# Discrete and Digital | TxA 2016

A Discrete paradigm for Design and Production
Gilles Retsin

*(Please note this version is non-copyedited)*

**The Slab**

For the 2014 Venice Biennale, Rem Koolhaas suspended a typical office floor slab under the gold pleated neo-classical cupola of the Italian Pavilion. A thin, plasterboard surface covered a thick, volumetric layer of HVAC tubes, cables, switches and sensors. This installation created a moment for architecture, not unlike the moment where Neo wakes up from the Matrix, after taking the red pill. The dome, and its contemporary equivalent of the plasterboard surface is the known world, normal, safe, controllable. A blur of brick, plaster, paint and goldleaf. This is the world Neo inhabits in the simulation set up by the Matrix. The world behind that, however, is a managerial world of ruthless logistics and cold precision. Far deeper and darker than the surface-thin plasterboard world, it is also a domain without architects - governed by other professions, sub-professions, consultants and corporations with global reach. The slab revealed what is left to the architect: the plaster surface below this ceiling, punctured with ventilation exhausts and fire escape signs. Koolhaas's slab invites the architects to make a choice. You could settle for the surface, decorate it, upload it with texture. Or you could take a risk, resist and go for the volume, the structure behind it. The last option will take you to the foundations, the first one will only let you scratch the surface. Engaging with the world beyond the surface gives architects access to what Marx defines as the "mode of the production" - the system of production and distribution - with all of its social and political consequences. At the same time, questioning the "volumetric package" also gives access to questions of architectural syntax - the system of part-to-whole relations, or "mereology" of our built environment. This paper is an invitation to leave the surface behind, and recolonise the depth of architecture, fundamentally questioning how it is produced, distributed, and given form. It's also an invitation to think about syntax, about part-to-whole relations, as a way to access another discussion about modes of production a. This discussion can not avoid "the digital" - both as an intellectual challenge to make sense of the single biggest force of change in our world, but also as a pragmatic realisation that production in general has become digital.

**We have never been digital**

In Breaking The Curve, Mario Carpo describes the inherently discrete nature of computational processes, opposing it to the continuous logic of pre-computational, modern science (Carpo, 2014). Carpo describes how the 1990's generations of digital designers, or "Spline Makers" , are using essentially old differential mathematics, and modern concepts such as geometry and topology. The following generation, as identified by Carpo, uses the discrete logics of computation - which he then relates to a new kind of science based on computational power. Building upon this distinction between the continuous and the discrete, this paper argues that perhaps - *we have never been digital*[1]. Hinting at Nicholas Negroponte's "Being Digital" ( Negroponte, 1995) and Bruno Latour's "We have never been Modern" (Latour, 1991) - this provocation argues that architects have fundamentally misunderstood not only the nature of the digital, but also its economy and social implication. By arguing that *we have never been digital*, this paper is critical of both what is considered "digital" in architecture, and consequently also what is considered

[1] "We have never been digital" and the link with Latour and Negroponte has been first used by Thomas Haigh, in the context of digital humanities. The statement here does not refer to Thomas Haigh's article - which is rather skeptical of the impact of digital technologies.

"post-digital"[2]. Per definition we can not be post-digital *yet*, when we have not been digital in the first place.

The work identified by Carpo as the Second Digital Age[3] is only discrete to a certain extend. From the point of view of production, the work in fact still relies on continuous fabrication techniques.The notion of discreteness only exists in the design process, but to realise the resulting complex geometries, the architects have to rely on the same fabrication techniques as the previous generation: mass-customising segments, through either CNC-milling, robotic fabrication or 3D printing. For example, if a robot is used to carve out a medieval sculpture out of a large block of stone, it is actually computerising a process that is merely analog. This harsh distinction between digital and analog fabrication is convincingly argued for by Neil Gershenfeld ( Gershenfeld, 2015). In order to be considered digital a fabrication process has to operate on a material that itself is digital.[4] Essentially, Mario Carpo's distinction between discrete and continuous, does not only exist in the digital world, but also in the physical world. Digital data is based on discrete units with limited connection possibilities, or whole numbers - whereas the continuous is based on infinite numbers. The core of computation is the use of one universal element, which can have two distinct values - 0 or 1. These binary unit or bit then becomes a versatile building block to compute with. In this sense we can also think of physical, material organisations as being digital or analog. If all the elements in an organisation are discrete, serialised and relational elements with a limited connection possibility, then it can defined as a digital organisation. In this case it's interesting to note that Gramazio Kohler's Programmed Wall, made of robotically assembled, discrete bricks, is not digital but analog, as the brick has a vast amount of connection possibilities. It's indeed continuously differentiated. A LEGO wall on the other hand, could be considered digital, as the male-female connections are limited.

