

nto



## **aula 3 / estratégias computacionais e visão global M1**

031024



## Sumário (TP+P)

Apresentação semanal Ai  
Estratégias computacionais em modelação 3D.



<https://forms.office.com/e/fR29HVDxs2>



# Planeamento provisório

Aula	Data (2024/25)	FASE	Conteúdo	Deliverable
1	19-Sep	M0	Apresentação, Estrutura, Programa e Objetivos da Disciplina, Metodologia e Avaliação. Revisões CAD	
2	26-Sep	M0	Primitivas, superfícies. Modelação direta	Ai - apresentações semanais! Início de aula (SUM 10%)
3	03-Oct	M0	Estratégias computacionais em modelação 3D	Ai - apresentações semanais! Início de aula (SUM 10%)
4	10-Oct	M1	M0, Apresentações fase 0	M0_ Apresentação + entrega Projeto fase 0 (20%)
5	17-Oct	M1	Design paramétrico, algorítmico e generativo. Scripting em CAD	Ai - apresentações semanais! Início de aula (SUM 10%)
6	24-Oct	M1	Simulação numérica estrutural	Ai - apresentações semanais! Início de aula (SUM 10%)
7	31-Oct	M1	GD Autodesk	Ai - apresentações semanais! Início de aula (SUM 10%)
8	07-Nov	M1	M1, Apresentações fase 1	M1_ Apresentação + entrega Projeto fase 1 (30%)
9	14-Nov	M2	Fundamentos de otimização	Ai - apresentações semanais! Início de aula (SUM 10%)
10	21-Nov	M2	Otimização estrutural em engenharia	Ai - apresentações semanais! Início de aula (SUM 10%)
11	28-Nov	M2	Otimização topológica	Ai - apresentações semanais! Início de aula (SUM 10%)
12	05-Dec	M2	Otimização em estratégias generativas	Ai - apresentações semanais! Início de aula (SUM 10%)
13	12-Dec	M2	Pós-processamento de soluções	Ai - apresentações semanais! Início de aula (SUM 10%)
14	19-Dec	M2	Balanço da UC; M2, Apresentações Finais (fase 2)	M2_ Apresentação + entrega Projeto fase 2 (40%)



**NEW**



# Apresentações grupos?

Constituição? =)

Teams...

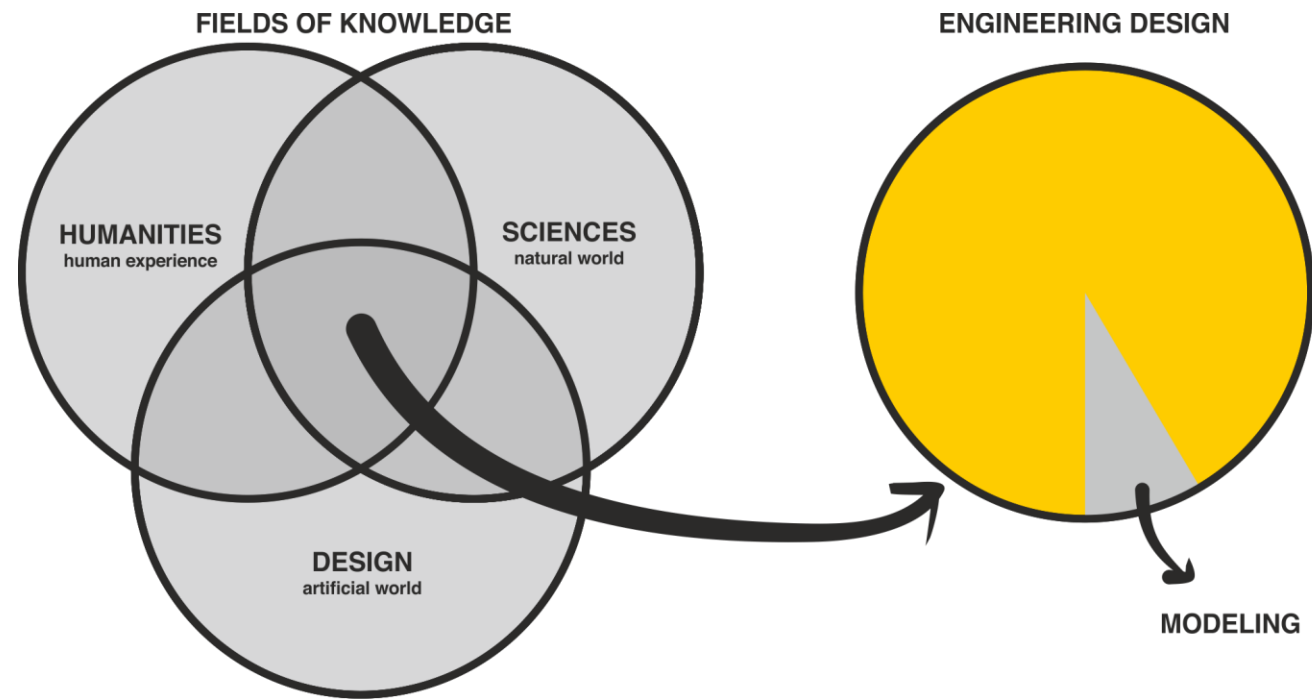


NOW



processos computacionais “ativos” em modelação





Design and/or modeling

**computacional**

paramétrico

algorítmico

generativo

+  
+  
+  
...



