
3. Algorithmic Design

Caetano et al. (2020)

Contextualisation of parametric design within other similar approaches. Caetano et al (2020) proposed an improved and sound taxonomy for the set of key Computational Design terms by analysing existing terminology.

Photo by Jimmy Chang on Unsplash
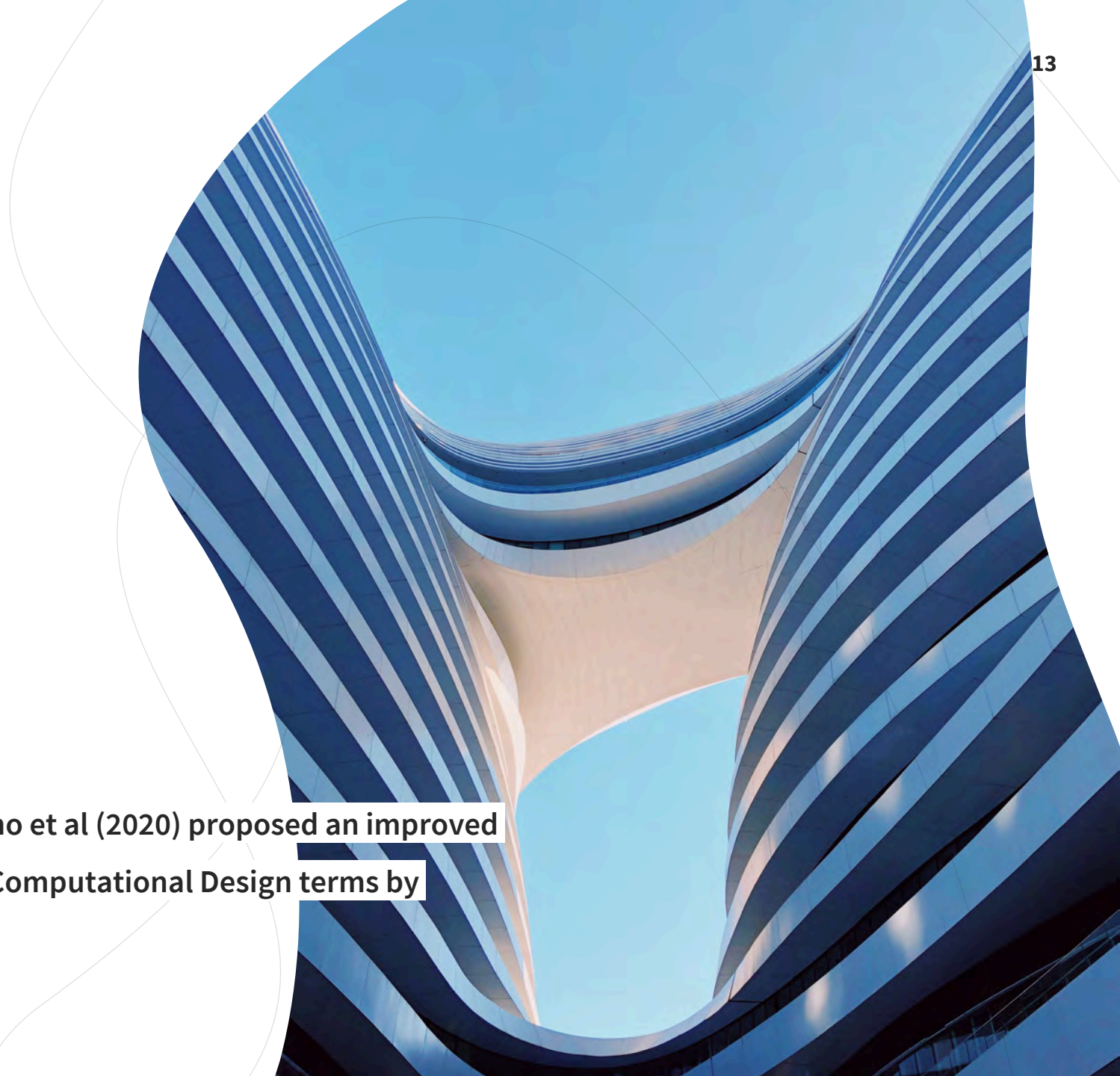
Computational Design:
1.   Parametric
2.   Generative
3.   Algorithmic Design

Caetano et al. (2020)

Parametric Design is design approach based on the use of parameters to describe sets of designs.

Computational Design:
1. Parametric
2. <mark>Generative</mark>
3. Algorithmic Design

Caetano et al. (2020)

Generative Design is a design approach that uses algorithms to generate designs.

More autonomous than parametric design.

Computational Design:
1. Parametric
2. Generative
3. ==Algorithmic== Design

Caetano et al. (2020)

Algorithmic Design is a Generative Design approach characterised by an identifiable correlation between the algorithm and its outcome.

Computational Design:
1.   Parametric (PD)
2.   Generative (GD)
3.   Algorithmic (AD) Design

Caetano et al. (2020) suggest the conceptual representation of the terms' extension regarding the Computational Paradigm.

Algorithm Design (AD) is a subset of Generative Design (GD).
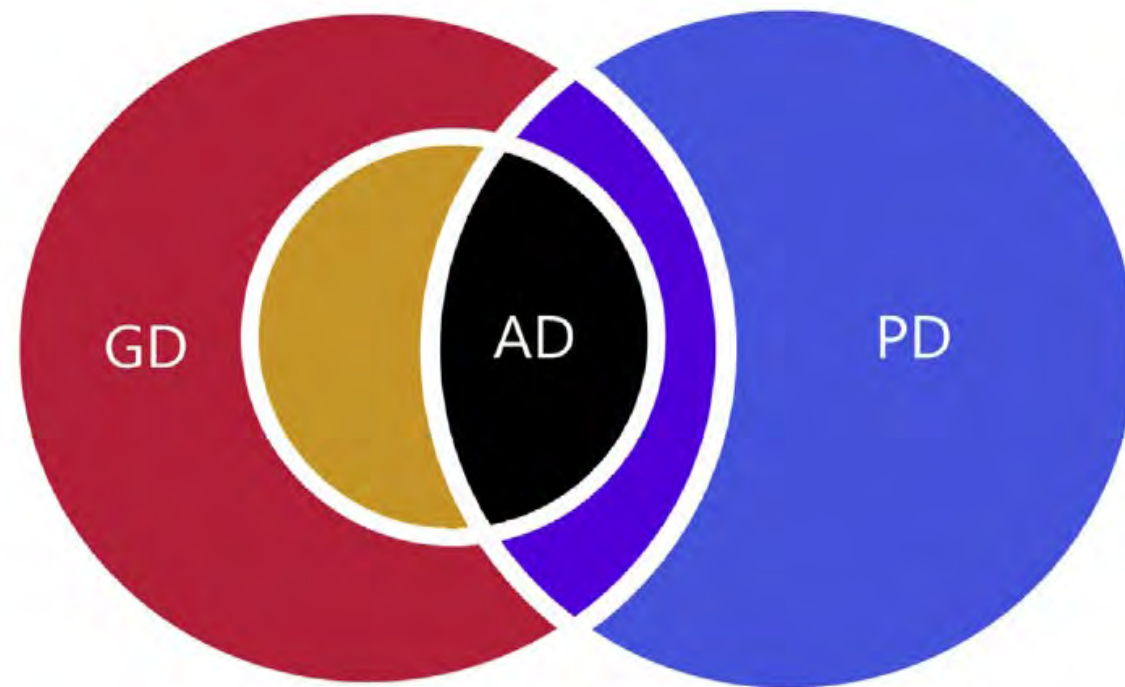
Example of parametric design:
Hangzhou Olympic Sports Centre
NBBJ Architects