Continuing this logic, Carpo's "Second Digital Age" does not operate with material that is digital. In fact, there is no notion of discreteness here, there is no unit or bit in the digital process which corresponds to a unit in the production process. There is no relation between the fabrication process and the design process - once finished, the resultant form has to be sliced up and rationalised in fabricatable data. This discrepancy between design and fabrication results in a representational gap between the two processes. These findings lead to the argument that fundamentally, the whole process is still to be considered continuous, rather than discrete, and therefore also analog, rather than digital. Lateron, we will expand this argument also from a point of view of production.

This discussion about discreteness can also be continued in relation to syntax, the system of part to whole relations or mereology of an architecture[5] In *The Mathematics of the Ideal Villa*, Colin Rowe compares the underlying geometric order of Le Corbusier's Villa's Stein to Palladio's Villa Malcontenta, arguing that both are based on classical composition ( Rowe, 1947). He then concludes, that modernism was actually not modern. Lateron, in his essay Post-Functionalism, Eisenman further dismantles modern architecture based on a criticism of form-follows-function, and argues for an architectural syntax that is truly modern - in the same way that atonal composition of Schoenberg and Webern is different from classical music (Eisenman 1976). The argument that *we have never been digital,* can therefore also be looked at from this more formal and architectural perspective. This paper argues that until now, architects

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[2] With the "Post-Digital" I refer here to a large body of work by a new generation of practitioners, encompassing people directly referring to themselves as "post-digital", but also the recent wave of Object Oriented Ontology - inspired work.

[3] Carpo refers to the work of EZCT, Biothing, Kokkugia and Michael Hansmeyer.

[4] This argument has also been used before by Neil Leach, arguing that "there is no such thing as digital architecture" Neil Leach, 'There is No Such Thing as Digital Design', in David Gerber, Mariana Ibanez (eds.), *Paradigms in Computing: Making, Machines, and Models for Design Agency in Architecture*, Los Angeles: eVolo Press, 2014, pp. 148-158.

[5] For more on mereology in architecture, Köhler, D. (2016) The Mereological City, Transcript Verlag

have only produced buildings with an analog syntax. The experiments from the 1990's are still based on surfaces, on geometry, sliced in continuously differentiated segments. Their physical material organisation is analog, as well as the designed syntax.

**Digital Production**

It could be argued that the architects' misunderstanding of the nature of the digital finds its origin in digital production. Since the 1990's obsession with the CNC machine, digital manufacturing machines have been mainly understood as devices that allow to build thousands of self-similar, but different variations at the same cost as an identical copy ( Carpo, 2011). This idea of variation and differentiation formed a powerful argument, opposed to the Fordist assembly line based on serial repetition (Lynn, 1999). Already in this argument, there is a misunderstanding about the economy of digital production. The CNC-machine, for example, was initially developed for its repeated precision, not for its capability to produce difference (Noble, 1984). Similarly, an industrial robot arm offers the capability for precision and repetition. The architects' discourse of difference was framed in a context of "mass-customisation", an economic buzzword that was popular in the 90's, which has since faded to the background of the discussion[6]. It has been replaced by new concepts such as the Sharing Economy, Internet of Things, Big Data and the Platform. In fact, the architects of the 90's also misunderstood the logic of mass-customisation itself as a form of formal differentiation, while it was actually thought of as an improvement in production chains. Today, the only commercially available item that is slightly customised along the lines of what the architects imagined, is the Nike iD shoe , for which customers can chose a few different colors and textiles. The vast majority of other products are still standardised, and in fact become ever more standardised. For example, the majority of the world now uses only one or two types of cellphones - a situation not incomparable to the Ford T. There is of course no need to customise the actual form or shape of your smart phone- why would you ? What is customised is the content, the software, the apps you install. The real premise of digital production, is not its ability to formally differentiate parts, but its potential to cut production chains short and to distribute manufacturing. As Jeremy Rifkin describes, with digital production, basically any type of product could be produced without involving a whole array of machines, factories, subcontractors, suppliers etc. Quick variations or iterations of these products can be produced without any additional cost (Rifkin, 2014). However it's important to realise that in fact, this is not about the idea of being able to produce lots of formally different products - everyone his own iPhone design - for that there are iPhone covers. The most seminal products of our digital age are designed as simple, rigid platonic solids: the iPhone, Alexa, MacBooks or Wifi-Routers. The actual potential of digital technologies is not the differentiation of shape, but the fact that you would be able to manufacture an iPhone anywhere in the world, without a massive production chain, and you would be able to iteratively and quickly improve the design. In the context of architecture, Jose Sanchez has advanced this argument to argue for 3D printed building blocks called "Polyominoes". (Sanchez, 2016) This idea links back to the aspect of mass-customisation that has appealed most to businesses, and is there to stay : made to order or built to order. An object is only manufactured at the moment someone has purchased it. This aspect of made to order relies however again on another form of the Fordist assembly line, dismissed by the architects of the 1990's : universal modular components. These modular building blocks, used for for hardware and electronics, are much more akin to Neil Gerschenfeld's idea of Digital Materials, than to the architects dreams of "formally differentiated" parts. Through focusing on formal differentiation, the architects of the continuous paradigm have wildly misunderstood the idea of production in the digital age. Just as Rem Koolhaas' suspended slab, digital production and mass-customisation are about the cold logics of extreme management and precision, relying on ideas of assembly, modularity and universality.