Design and/or modeling

**computacional**

paramétrico

algorítmico

generativo

+  
+  
+  
...



muita variação de terminologia e interpretação, vamos discutir segundo uma convenção possível

Design and/or modeling

**computacional**

paramétrico

algorítmico

generativo

+  
+  
+  
...



**check this out**

Computational design in architecture: Defining parametric, generative, and algorithmic design  
Inês Caetano, Luís Santos, António Leitão, *Frontiers of Architectural Research* (2020), 9, 287-300

**computational design**

parametric design

algorithmic design

generative design



computational design



“**Computational design** is the application of **computational** strategies to the **design process**”

1. Explore multiple design options
2. Get under the hood and access your data
3. Automate repetitive tasks
4. Test what your design is REALLY doing
5. Think algorithmically

@5 Ways Computational Design Will Change the Way You Work

<https://www.archdaily.com/785602/5-ways-computational-design-will-change-the-way-you-work>



“**Computational design** is the application of **computational** strategies to the **design** process”

Wider vision > CA\*

Focused vision > algorithmic design  
(frequently used as synonyms, as well as “procedural”)



computational design

**parametric design**





o que será?



como podemos definir?

intimamente associado ao design algorítmico, mas também um termo comum e com uma dimensão muito particular em projeto de engenharia

**“parametric design is a methodology where you specify the key parameters of your project and make changes interactively, with the model updating automatically”**



exemplo rápido

Solidworks

(variáveis e funções, design tables...)

computational design

parametric design

**algorithmic design**



**Algorithmic Design (AD) defines the creation of architectural designs through algorithmic descriptions.** Using AD, the architect **does not build the model directly, but instead, builds the program that builds the digital model.**

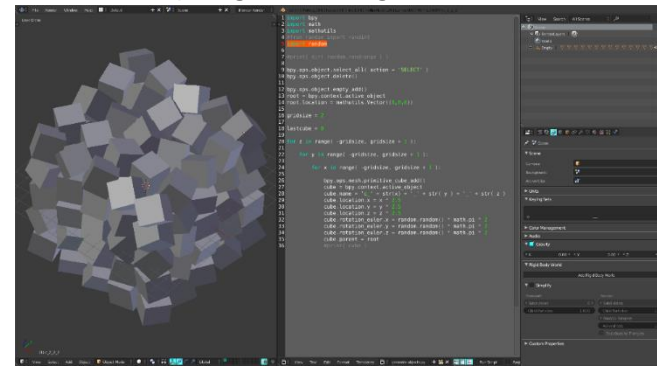
As such, AD can essentially be described as the production of architectural models from programs written by the architect. It is a design process that produces parametric models through a combination of geometric, as well as symbolic and mathematical representations of objects. The Algorithmic Design method is nowadays increasingly present in the architectural production process.

### **Integrated Algorithmic Design**

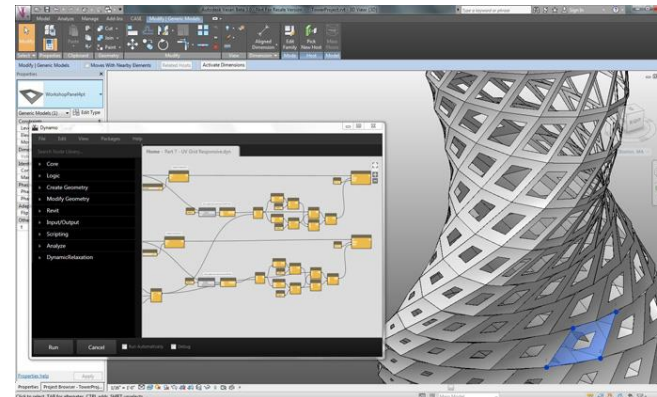
**Renata Alves Castelo Branco**

Master of Science Thesis in Architecture  
IST, 2017

code (text based programming)



graphical or visual programming



. what is this for?

...

. Mass customization

. Mass personalization...

“extreme case of mass customization. Mass personalization aims for a market segment of one ...

One aspect of mass personalization is the requirement for the active involvement of the customer in the design process”

Co-design?