http://www.nbbj.com/work/hangzhou-stadium/#next

Paper on integrated parametric design process:
https://issuu.com/pabloherrera/docs/28122011_hz_tennis_issuu_original_2011
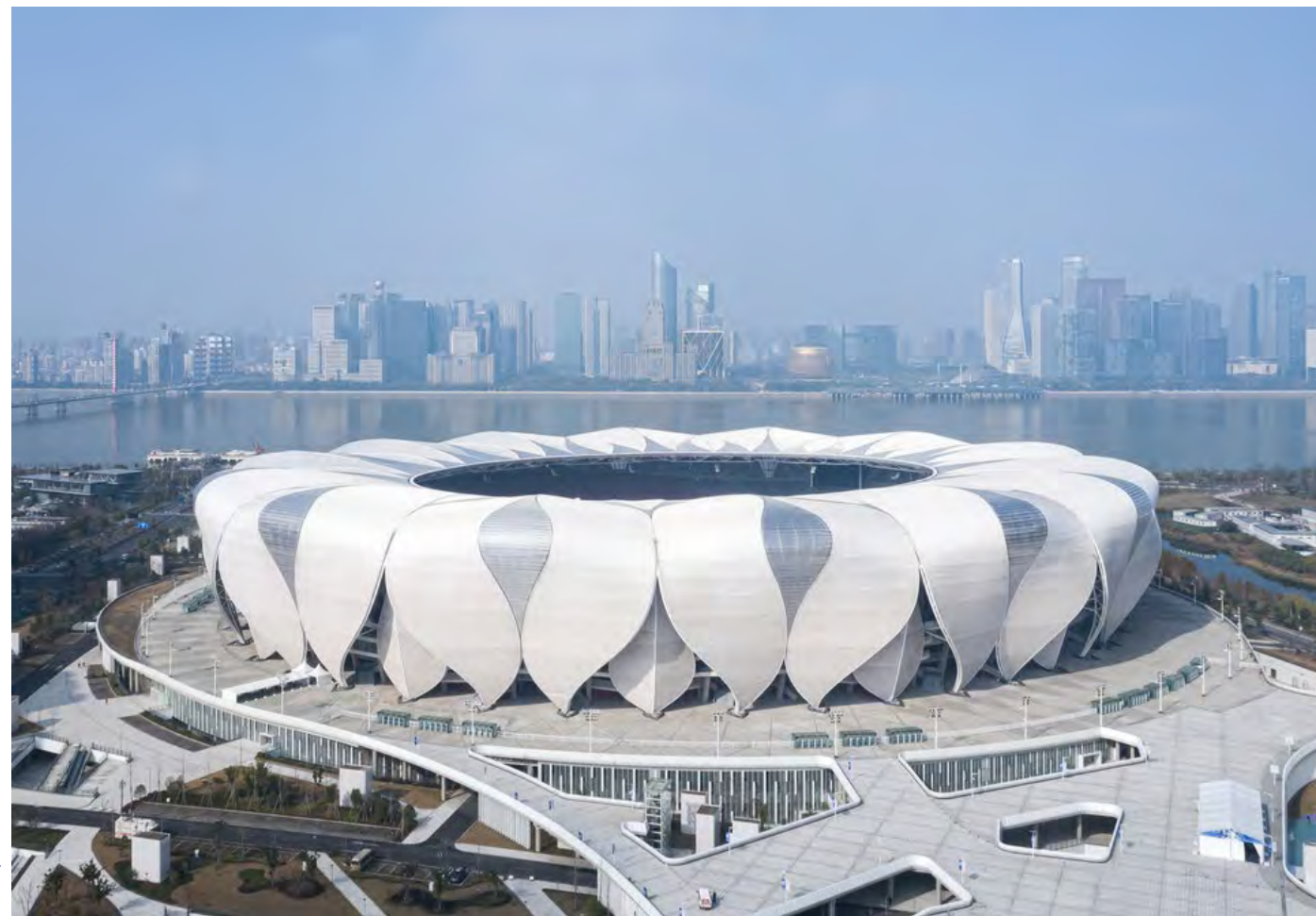
Example of parametric design: Hangzhou Olympic Sports Centre NBBJ Architects
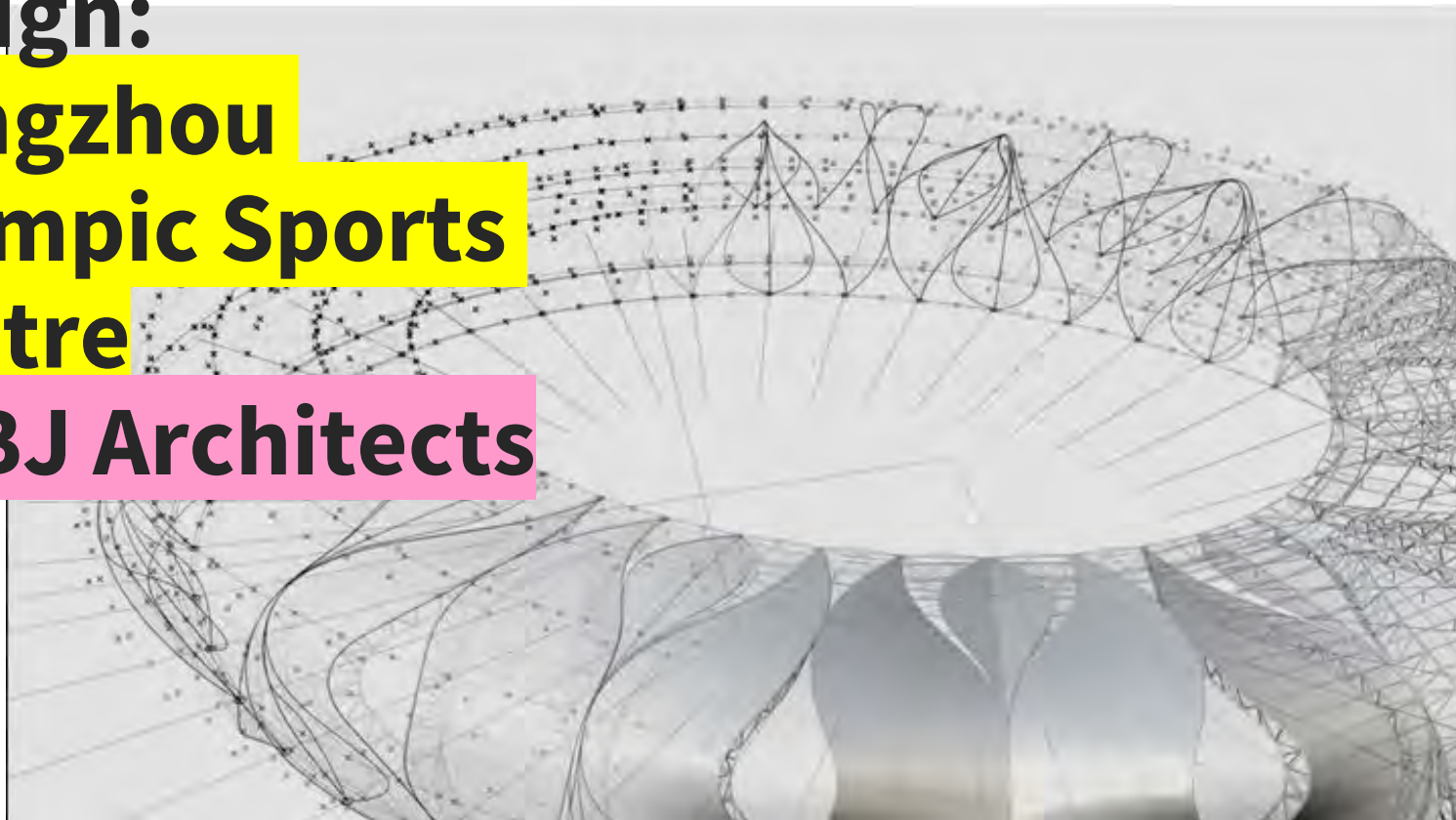
Computational Design

NBBJ used computational design tools during schematic design and design development to refine the competition design and explore how best to maximize the fan experience, use less material such as steel and model energy performance.

1 of 10

Example of parametric design:
Hangzhou Olympic Sports Centre
NBBJ Architects

Form variations, based on point cloud constraints

http://www.nbbj.com/work/hangzhou-stadium/#next

Paper on integrated parametric design process:
https://issuu.com/pabloherrera/docs/28122011_hz_tennis_issuu_original_2011

CIRCULAR ARC
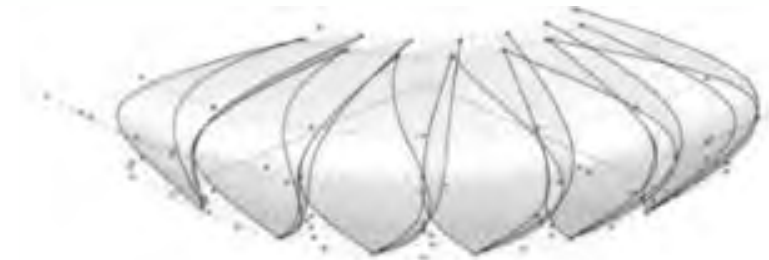
CONTROL SURFACES
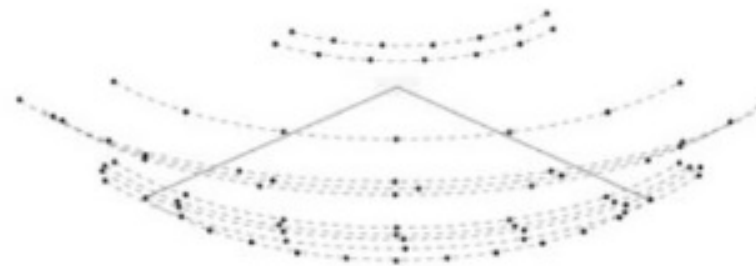
POINT CLOUD CONSTRAINTS
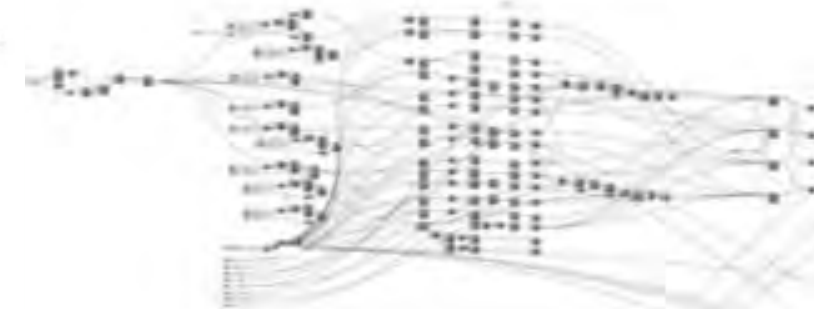
Example of parametric design: Hangzhou Olympic Sports Centre NBBJ Architects

Form variations, based on point cloud constraints

http://www.nbbj.com/work/hangzhou-stadium/#next

Paper on integrated parametric design process:
https://issuu.com/pabloherrera/docs/28122011_hz_tennis_issuu_original_2011

Figure 3. Variations on the exterior envelope. The point cloud constraints were manipulated to create different geometric effects. The number of petal modules could also be increased or decreased.

Common tools (plug-ins mostly) for parametric design

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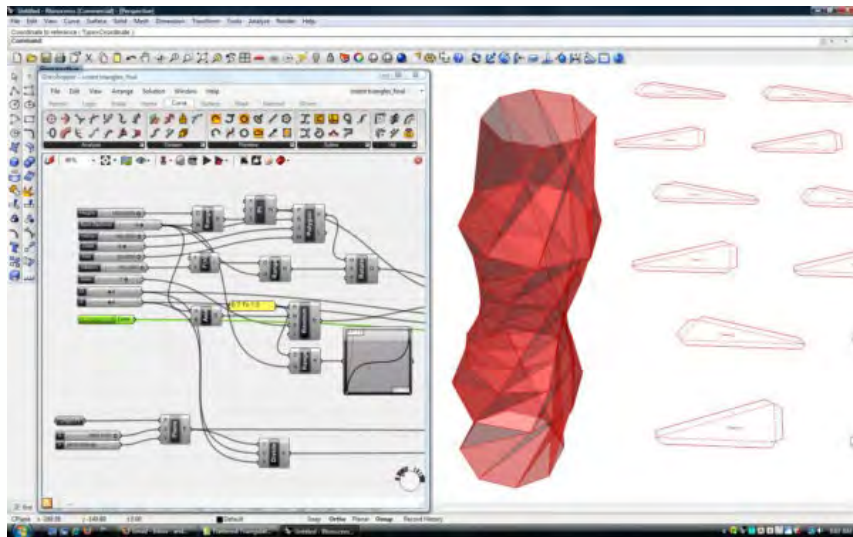

GRASSHOPPER 3D

1. **Grasshopper 3D-** most common
2. Ladybug (Environmental analysis)
3. Honeybee (environmental analysis)
4. Geco (environmental analysis)
5. Heliotrope-Solar (environmental analysis)
6. **Kangaroo** Physics (structural analysis)
7. **Karamba** (structural analysis)
8. BullAnt (structural analysis)
9. Hummingbird (structural analysis)
10. Mantis (structural analysis)