[6] A quick Google Trends search graph shows the decline in popularity of the term "mass customisation".

**Being Digital**

The architectural model closest to Rifkin's idea of digital production is probably the Wikihouse : a platform for an open-source house, that can be produced out of small-scale elements, manufactured on cheap, self-built CNC machines which in themselves are also open-source. We see all the characteristics of a digital economy here : the idea of a wikipedia-like platform that brings together free information, distributed manufacturing, short production chains, and the ability to iterate. Of course, every Wikihouse can be slightly different - customised to the family and site, but fundamentally it has nothing to do with formal differentiation itself. The Wikihouse is in this sense more "digital" than any parametric design, or 1990's surface project. This is altogether a very different understanding of digital production compared to the mass-customised Nike-shoe. Moreover, it has a political implications: the agency for production and design, the platform, can be owned by people or cooperatives rather than large companies.[7] The wikihouse is a clear example of how production can be democratised. It's this type of digital economy that forms the basis for what Paul Mason calls post-capitalism, the moment where freely available information products disrupt the artificial scarcity of the market. (Mason, 2015)

However, in the context of our previous discussion about digital syntax, the Wikihouse is syntactically still analog. It's digital in its economy, but not in its syntax. Ironically, the Wikihouse is based on a parametric and continuous understanding of part to whole relations. First, a global form is defined, which is then sliced into thousands of different elements. A large amount of waste occurs, as the parts do not correspond to the sheets they are cut from. Moreover, the large amount of different parts result in a complicated assembly process, and opens up more space for errors to occur.

This paper will further expand a proposal for an architecture that is both digital in its design, production, syntax and economy. Essentially a fully digital architecture would establish a new type of non-analog syntax, that is based on a set of versatile and recombinable bits or parts, that can be manufactured and shared through a wiki-like platform of production. This digital syntax per definition rids itself of geometry and becomes purely based on relations. In the attempt of "being digital", architecture inevitable escapes the surface, and again gains access to discussions about modes of production - which allows the discourse to take part in a larger discussion about the social and political consequences of the digital.

**Towards a Discrete Syntax**

In Animate Form, Greg Lynn advances an influential argument for a new type of architecture - closely associated to a new idea of design and production. A series of NURBS curves, perhaps the most seminal diagrams of the digital, explain how architects now are not engaged in assembly anymore, but have access to continuous differentiation of matter. Using Tafuri, Lynn compares the modernist curve to the assembly line, and then situates his curve in a new domain of production and differential calculus. However, as Daniel Köhler points out, Greg Lynn's understanding of the curve already implies the loft - which in itself again introduces a form of repetition (Köhler, 2016). Moreover, this lofted surface immediately also implies a mode of production: segmentation. Most iconically - this segmentation method was then later applied to construct the Yokohama Port Terminal by FOA. An initially continuous surface is defined, and then laterally sliced into a multitude of different segments. A whole generation of computational research in architecture has exactly done that : defining an overarching form - shaped in a field of forces, and then rationalising it in a series of differentiated segments. The argument behind this "mereological nihilism"[8] is that digital fabrication tools afford us this degree of difference. Continuing the critique of the lofted surface - with its absence of parts, Köhler then reproduces Greg-Lynn's curve as an assembly of line-segments, conceived as physical bodies, hinged together (Köhler, 2016). This