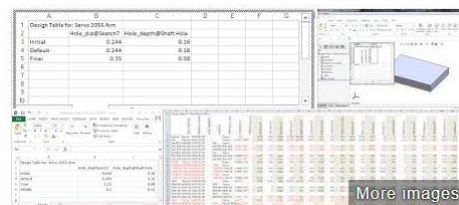


ou mesmo em videojogos, hoje em dia mesmo muito presente =)  
Alguém sabe como? E em que níveis? Tipicamente com a designação “procedural”...

can I do it?



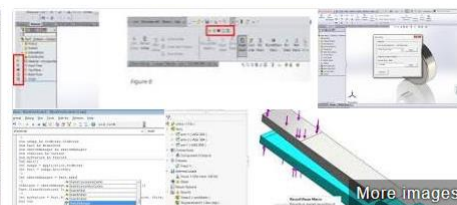
- \* algorithmic design
- \* computational design



## Solidworks Design Table

Select **design table** settings when you insert a **design table**. Dimensions Dialog Box. The Dimensions dialog box appears after you select the Auto-create option in the **Design Table** PropertyManager and click OK. The **SOLIDWORKS** software asks you which dimensions you want to add to the **design table**.

[2018 SOLIDWORKS Help - Design Table Configurations](#)  
SolidWorks Web Help

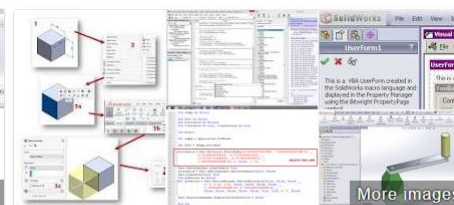
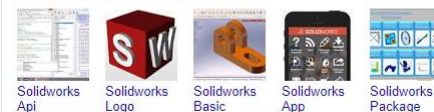


## Solidworks Macro

Making **Macros** in **SOLIDWORKS**. ... The API enables users to create custom programs (**macros**) that can assist them in automating many of the tasks of the graphical user interface (GUI). This can be as simple as creating PDFs of several drawings to more complex tasks such as generating complete parts and assemblies from code.

[Making Macros in SOLIDWORKS - Engineers Rule](#)  
Engineers Rule

People also search for



## Solidworks Api

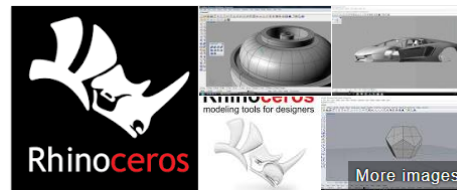
Welcome. This online reference guide documents the **SOLIDWORKS** Application Programming Interface (API), which you can use to automate and customize the **SOLIDWORKS** software. ... To enable your desired access to API Help, select Help > Use **SOLIDWORKS** Web Help. A check mark indicates that API Help is enabled on the Web.

[2017 SOLIDWORKS API Help - Welcome](#)  
SolidWorks Web Help

People also search for



\* algorithmic design




### Rhinoceros 3D

Computer application

Rhinoceros is a commercial 3D computer graphics and computer-aided design application software developed by Robert McNeel & Associates, an American, privately held, employee-owned company founded in 1980. [Wikipedia](#)

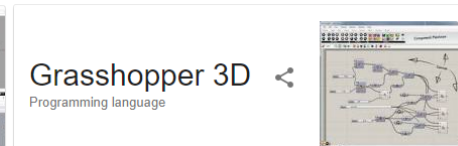
**License:** Proprietary  
**Developer(s):** Robert McNeel & Associates  
**Stable release:** Rhino 6.0 / February 6, 2018; 8 months ago  
**Operating system:** [Microsoft Windows](#), [macOS](#)



### Blender

Computer software

Blender is a professional, free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games. [Wikipedia](#)



### Grasshopper 3D

Programming language

Grasshopper is a visual programming language and environment developed by David Rutten at Robert McNeel & Associates, that runs within the Rhinoceros 3D computer-aided design application. Programs are created by dragging components onto a canvas. [Wikipedia](#)

**Stable release:** 1.0 (April 4, 2014)



### Dynamo Studio

Dynamo Studio is a stand-alone programming environment that enables designers to create visual logic to explore parametric conceptual designs and automate tasks. Download Free trial.