Brief historical account

Architettura Parametrica, coined by Luigi Moretti

Moretti, L., Bucci, F. & Mulazzani, M. (2002). *Luigi Moretti: works and writings*, Princeton Architectural Press.
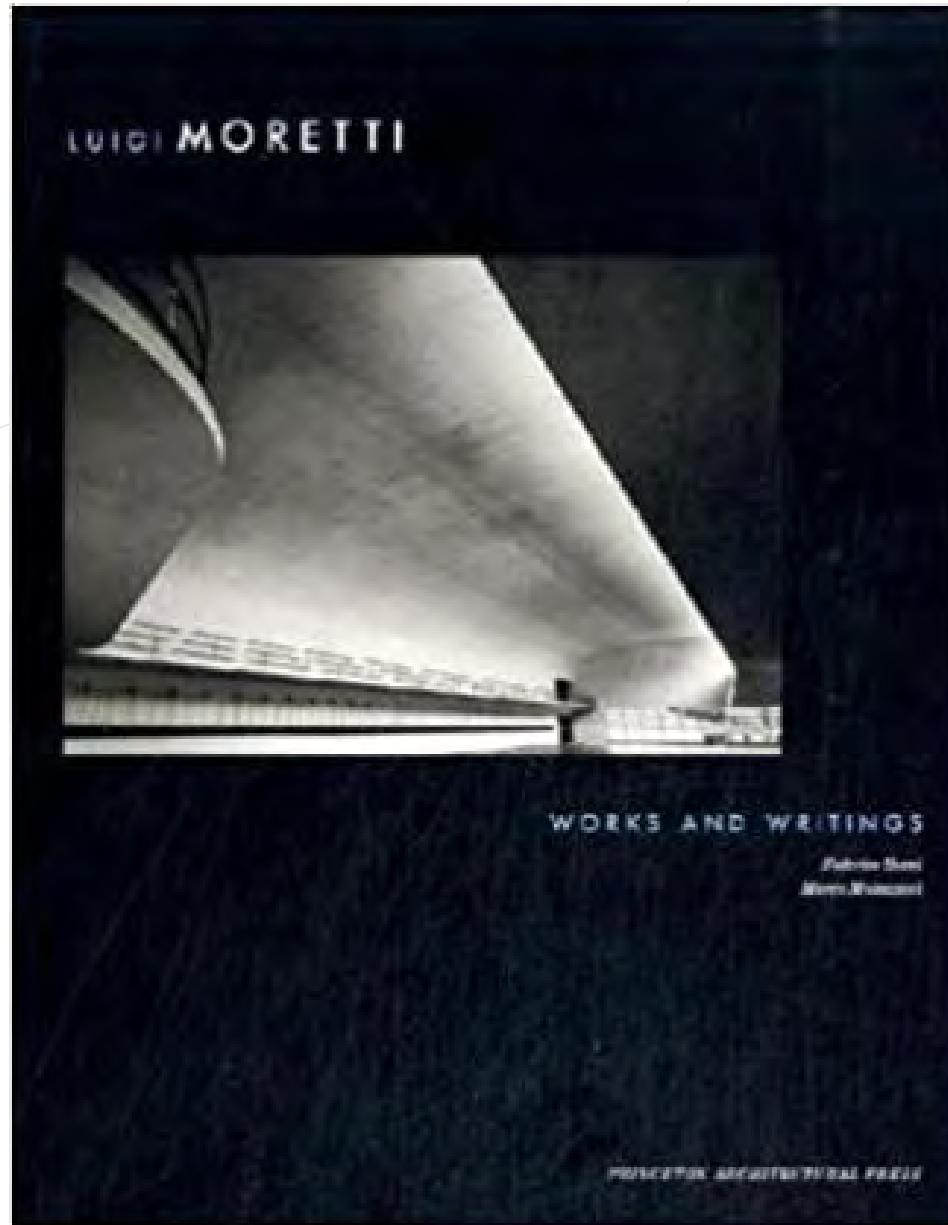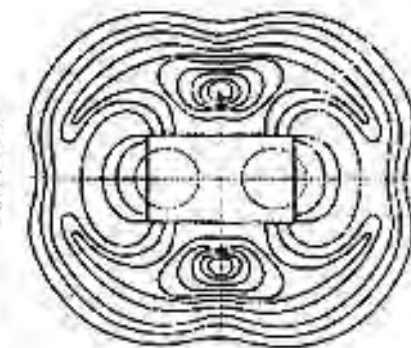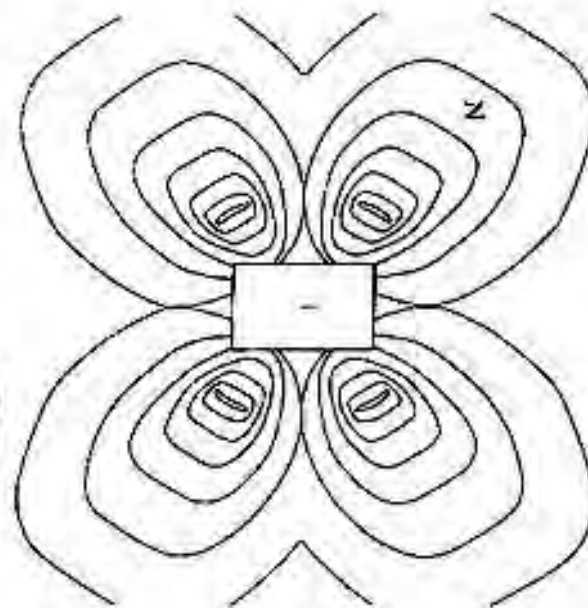
Architettura Parametrica, coined by Luigi Moretti

He did a research about the relationship between architectural design and parametric equations under the banner of 'Architecttura Parametrica' between 1940-1942. Initially without computer.

Eventually in 1960 he was able to exhibit the models of parametrically designed stadia- *Progetti di strutture per lo sport e lo spettacolo.*

Frazer, J. (2016). Parametric Computation: History and Future. *Architectural Design,* 86, 18-23.

Architettura Parametrica, coined by Luigi Moretti

"the relations between the dimensions dependent upon various parameters"

**"the parameters and their interrelationships become [...] the code of the new architectural language, the "structure" in the original sense o f the word [...]. The setting of parameters and their relation must
be supported by the techniques and tools offered by the most current sciences, in particular by logics, mathematics [...] and computers. Computers give the possibility to express parameters and their relations
through a set of (self-correcting) routines".**

Moretti, L., Bucci, F. & Mulazzani, M. (2002). *Luigi Moretti: works and writings*, Princeton Architectural Press.

Sketchpad (1963)

Ivan Sutherland

Sketchpad was defined as *"A Machine Graphical Communication System"*

Parametric system for architectural design

Sketchpad (1963)

Ivan Sutherland

Based on advanced **associative logic**, an innovative feature which facilitated **links** between objects.
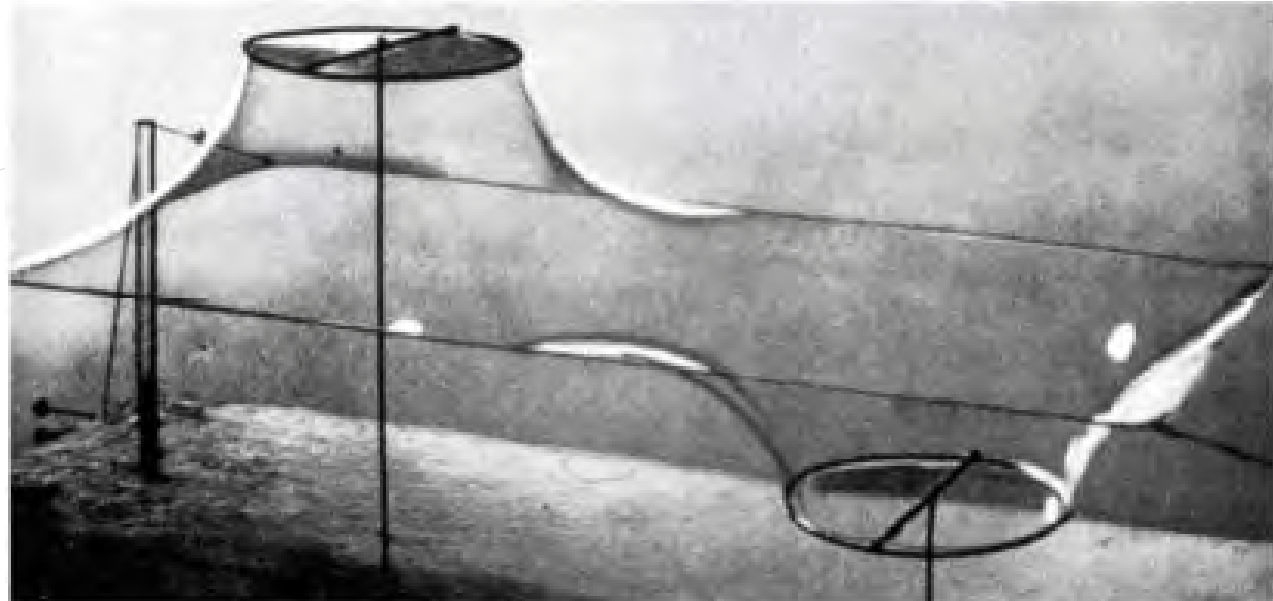
Sagrada Familia

Antoni Gaudi

Used gravity as one of the nature's parametric outputs.

Frei Otto

Experimental model

Bubbles to emulate
tensile structure

Parametric design now:

Dependent on a ==parametric model==

Patrick Janssen defines a ==parametric model== as: *"an algorithm that generates models consisting of geometry and attributes (e.g. material definitions). This algorithm uses functions and variables, including both dependent and independent variables. Some of the **independent variables** can be given a **more prominent status**, as the interface to the parametric model – these are referred to as the **parameters of the model**."*

Cited in Frazer (2016).

Frazer, J. (2016). Parametric computation: History and future. *Architectural Design,* 86**,** 18-23.

Parametricism

Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

"**Algorithm is a procedure used to return a solution to a question- or to perform a particular task- through a finite list of basic and well-defined instructions.**"

It follows human aptitude to split problems to a set of simple steps. So that they can be computed.
A basic analogy to this is a cooking instructions, however it needs to be well-defined.

Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

Important properties of algorithm

1. An unambiguous set of properly defined instructions
2. Expects a defined set of input
3. Generates well-defined output

Visual scripting

Going back to the <u>cooking instructions</u> we mentioned in podcasts..

1. Instructions need to be well defined (duration, amount, etc)
2. Amount of ingredients (input) has to be precisely declared
3. No vagueness
4. Well defined output

Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.
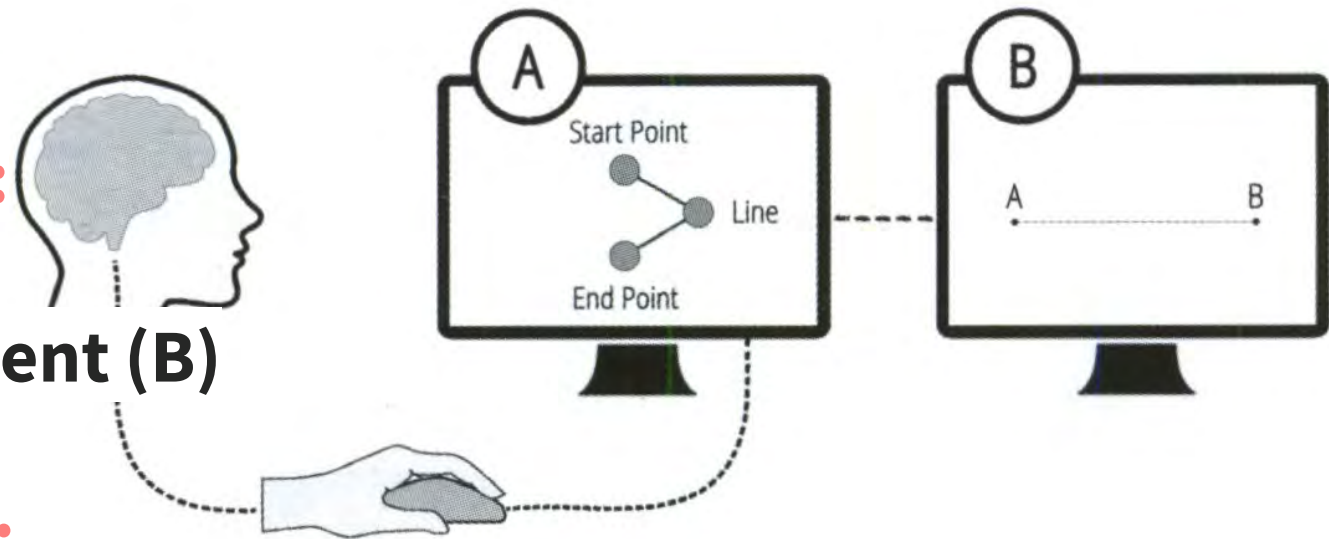
There are two working environments:
Visual Editor (A)
3D Modelling Environment (B)
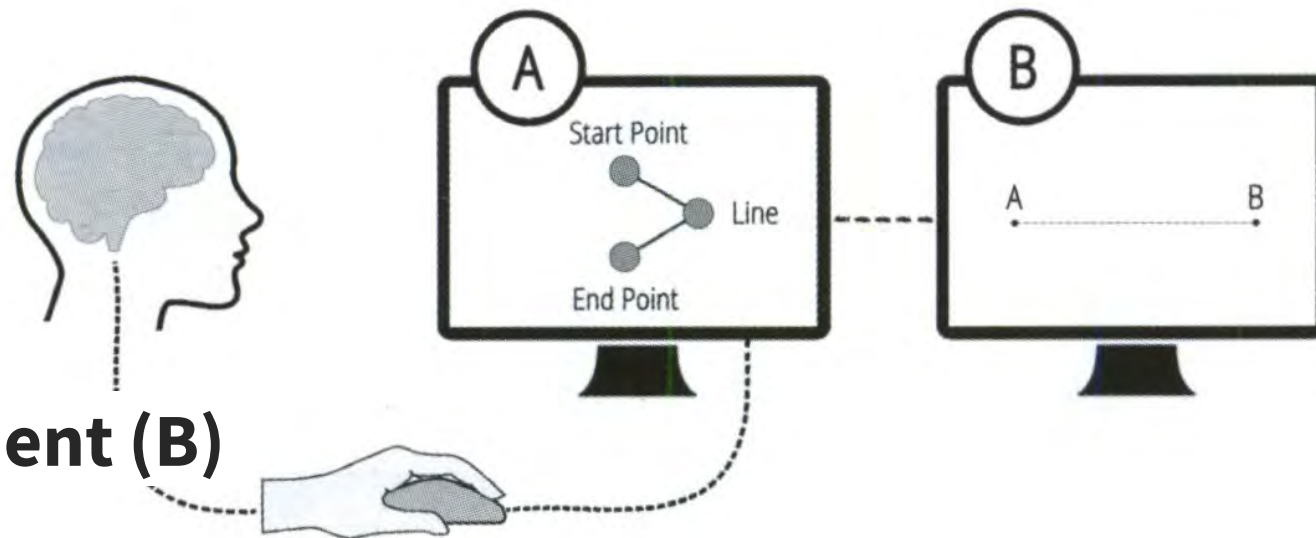
Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