[7] Although Nick Srnicek in is skeptical about the possibility of competing with platforms (Srnick, 2016)

[8] Mereological Nihilism or Compositional Nihilism is the negation that Objects with proper parts exist, see Peter Van Inwagen

compelling diagram literally “breaks the curve” - as in Mario Carpo’s text. Inspired by Köhler’s provocation, this paper will attempt to break some more curves, and does this by illustrating a series of projects using the same NURBS curve as a syntactical diagram. The projects, by Gilles Retsin Architecture, are organised in three parts towards a digital syntax, starting from the continuous to the discrete-but-not-yet-digital, to the digital.

Fig 1: SoftKill ProtoHouse, 2012, Prototype for a 3D printed house, 2011-2012, AA-DRL thesis project. In collaboration with Sophia Tang, Nicholette Chan, Aaron Silver. Critics : Robert Stuart-Smith, Knut Brunier, Tyson Hosmer

## 1. The ultimate continuous

The first step in our syntactical journey starts with the SoftKill Protohouse ( Fig 1) , a project developed at the AA-Design Research Lab in 2012. The Protohouse is a prototype for a 3D-printed house, speculating on the existence of fictional 3D-printer which can print large blocks of material on a very high resolution and with sufficient material strength. The project is not based on a geometrical understanding of space : it starts with a a large, voxelised volume, that contains data from a stress analysis. Every voxel in this space contains data about deflection, maximum force, tension and compression as well as vector information, as for example the direction of stress flow. Subsequently, this space is randomly populated with agents[9], that manoeuvre through the vectorfield, leaving a trace behind.

[9] Boids as in Craig Reynolds algorithm

These traces then combine with each other, bundling into a fibrous mass of material. The Protohouse is a first, important, step in moving away from surface, geometry and topology. The algorithmic process produces an organisation of material that is completely volumetric, and fundamentally different from Lynn's lofted surfaces, or earlier agent-based projects which manoeuvre over surfaces[10]. Greg Lynn's NURBS curve diagram therefore becomes a continuously differentiated mass of lines. This approach is an important precedent for the discrete, as it establishes a volumetric syntax. Based on a fictional large-scale 3D-printer, there is however no notion of a parthood or assembly - just a continuous distribution of material. In fact, the project can be understood as the *ultimate continuity*, as it's not continuous just in the UV-space of a surface, but in a volumetric way. So, despite the non-geometric qualities of the project, the protohouse should still be considered a continuous and analog syntax.

Fig 2 : Budapest New National Gallery, Gilles Retsin Architecture w. Lei Zheng (2014)
Fig 3 : Guggenheim Helsinki, Gilles Retsin Architecture (2014)

**2. The Discrete**

In a further step towards discreteness, the amount of entropy in the system is reduced, and an initial approach to parthood, serial repetition and assembly is introduced. Rather than supposing a large, notional 3D printer, the subsequent development looks at the assembly of line-segments into a large whole. The elements don't have a predefined connection - they can be connected in multiple ways. In that sense, the connection is not serialised, and there is still a considerable amount of customisation and tolerance in the system. The competition for the Budapest National Gallery (2014) and the Helsinki Guggenheim (2014) ( Fig 2, Fig 3, Fig 5 ) reflect this approach. Both projects are based on a serial repetition of discrete "sticks" or linear timber struts. This kind of material organisation is discrete, but given the high amount of tolerance in the connections, it is also still analog. These "Stick projects" are fundamentally different from Lynn, as they are not based on surface, topology and geometry, but on volume. Greg Lynn's curve diagram becomes a volumetric assembly of sticks. (Fig 6) This approach is also different from the Protohouse, as there is a notion of parts, assembly and serial repetition. At the same time, they resonate with the volumetric and fibrous organisation of the Protohouse. In conclusion -

[10] Such as for example Kokkugia's Baltic Air Terminal (2010) with Buro Happold

sticks are discrete, but not yet digital. Both Stick projects start to dissolve defined wholes, introducing a porous assembly based on parts. Although diagrammatically organised as a series of slabs, the argument for Budapest National gallery is that there are in fact no slabs active as objects in the composition. There are only parts, and relations between the parts.