[Dynamo Studio](#) | [Computational BIM Design](#) | [Autodesk](#)

\*\* BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.



fusion and rhino



solidworks

exemplos

computational design

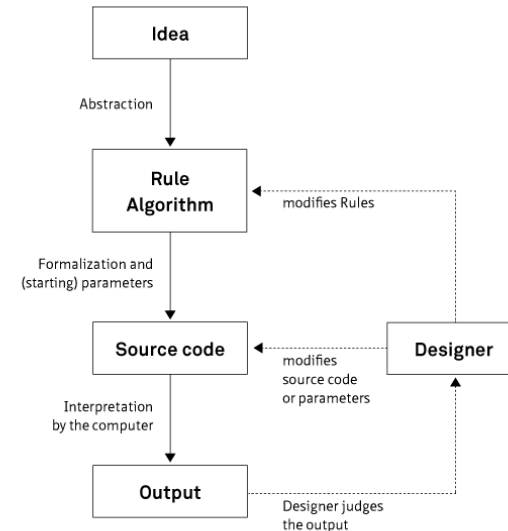
parametric design

algorithmic design

**generative design**



Generative design is an **iterative design process that involves a program that will generate a certain number of outputs that meet certain constraints**, and a designer that will fine tune the feasible region by changing minimal and maximal values of an interval in which a variable of the program meets the set of constraints, in order to reduce or augment the number of outputs to choose from. The program doesn't need to be run on a machine like a digital computer, it can be run by a human for example with pen and paper. The designer doesn't need to be a human, it can be a test program in a testing environment or an artificial intelligence, for example a generative adversarial network. The designer learns to refine the program (usually involving algorithms) with each iteration as their design goals become better defined over time.



Copyright Hartmut Bohnacker, Julia Laub, Benedikt Groß, Claudius Lazzaroni (2009)  
Book „Generative Gestaltung“, [www.generative-gestaltung.de](http://www.generative-gestaltung.de)





### **The Benefits of Generative Design**

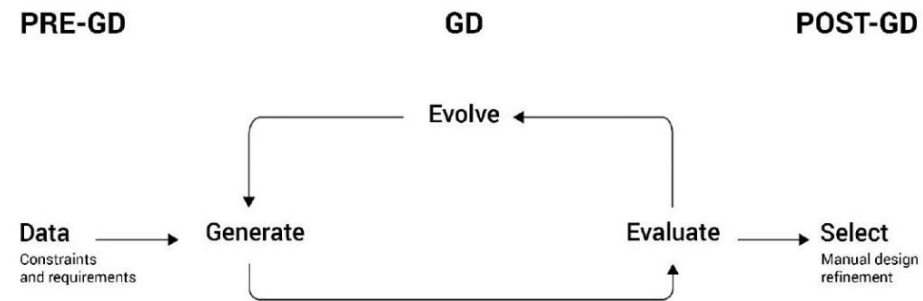
- Enables exploration of a broader range of concepts
- Enables generation of effective designs for different/multiple manufacturing process
- Enables significantly increased design innovation
- Enables performance driven design early in the design process
- Dramatically reduces design/analysis cycles

<https://enginsoftusa.com/what-is-generative-design.html>

another reference that mixes things...



Generative design is the use of algorithmic methods to generate feasible designs or outcomes from a set of performance objectives, performance constraints, and design space for specified use cases. Performance objectives and constraints may include factors from multiple areas including operational performance, weight/mass, manufacturing, assembly or construction, usability, aesthetics, ergonomics, and cost.



### Generative Design is Doomed to Fail

Daniel Davis – 20 February 2020

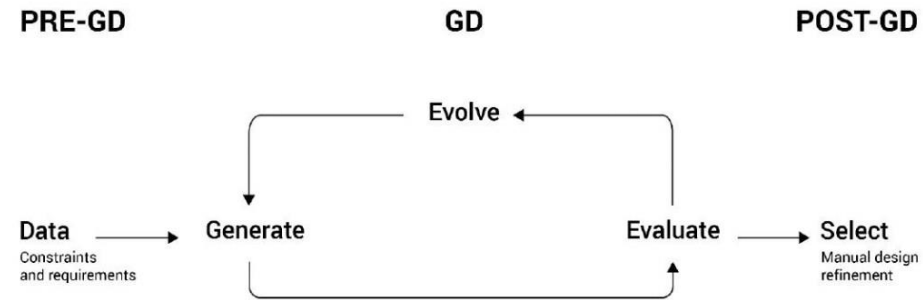
<https://www.danieldavis.com/generative-design-doomed-to-fail/>



why now?

**None of this is new. People have been peddling generative design as far back as the 1980s.** But it never had the clout of someone like Autodesk. After years of never really going anywhere, suddenly everyone is talking about generative design. Suddenly it feels inevitable.