There are two working environments:
**Visual Editor (A)**
3D Modelling Environment (B)

Producing two outputs:
Node diagram, called *parametric diagram*
Output of *parametric diagram* constituted by parametric 3D or 2D geometry.
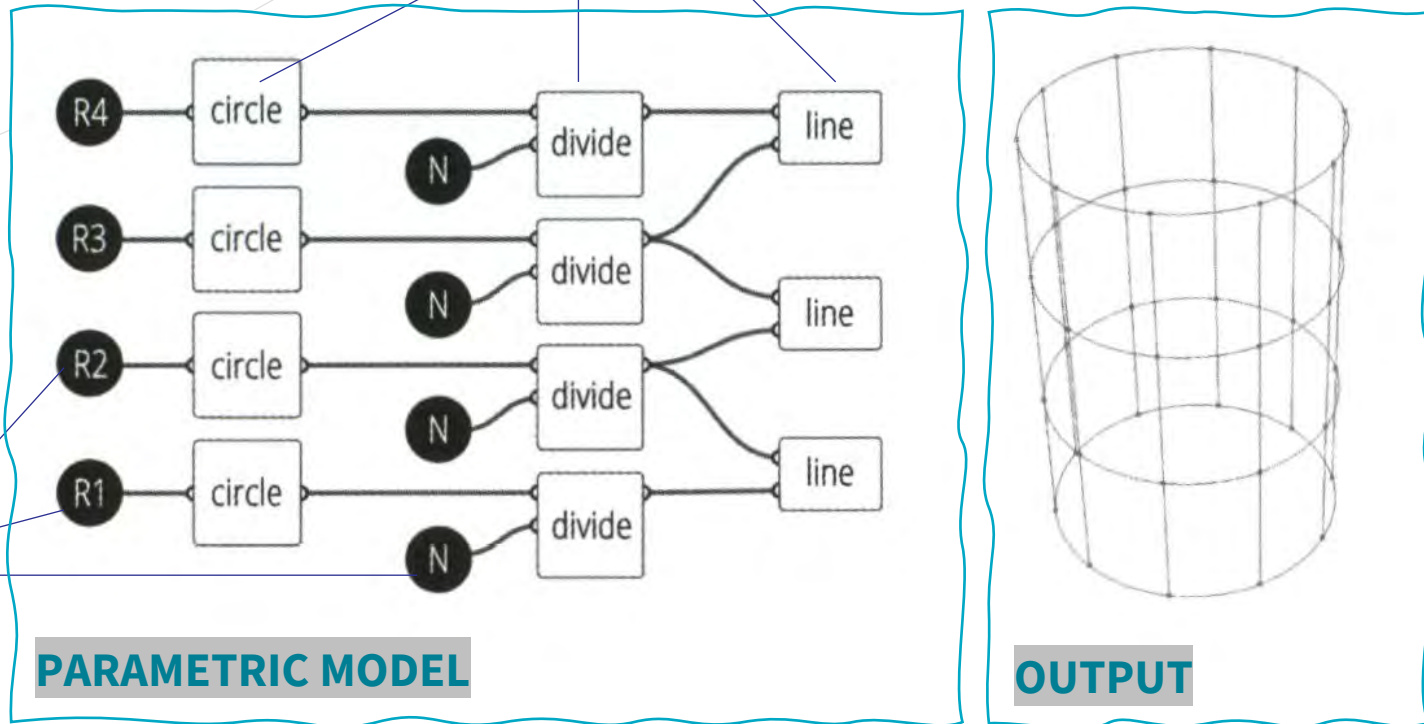
Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

0. *Draw four circle*
1. *Subdivide the four circles into N parts, we get N points for each circle*
2. *Connect the corresponding points*
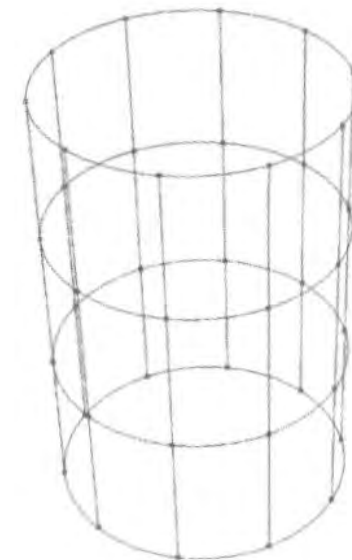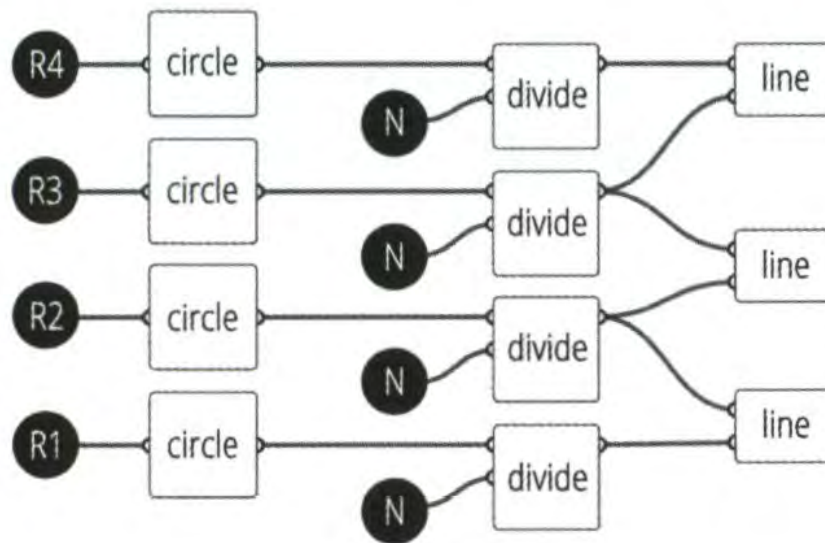
VISUAL TRANSPOSITION OF THE ALGORITHM

Visual scripting

0. *Draw four circle*
1. *Subdivide the four circles into N parts, we get N points for each circle*
2. *Connect the corresponding points*

MAIN FUNCTIONS

PARAMETERS

PARAMETRIC MODEL

OUTPUT

VISUAL TRANSPOSITION OF THE ALGORITHM

The advantage of the *parametric diagram* is in the intuitive logic, which allows designers to manipulate parameters.
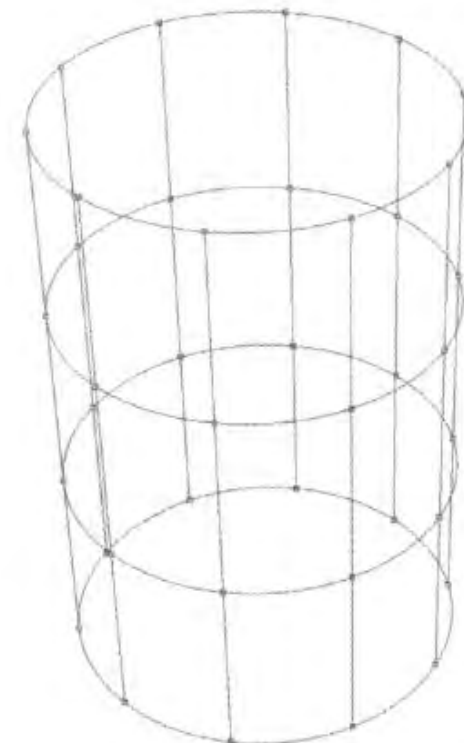
Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

Algorithm can define every type of geometry.

The image Tedeschi illustrate can be sketched by writing following list of instructions:
  0. Draw four circle
  1. Subdivide the four circles into N parts, we get N points for each circle
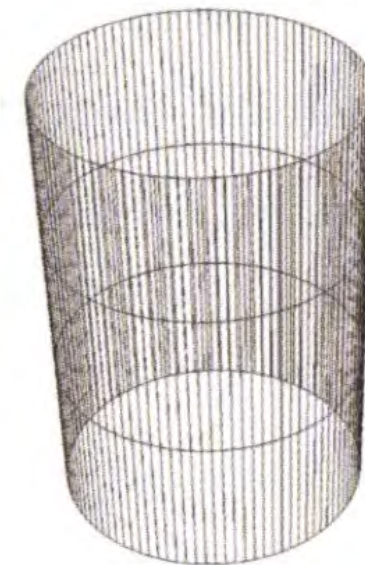 *2. Connect the corresponding points*

Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

What happen if parameters are being manipulated?