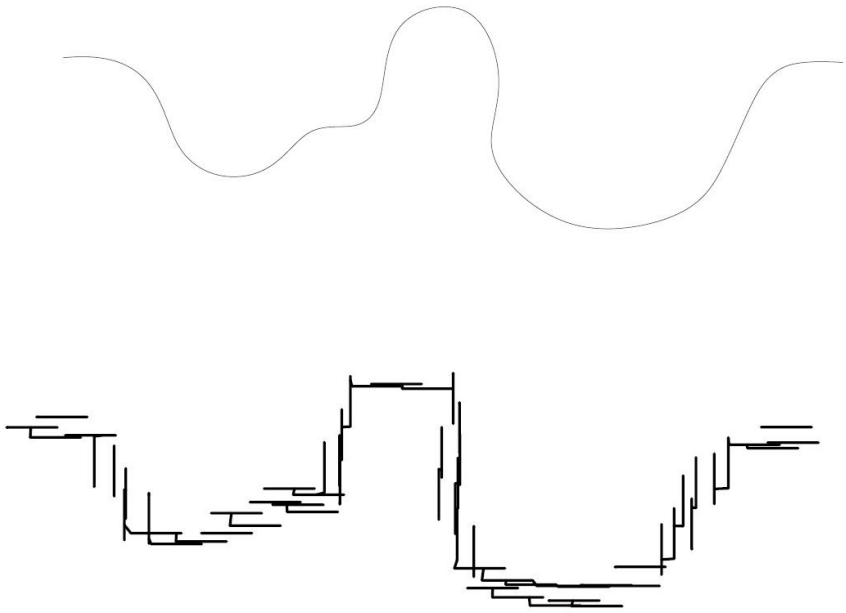


Fig 4: Discretizing Greg Lynn's NURBS curve, Gilles Retsin (2016)

Fig 5: Guggenheim Helsinki, Gilles Retsin (2014)

It's interesting to note here that this kind of approach relates more to Stan Allan's field conditions rather than Greg Lynn's writing. Essentially Allan's Field Conditions are based on serial repetition, and the dissolution of the figure. Figures are composed out of the interaction and relation of a multitude of elements. This idea already goes beyond geometry and topology. Moreover, the field conditions proposed by Allen are also open-ended, and not part of a formal style - they could for example be both curved or straight. Allan's field conditions already imply an aesthetic and ethical world that is very different from Lynn's and the later proto-parametric approaches. It flirts with minimalist artists like Sol Lewitt and Donald Judd - which of course have an inherent link to the syntactical and systemic. It also identifies some of the core buildings of late-modernism as field conditions, such as Le Corbusier's Venice Hospital and indirectly projects such as Van Eyck's Orphanage. In doing so, it creates a historical link between new, computational approaches and late-modernism. We'll speculate more about this further along in this paper, but essentially one could draft an alternative history of precedents for the digital, bypassing Antonio Gaudi, Frei Otto and Greg Lynn. This lineage would then run over early computational experiments by people like Paul Coates and the structuralist architecture of Van Eyck and Hertzberger, to the serialised production of Jean Prouve, minimalist art by Sol Lewitt to Stan Allan's Field Conditions and then effectively the Discrete and the Digital as outlined further below.