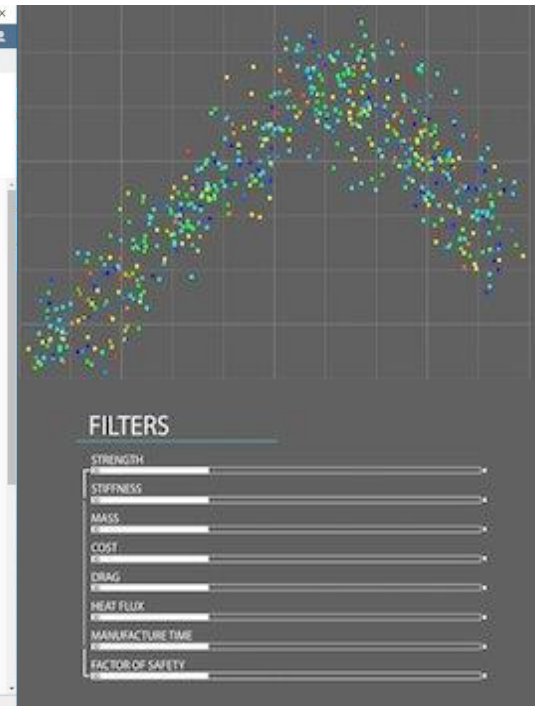
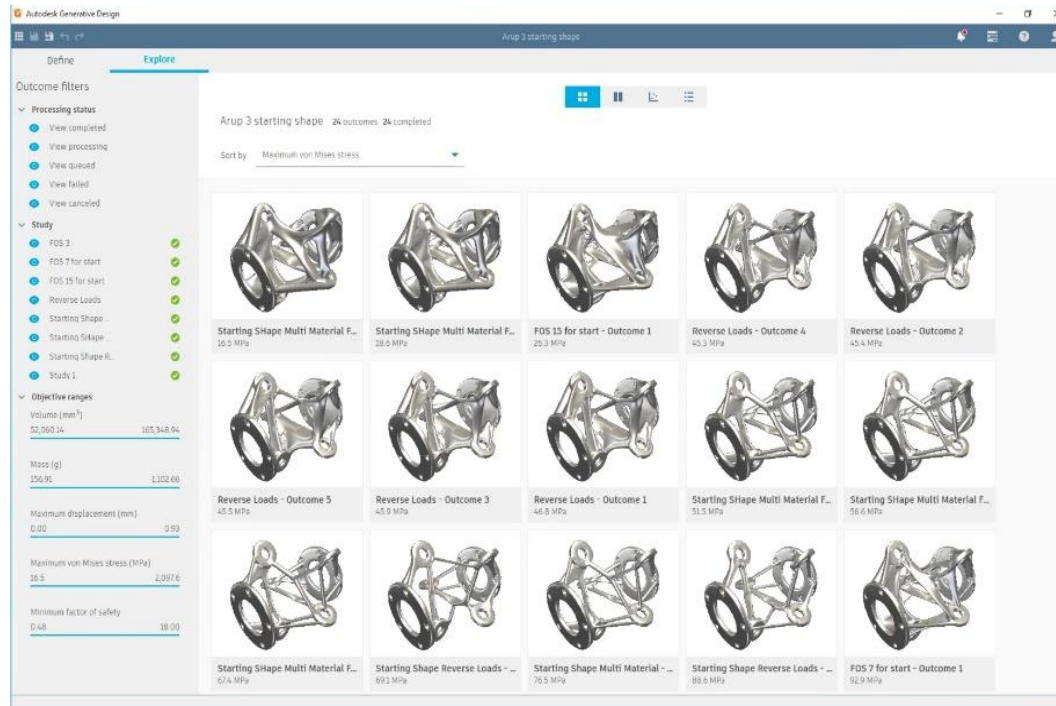
And... more reasons?