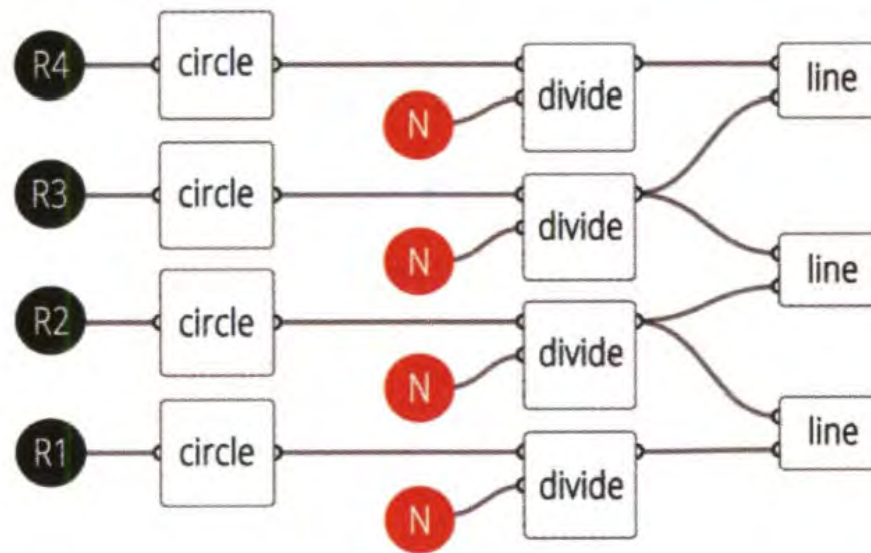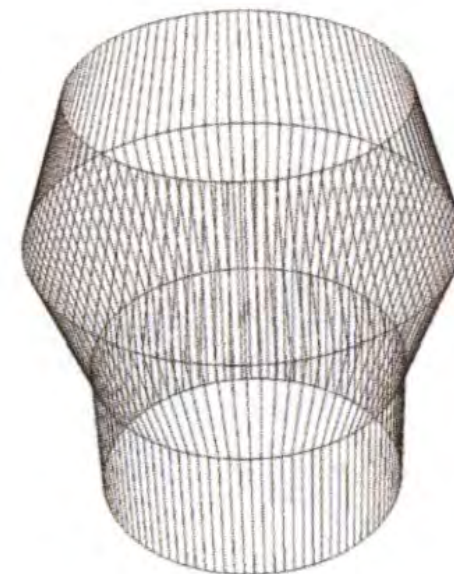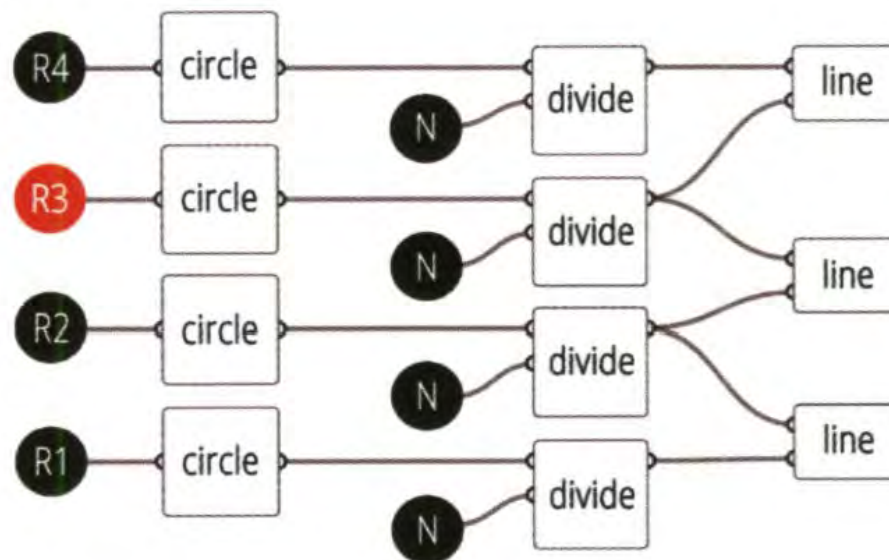**N PARAMETERS ARE MODIFIED, MORE LINES ARE GENERATED**

Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

What happen if parameters are being manipulated?

R3 IS MODIFIED, RADIUS OF CIRCLE 3 IS INCREASED IN FIGURE
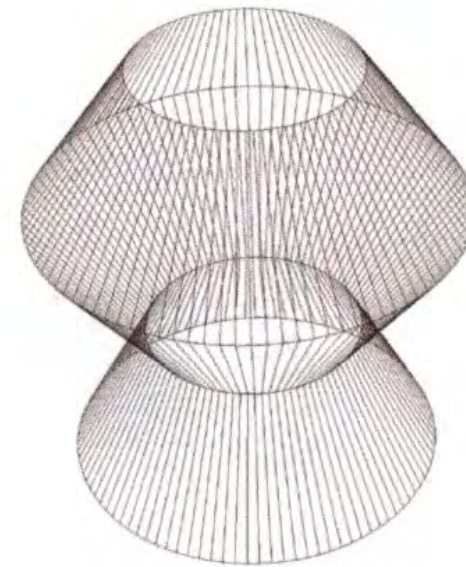
Visual scripting

Tedeschi, A. (2014). *AAD, Algorithms-aided design: parametric strategies using Grasshopper*, Le penseur publisher.

What happen if parameters are being manipulated?

The parametric diagram has potentials to create **associative models** that explore multiple configurations.
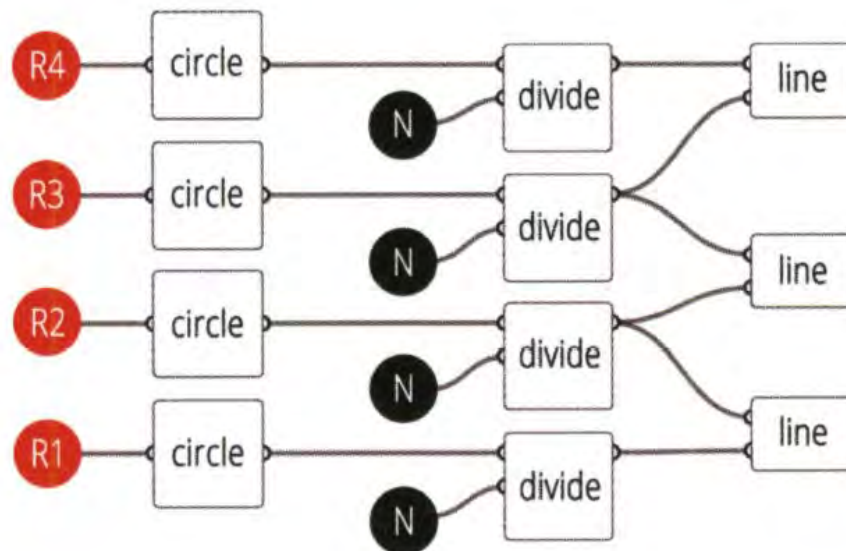
R1, R2, R3 AND R4 ARE MANIPULATED

PATRIK SCHUMACHER ON PARAMETRICISM AND PARAMETRICISM 2.0

Patrick serves the director of Zaha Hadid Architects, and has been leading ZHA since Hadid's death in 2016. He is also an architectural theorist . He coined the term "Parametricsm" in 2008 and his manifesto is published a year later in the Architectural Design journal.

He considered Parametricsm as a global convergence in recent avant-garde architecture which elucidates of a new style. Parametricm 2.0, opinionated in 2016, is set to solve socio-environmental problems.

 https://en.wikipedia.org/wiki/Parametricism

Parametricism 1.0 (2009-2014)

Schumacher, P. (2009). Parametricism: A new global style for architecture and urban design. *Architectural Design,* 79**,** 14-23.

Link to publication from Schumacher's website, <u>click here.</u>

- An avant-garde architecture style
- Rooted in digital animation techniques
- Based on **advanced parametric design systems** and **scripting techniques.**
- "The great new style after modernism"
- Parametricism comes **from creative exploitation of parametric design systems** in view of articulating increasingly complex social processes and institutions.
- Relevant on **all scales** from architecture, interior to urban design.

Parametricism 1.0 (2009-2014)

Schumacher, P. (2009). Parametricism: A new global style for architecture and urban design. *Architectural Design,* 79**,** 14-23.
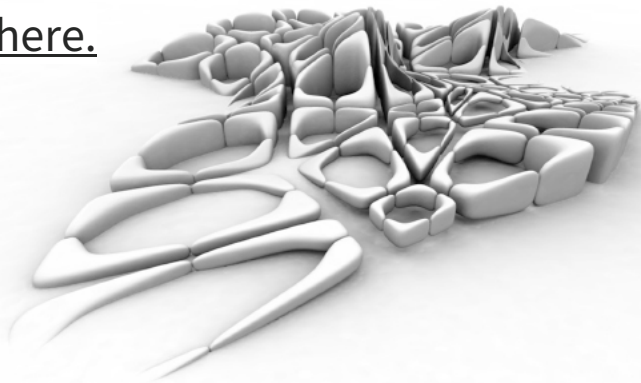
Link to publication from Schumacher's website, click here.
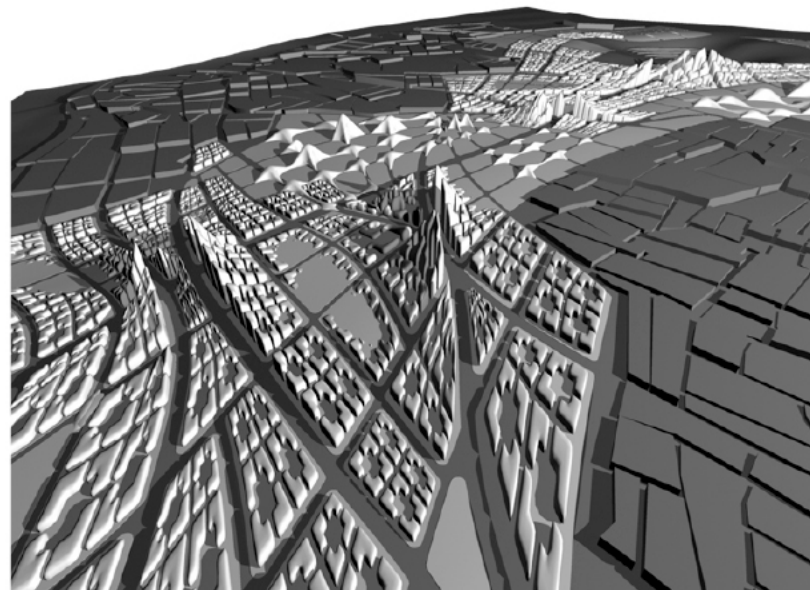
Zaha Hadid Archiects, Kartal-Pendik Masterplan, Istanbul, Turkey, 2006
Fabric study. The urban fabric comprises both cross towers and perimeter blocks. The image shows the morphological range of the perimeter block type. Blocks are split into four quadrants allowing for a secondary, pedestrian path system. At certain network crossing points the block system is assimilated to the tower system: each block sponsors one of the quadrants to form a pseudo tower around a network crossing point.
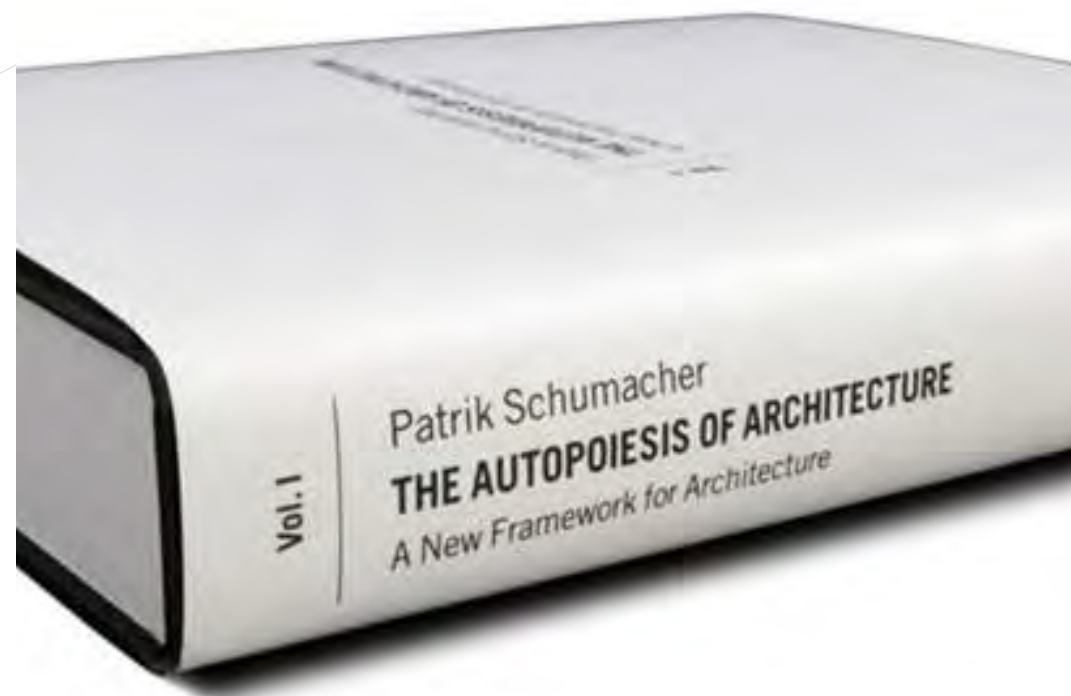
Parametricism 1.0
(2009-2014)

Schumacher, P. (2011). *The Autopoiesis of Architecture, Volume I: A New Framework for Architecture*, John Wiley & Sons.