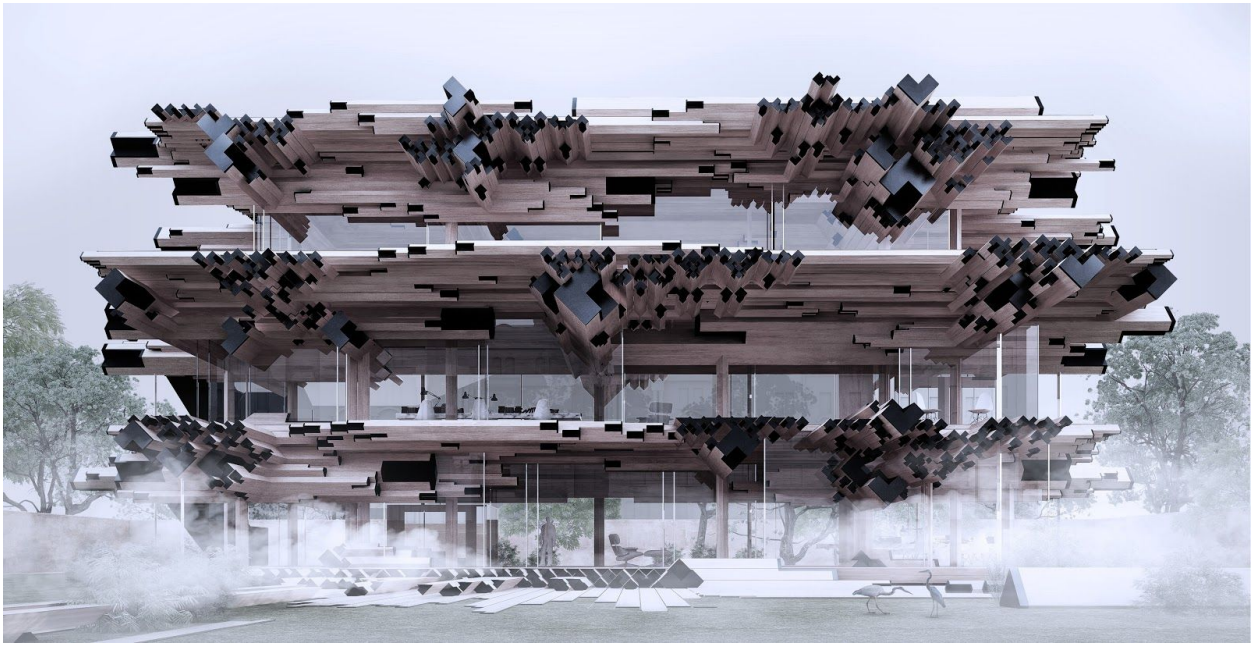


Fig 6 Diamond House, Wemmel, Belgium ( 2016) Gilles Retsin Architecture

**3. Discrete and Digital**

The next iteration of work advances and prototypes a digital syntax, based on serially repeated building blocks with a digital connection logic, similar to Neil Gerschenfelds Digital Materials. As explained before, these building blocks act the same way as Digital data, which means that they can be recombined, are reversible, universal and versatile. The first important precedents of this approach is EZCT's Universal House project ( Morel, 2011) , which proposes a physical building block that can be assembled into multiple different buildings. With a kind of dark humor, the building block itself is literally a cube or voxel, suggesting a logical and rational endpoint for architecture where all questions concerning syntax and part-to-whole relations are irrelevant. This voxel-like blocks would enable a kind of war-craft

like post-digital, post-design world. The work below aims to take a different approach and tries to never assume a pixel or block like element, but rather an element that contains a certain kind of design agency and establishes particular relations between elements. The first experiment with this fully digital project is the Diamond House (2016), a project for a multi family home in Wemmel, Belgium. The project is based on an L-shaped and a rectilinear element with male-female connections. The elements are hollow, assembled out of timber sheet material. In principle, they could be produced on a small CNC-Router, as a form of distributed manufacturing. The elements are hierarchically scalable, which means that they can appear at the same time on multiple different scales. Just as the other examples - we first assume a space filled up with points, that can contain data like stress, vectors etc. Each voxel is linked to a digital building block, which for example orients in the direction of the vector, or could obtain a specific position based on the neighbouring voxels. A syntax emerges from the relations between elements.(Fig 6, 7, 8) Greg Lynn's NURBS curve diagram now becomes a volumetric, voxelized cloud of data. The content of the voxel can be varied, as well as the size or resolution of the voxel space. Unlike the lofted NURBS surface, this discrete assembly is already three dimensional and tectonic.[11] ( Fig 9) It is non-geometrical and non-topological.