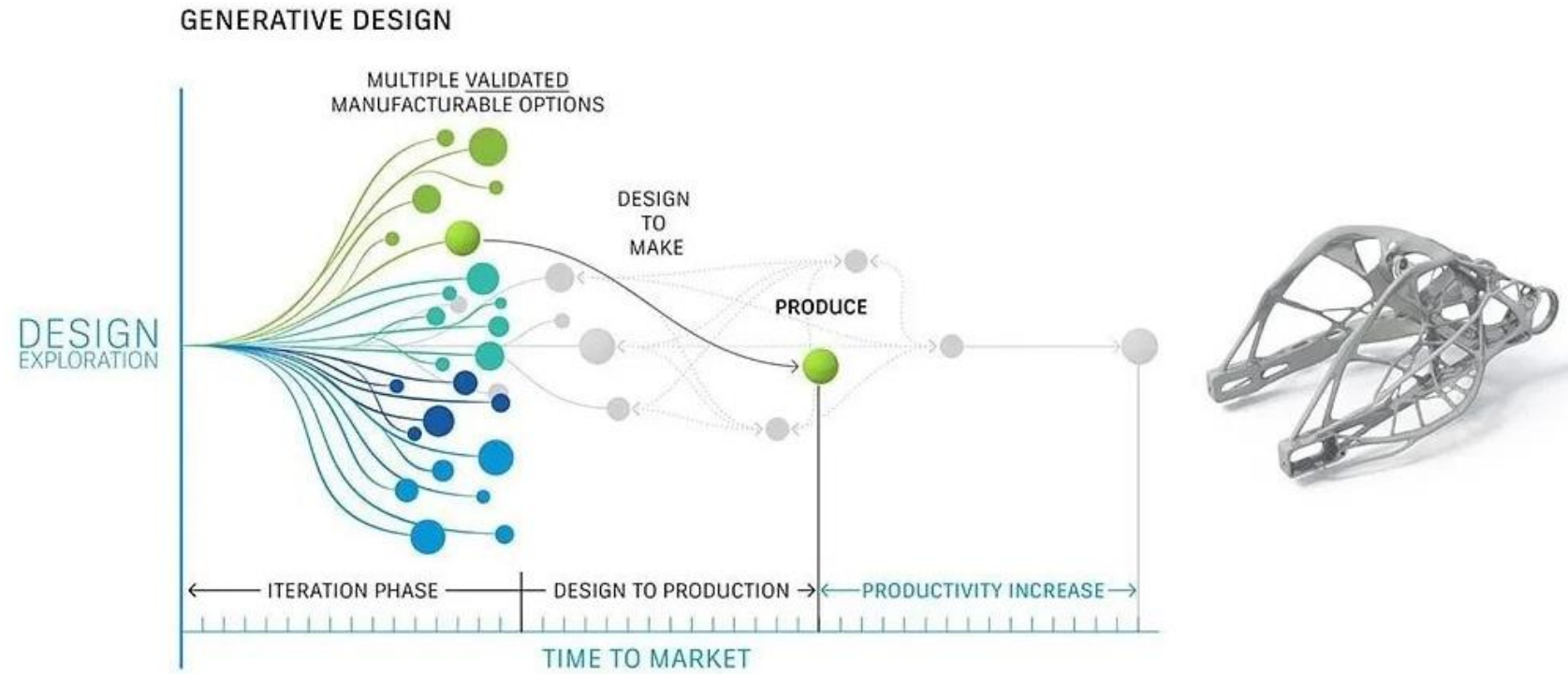
### **Generative Design is Doomed to Fail**

Daniel Davis – 20 February 2020

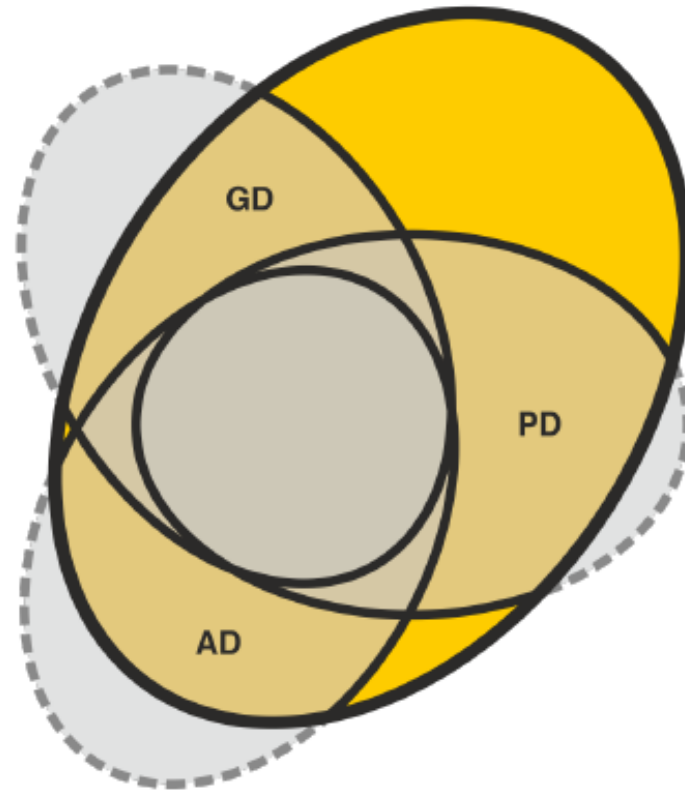
<https://www.danieldavis.com/generative-design-doomed-to-fail/>