Duality in defining and locating Parametricsm:
Visual sense and process-based architecture.

The concept of *autopoiesis* reflects that architecture can be theorised as a distinct **system of communications.**

Central thesis: phenomenon in architecture is fully grasped when is analysed as **autonomous network** (autopoietic system) **of communications.**

Parametricism 2.0 (2015-present)

*"Parametricism is architecture's **answer** to contemporary, computationally empowered civilisation, and is the only architectural style that can **take full advantage of computational revolution** that now drives all domains of society."*

Schumacher, P. (2016). Parametricism 2.0: Gearing Up to Impact the Global Built Environment. *Architectural Design,* 86**,** 8-17.

Guest-Edited by PATRIK SCHUMACHER

RETHINKING ARCHITECTURE'S AGENDA FOR THE 21ST CENTURY

PARAMETRICISM 2.0

AD

ARCHITECTURAL DESIGN March/April 2016

Profile No 240

Parametricism 2.0 (2015-present)

"Only (parametricism) congenial to recent advances in structural and environmental engineering based on computational analytics and optimisation techniques.

*All other approaches are **incapable of working** with the efficiencies…"*

Schumacher, P. (2016). Parametricism 2.0: Gearing Up to Impact the Global Built Environment. *Architectural Design,* 86**,** 8-17.

Guest-Edited by PATRIK SCHUMACHER

PARAMETRICISM 2.0

RETHINKING ARCHITECTURE'S AGENDA FOR THE 21ST CENTURY

ΛD

ARCHITECTURAL DESIGN March/April 2016

Profile No 240

Parametricism 2.0 (2015-present)

Parametricism is the only contemporary approach than can address challenges posed to architecture by the new **social dynamics** of Information Age.

Schumacher, P. (2016). Parametricism 2.0: Gearing Up to Impact the Global Built Environment. *Architectural Design,* 86**,** 8-17.

Parametricism 2.0 (2015-present)

Schumacher **gathered key protagonists (and experts)** in this edited AD journal of Parametricism in a range of values to illustrate that Parametricism **can** take on relevant, high-performance projects:

Schumacher, P. (2016). Parametricism 2.0: Gearing Up to Impact the Global Built Environment. *Architectural Design*, 86**,** 8-17.

Structural and engineering innovations
Parametricing the social processes
Material culture
Parametric Regionalism
Parametricism in Urban models
Parametricism in Product Design
And many more

Parametricism 2.0

Guest-edited by Patrik Schumacher
LIST OF CONTENT

Parametric Design Thinking

Schnabel (2007)

Schnabel, M. A. (2007). Parametric designing in architecture. *Computer-Aided Architectural Design Futures (CAADFutures) 2007*. Springer.

Set to answer the question that:
The **framing of design creation** using parametric methods enhance process.

Scope: architecture studio

Observations from the studio project:
- Designing in **layers** allow architects to deal with more complex problems.
- A novel set of opportunities is presented by parametric design.
- Studying causes of problems and their relationships to, and dependencies on, other elements directly.

Framing of design problem

Design intent

Creation

Interaction between:

Establishing connection to building information models
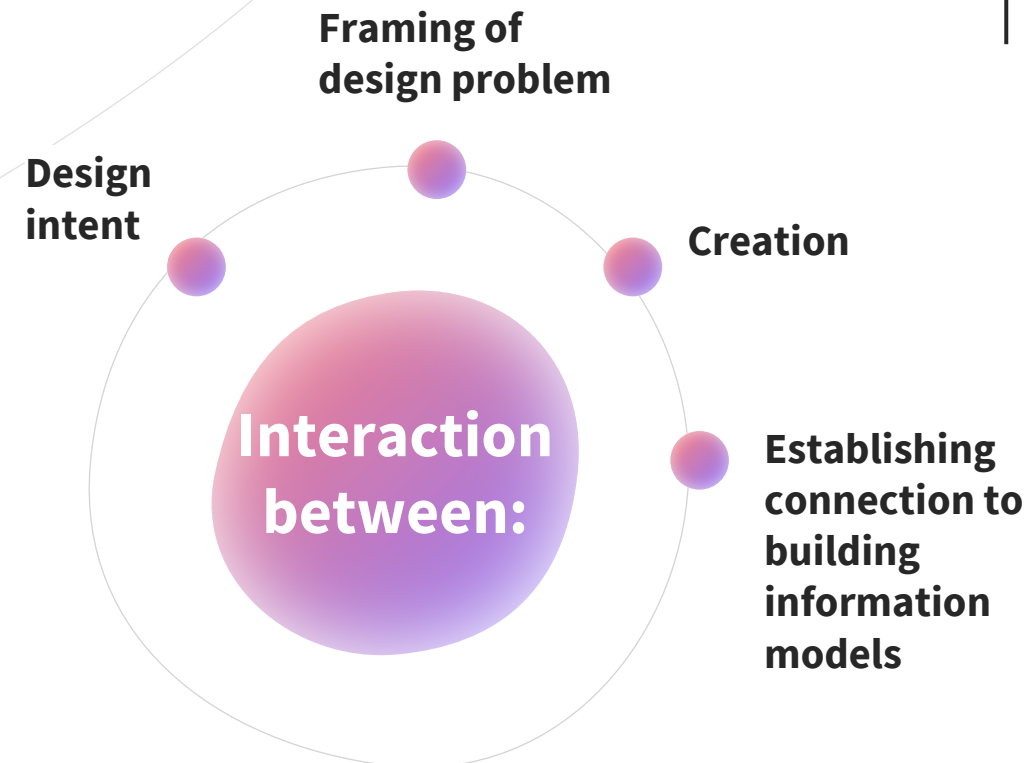
- Parametric dependencies allow for a **level of ambiguity** that is required in **creative processes**.
- VS conventional approached: non-linear design processes and re-representation of ideas can lead to **architectural expressions**.

Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies,* 52**,** 115-143.

Set to highlight aspects of particular parametric design thinking (**PDT**) **based on practice**.

Distilled from **six years of practice** in Zaha Hadid Architects Computation and Design group (**ZHCODE**).
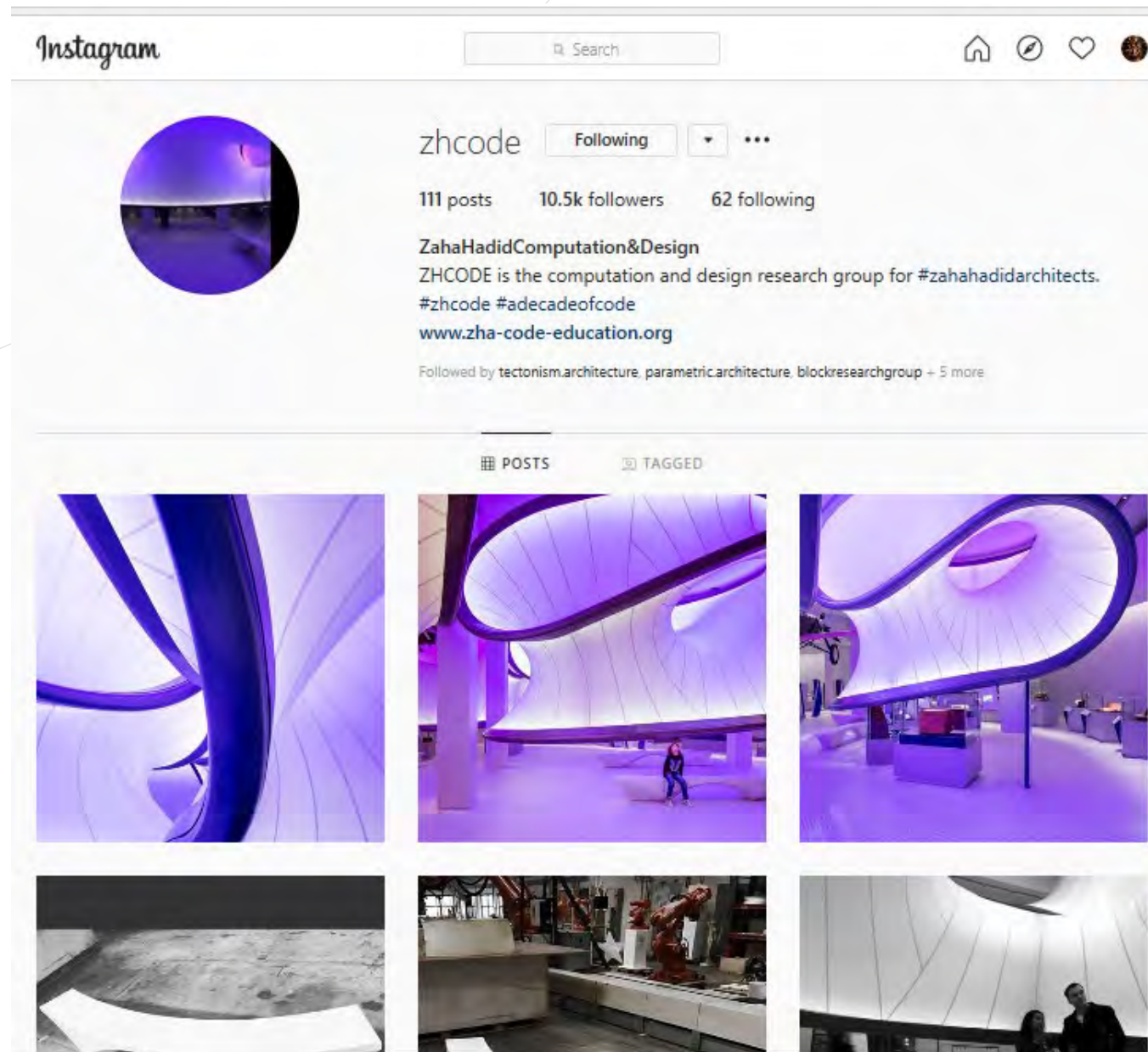
Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies, 52*, 115-143.

Definition of Parametric design thinking (PDT) according to Bhooshan (2017):
Computationally augmented form of design thinking

Components of PDT:
1. **Cognitive Model**
2. **Design Method**
3. **Information Processing Model**

Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies,* 52**,** 115-143.

Components of PDT:
1. **Cognitive Model**
2. **Design Method**
3. **Information Processing Model**

Darwinism in design:

A cognitive model in relation to the current discussion on design thinking.

Acknowledgement of collective cognitive model in multiple authors' projects.

Iterative process which requires balance between: exploratory and exploitative phases, to find optimal solutions.

Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies*, 52**,** 115-143.

Components of PDT:
1. **Cognitive Model**
2. **Design Method**
3. **Information Processing Model**

Design method in relation to above mentioned cognitive model is:

Directed search of design space.