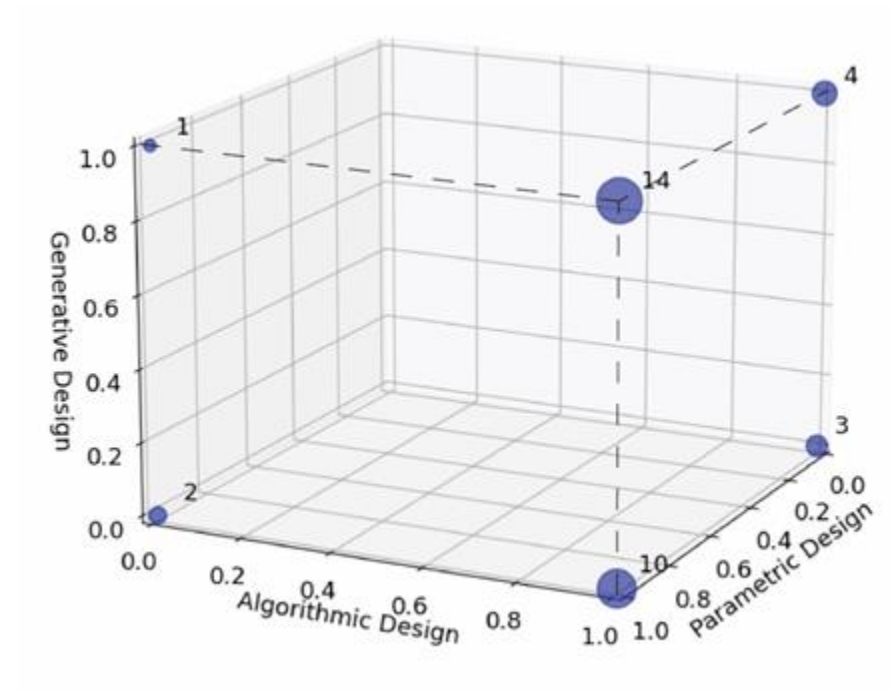


espírito crítico...

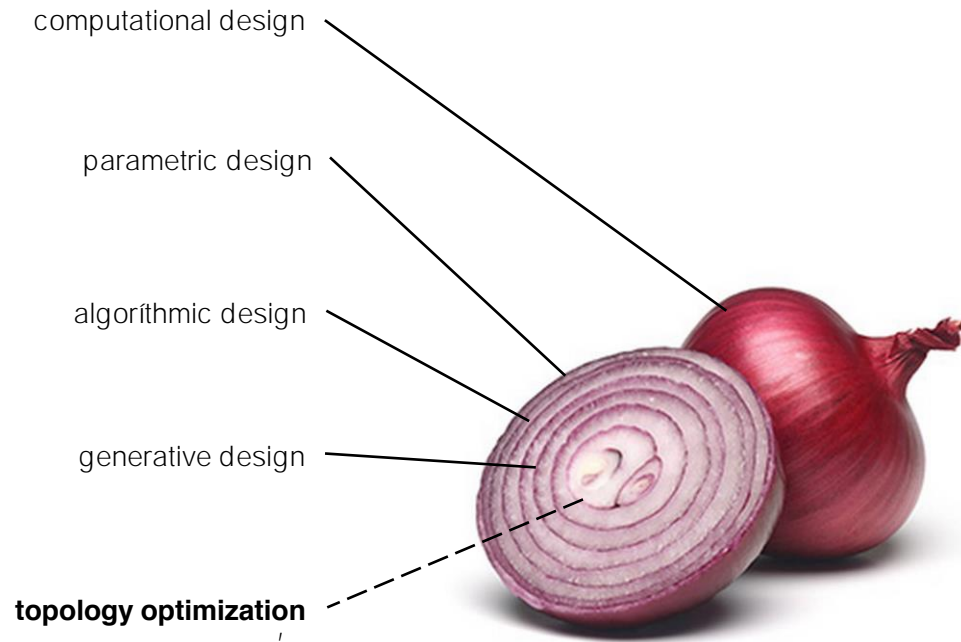


# COMPUTATIONAL DESIGN





in sum..





topology optimisation  
and  
generative design

**not the same thing!**



O que esperamos para a próxima fase?

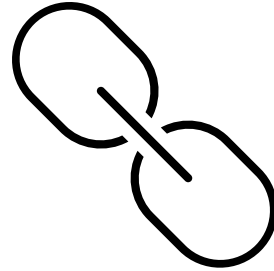
Como se liga à seguinte?

O que se pretende fazer?

Exemplos de trabalho (mestrado)

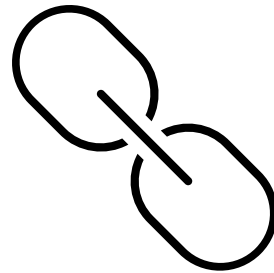


**Diogo Carvalho** / Descodificar Design Computacional: estudo aplicado em produtos cerâmicos



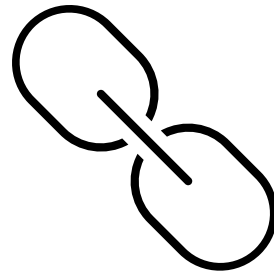


**Ana Simões** / O processo criativo mediado pelo design computacional: uma abordagem metacognitiva



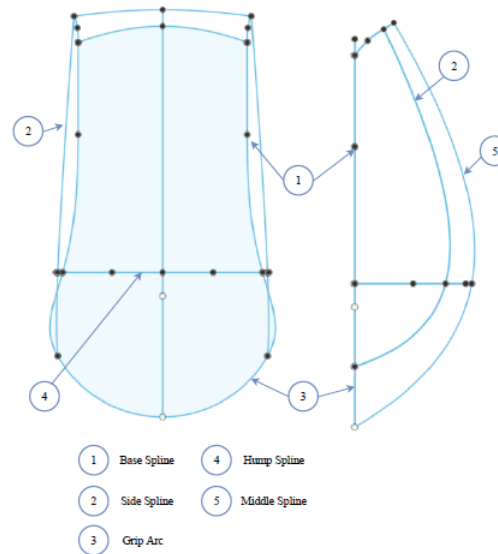
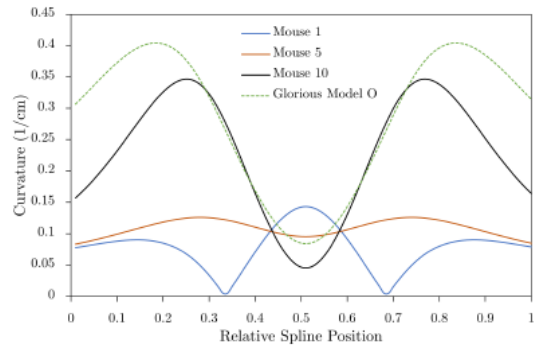


**Carlos Costa** / Aplicação de ferramentas computacionais no design de produto: um estudo exploratório





# Álvaro Francisco / Algorithmic design of a product based on customer data



CREATE MOUSE

Typology: Symmetric

Mouse Length: 12.40 cm

Hump Height: 3.60 cm

Hump Position: 8.00 cm

Front Width: 2.70 cm

Back Width: 3.20 cm

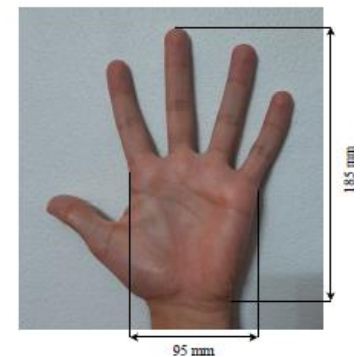
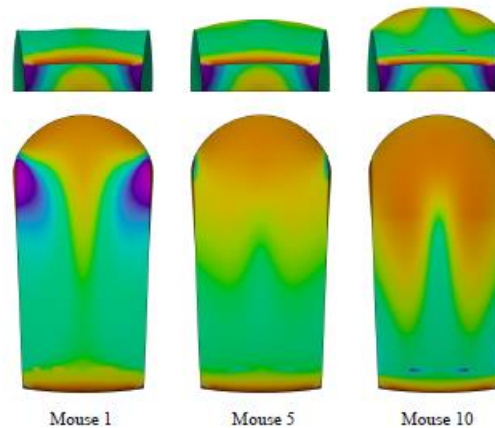
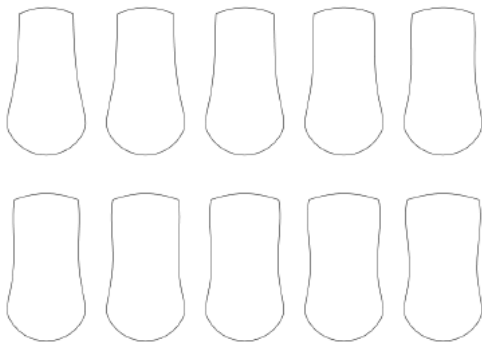
Scroll Position: 2.30 cm

Scroll Height: 1.50 cm

Fillet: 0.15 cm

Curvature: 0.10 cm

OK Cancel







5  
min



**WORK**





## Projeto

### Fase 0



M0 – Modelação 3D assistida por computador (equipa); apresentação em aula e discussão; entrega de elementos CAD; criação de plataforma web, incluindo a memória descritiva relativamente à fase M0, e que será ampliada ao longo do semestre. Esta será pública, acessível também aos colegas.



## Tarefas para hoje

- . Discutir e acompanhar projetos
- . Preparar “new” ou M0 para apresentar na próxima semana



## Tarefas para esta semana

- . Trabalhar na modelação
- . Website
- . Entrega
- . Formação complementar
- . Apresentação (8 min)

- > Contexto
- > Estratégia e competências
- > Análise de processo e resultados
- > Conclusões
- > Visão para próxima fase



# Critérios avaliação M0

<b>Apresentação</b>		<b>0.15</b>
Contexto	0.1	
Apresentação	0.3	
CAD	0.3	
Discussão	0.3	
<b>Entrega</b>		<b>0.85</b>
Site (memória descritiva)		0.3
Forma	0.35	
Função	0.65	
CA		
D		0.7
Modelação	0.85	
Assembly	0.15	

Anotações
Formato livre. Importante introduzir equipa e objeto, discutir estratégias, analisar resultados, mostrar espírito crítico e apontar caminho para fases seguintes.
Espírito semelhante ao da apresentação. Mostrar espírito crítico e processo (não "descriçãode botões")
Ficheiros 3D, acompanhados pela discussão na memória descritiva. Assembly correto, com mates adequados.



031024