This method seek from all possible solutions, a solution that is efficacious in its design and production and harmonious for human occupation.
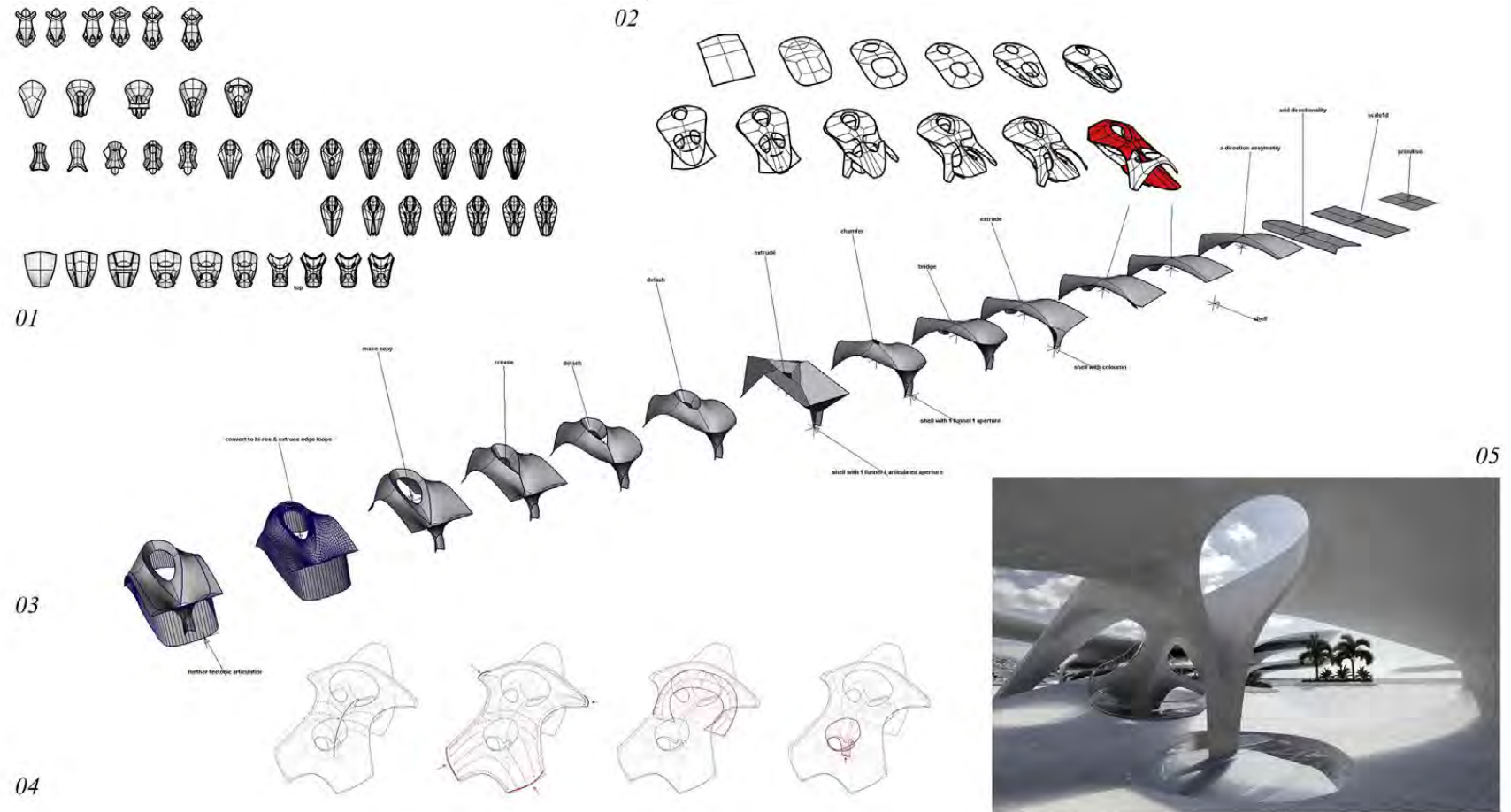
Bhooshan (2017)

Figure 3 Directed Search of solution space. **01** A genetic lineage of design options **02, 03** A sequence of geometric operations, amenable for hybridizing of options **04** Heuristics of structural behavioural **05** A synthesized solution. **Images:** courtesy of Zaha Hadid Architects and Block Research Group

Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies*, 52**,** 115-143.

Components of PDT:
1. Cognitive Model
2. Design Method
3. Information Processing Model:

Computer Aided Geometric Design (CAGD)

Two categories of computational representations of objects:
1) Drawing based (CAD, CADG)
2) Model based (BIM)

CAGD allows abstraction of complex physical phenomena and machine parameters associated with manufacturing method; into the geometric properties and constraints.

What is the benefit?
An interactive and yet precise control over geometries

Bhooshan (2017)

Bhooshan, S. (2017). Parametric design thinking: A case-study of practice-embedded architectural research. *Design Studies*, 52**,** 115-143.

**He also highlights the need for architectural design and practice to follow a research programme,
Instead of ad-hoc solutions to design tasks.**

Cumulative research enabling network involving *academic institutions, professional firms and embedded research groups* to effectively realise architectural projects.
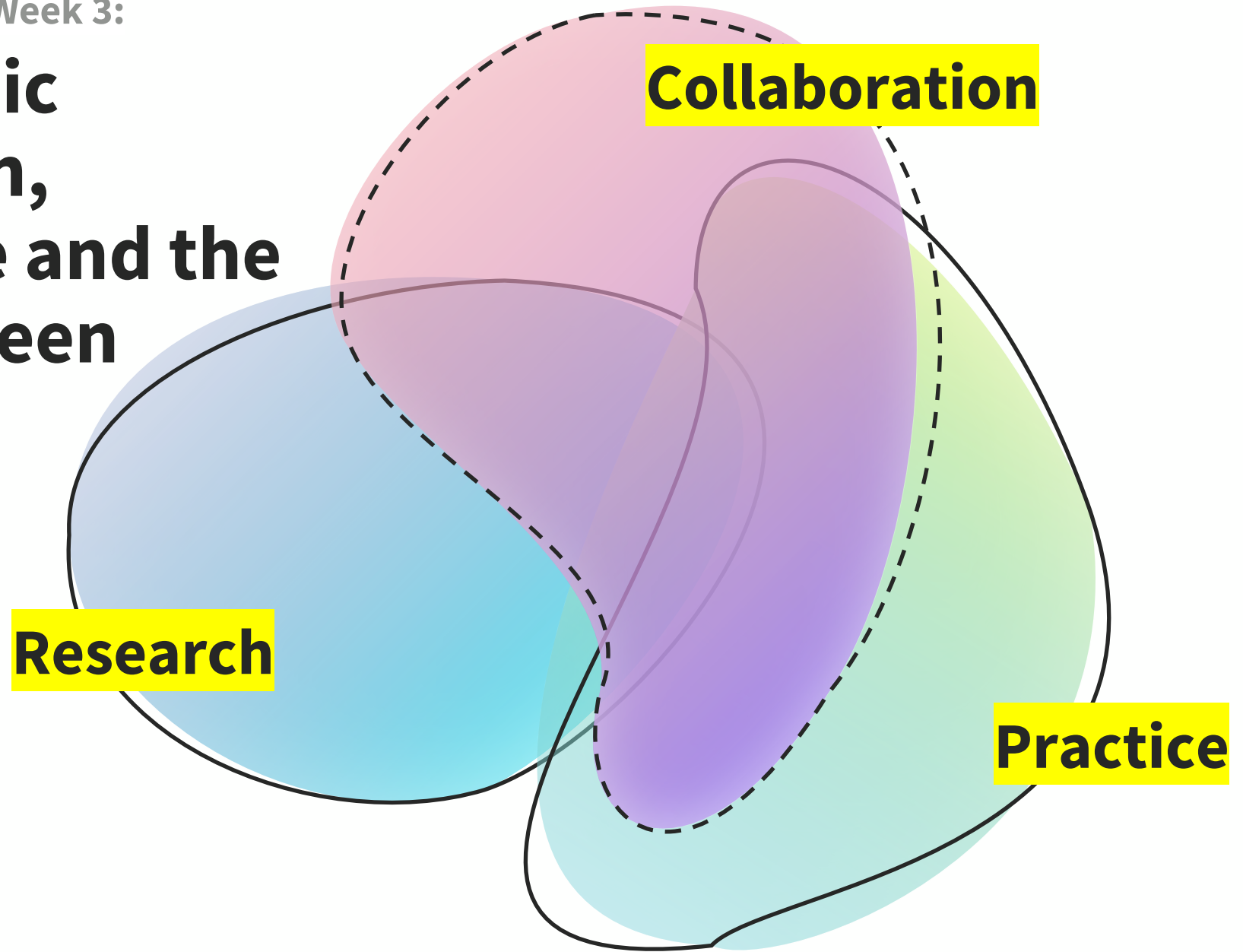
Previously on Week 3:

What are the drivers of these advancement in digital tools?

Symbiosis of design research and practice

Academic research, practice and the in-between

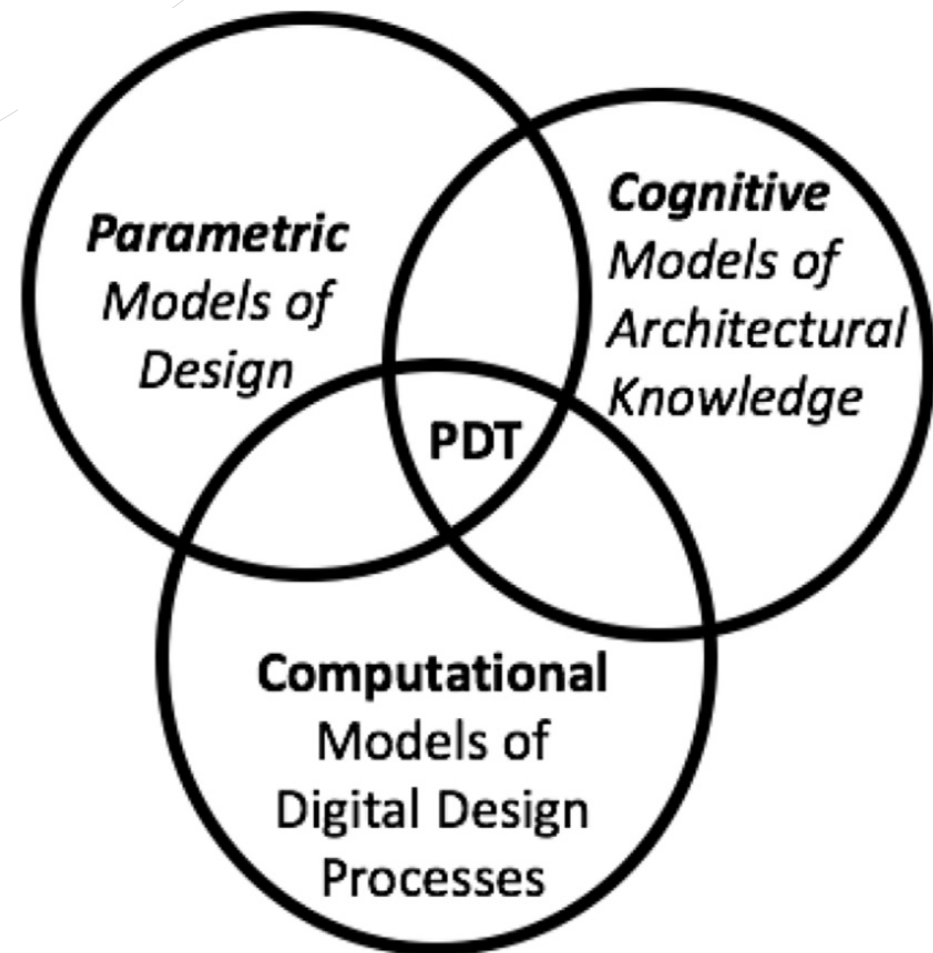**Collaboration**

Research

Practice

==Oxman (2017)==

Oxman, R. (2017). Thinking difference: Theories and models of parametric design thinking. *Design Studies,* 52**,** 4-39.

Whilst Bhoosan (2017) explored PDT from the perspective of design practice, Oxman (2017) provides review on theoretical takes on PDT-Parametric Design Thinking.

The aim is to understand **the impact of parametric design** on the emergence of **new ways of thinking.**

Oxman (2017) illustrates PDT as intersection of other related fields

Oxman (2017)

Continuity and change in the evolution of models of design thinking: from traditional paper-based media to computational media-related models.

They share cognitive concepts.

The evolution is:
From *typological thinking* to *topological thinking*.

Typological thinking: design by sub-types
Topological thinking: design of versioning types, by changing values of their associative relationships.

Oxman (2017)

Differentiation as key design strategy of PDT.

Differentiation strategies support new types of creative thinking.

Understanding how to manipulate and explore associative relationship in topological parametric scheme

Differentiation is:
Local specialisation of a repetitive formation

Parametric Design System

Characteristics of a parametric design system

Jabi, W. (2013). *Parametric design for architecture*, Laurence King Publishing.
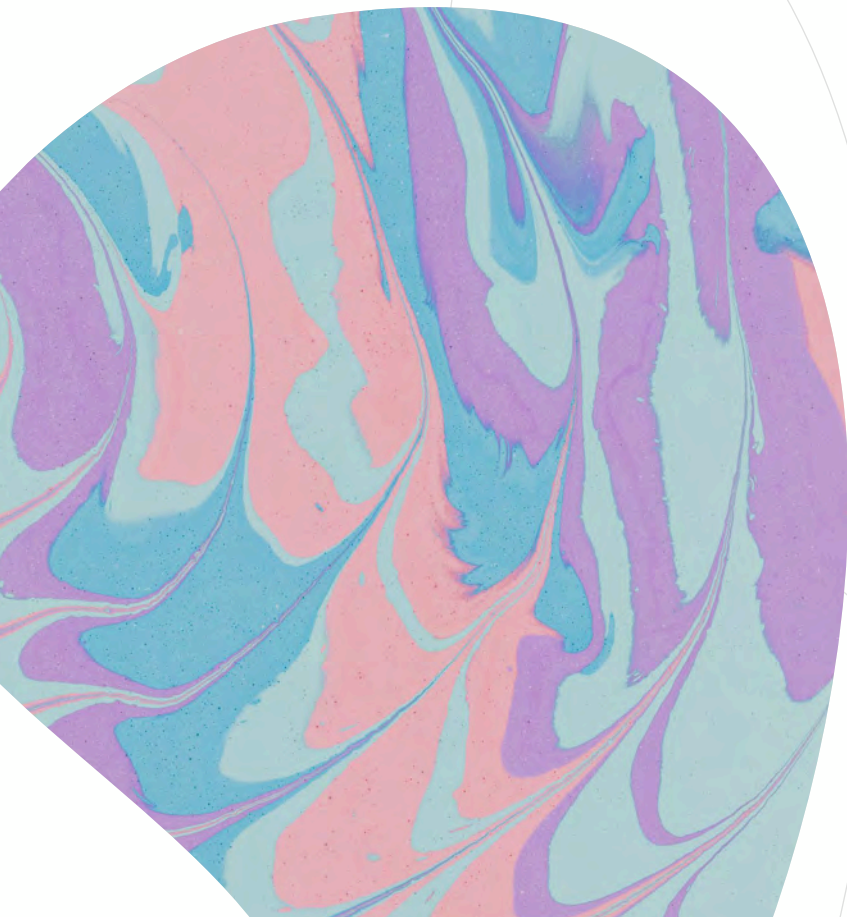
Object-orientation

Object oriented approach, which is a well-established computer science topic. Interaction with parametric system that reflects its internal algorithmic structure. Each object has *values* that determines its *attributes*.

Methods

Methods are functions and algorithms that act on an object by modifying its attributes.

Families and inheritance

Objects which share certain characteristics can be organized as members of a *class* or *family* of objects. Sharing certain attributes with their siblings and inherit certain attributes from their parents is the advantage.

Parameters

Parameter usually signifies a variable term in equations that determine other values. It is characterized by having a range of possible values.

Types of parameters

Jabi, W. (2013). *Parametric design for architecture*, Laurence King Publishing.

- **Mathematical** parameters: most basic type, such as numbers, logical values and strings of characters
- **Geometric** parameters: example includes points, lines, surfaces and solids
- **Topological** parameters: describe how two and more entities are related
- **Representational** parameters: describing and abstracting entities from outside themselves. For example, walls and windows
- **Material** parameters: built on the first four parameters by adding and connecting several physical attributes such as weight, tension, friction, etc
- **Environmental** parameters: time, wind, thermal variations are to name but a few
- **Human** parameters: most challenging class of parameters

Parametric patterns

Jabi, W. (2013). *Parametric design for architecture*, Laurence King Publishing.

Practitioners are still building this knowledge, collecting and systematically developing comprehensive bank of patterns using a consistent template.

Jabi (2013) compiled some of them on his book.

PART II PARAMETRIC PATTERNS

How Designers Use Parameter

Add, erase, relate and repair

Woodbury, R. (2010). Elements of parametric design.

In conventional design system, designers *add* and *erase*.

**Parametric modelling requires designers to:
Add, erase, relate and *repair*.**

Relating requires explicit thinking about the relations between objects.

Repairing occurs after an erasure, to attend to remaining parts.

Three parts how designers use parameters

Woodbury, R. (2010). Elements of parametric design.

1. **The shift between conventional and parametric**
2. **New skills**
3. **New strategies**

Parametric modelling relies on **establishing relationships.**

The cost is it depends on **designers' ability** to **redefine relationships**, and willingness to consider relationship-definition phase as **integral design process.**

"Relationship creation"

Three parts how designers use parameters

Woodbury, R. (2010). Elements of parametric design.

1. **The shift between conventional and parametric**
2. **New skills**
3. **New strategies**

1. CONCEIVING DATA FLOW
2. DIVIDING TO CONQUER
3. NAMING
4. THINKING WITH ABSTRACTION
5. THINKING MATHEMATICALLY
6. THINKING ALGORITHMICALLY

THESE ARE BASIC SKILLS OF PARAMETRIC CRAFT.

Three parts how designers use parameters

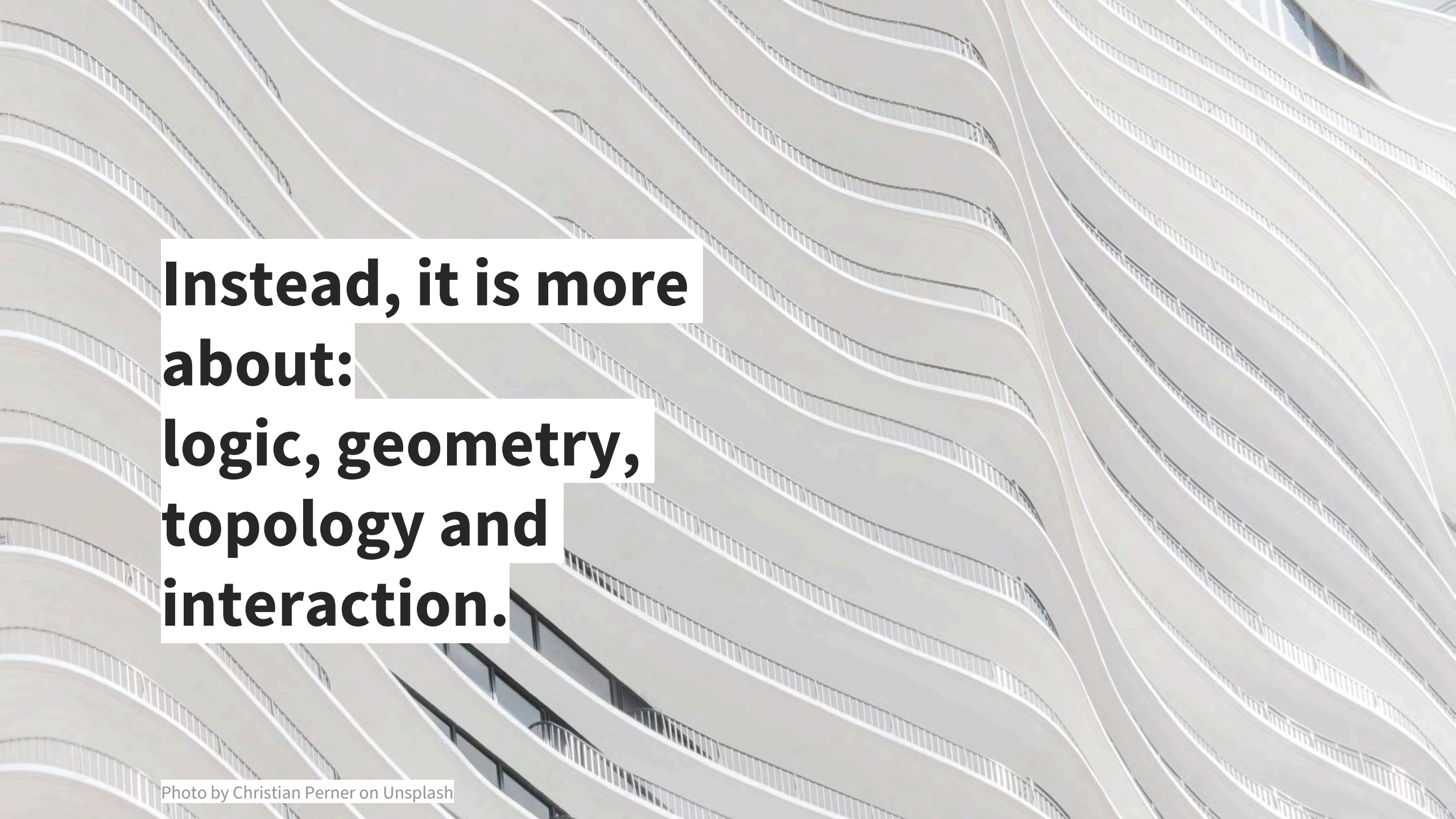Woodbury, R. (2010). Elements of parametric design.

1. **The shift between conventional and parametric**
2. **New skills**
3. **New strategies**

1. SKETCHING
2. THROW CODE AWAY
3. COPY AND MODIFY
4. SEARCH FOR FORM
5. USE MATHEMATICS AND COMPUTATION TO UNDERSTAND DESIGN
6. DEFER DECISIONS
7. MAKE MODULES
8. HELP OTHERS
9. DEVELOP YOUR TOOLBOX

To summarise..

Parametric design is not about computer software or any particular syntax.

Instead, it is more about:
logic, geometry, topology and interaction.

Re-iterating aims and objectives

- To **introduce** the concept of parametric design
- To **contextualise** parametric design within the umbrella of **computational design field**
- To infer **parametric design thinking**
- To provide illustration on **how designers can use the concept** in their practices