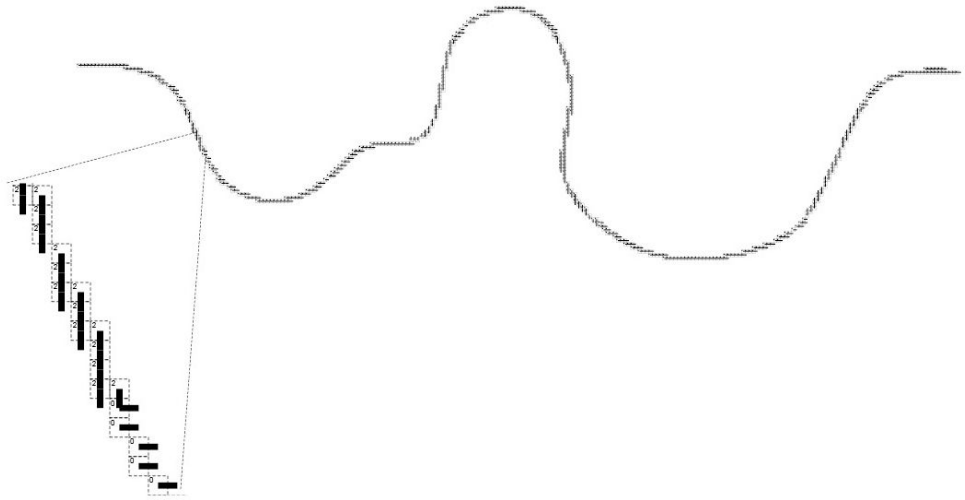
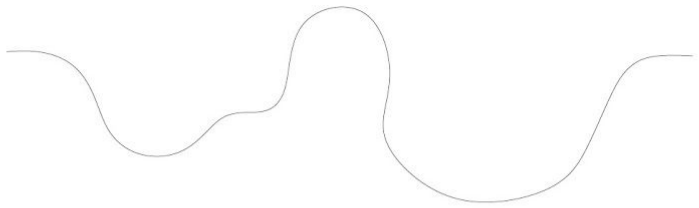
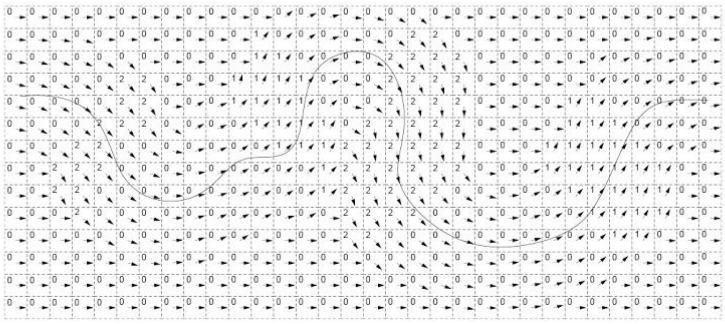
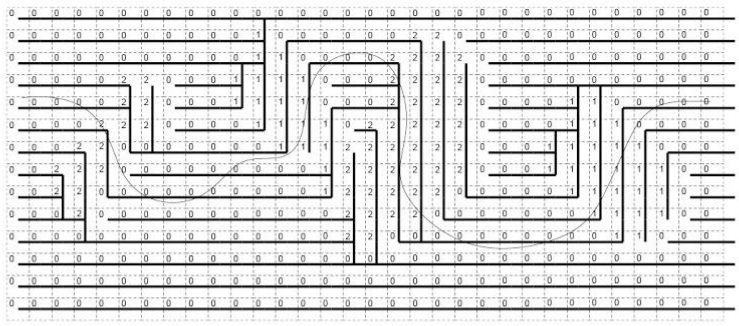


Fig8, Digital and Discrete version of Greg Lynn's NURBS curve, Gilles Retsin ( 2016)

[11] It's important to distinguish the system described above from operations based on mere aggregation, where the geometry of the part defines the whole. See for example, Bloom by Alisa Andrasek and Jose Sanchez. This voxel organisation is also fundamentally different from a spatial subdivision or tessellation, which is again geometrical, as in for example the work by Aranda Lasch.







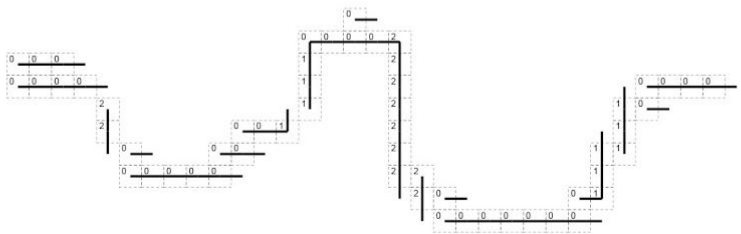


Fig 6, Digital and Discrete version of Greg Lynn’s NURBS curve, Gilles Retsin ( 2016)

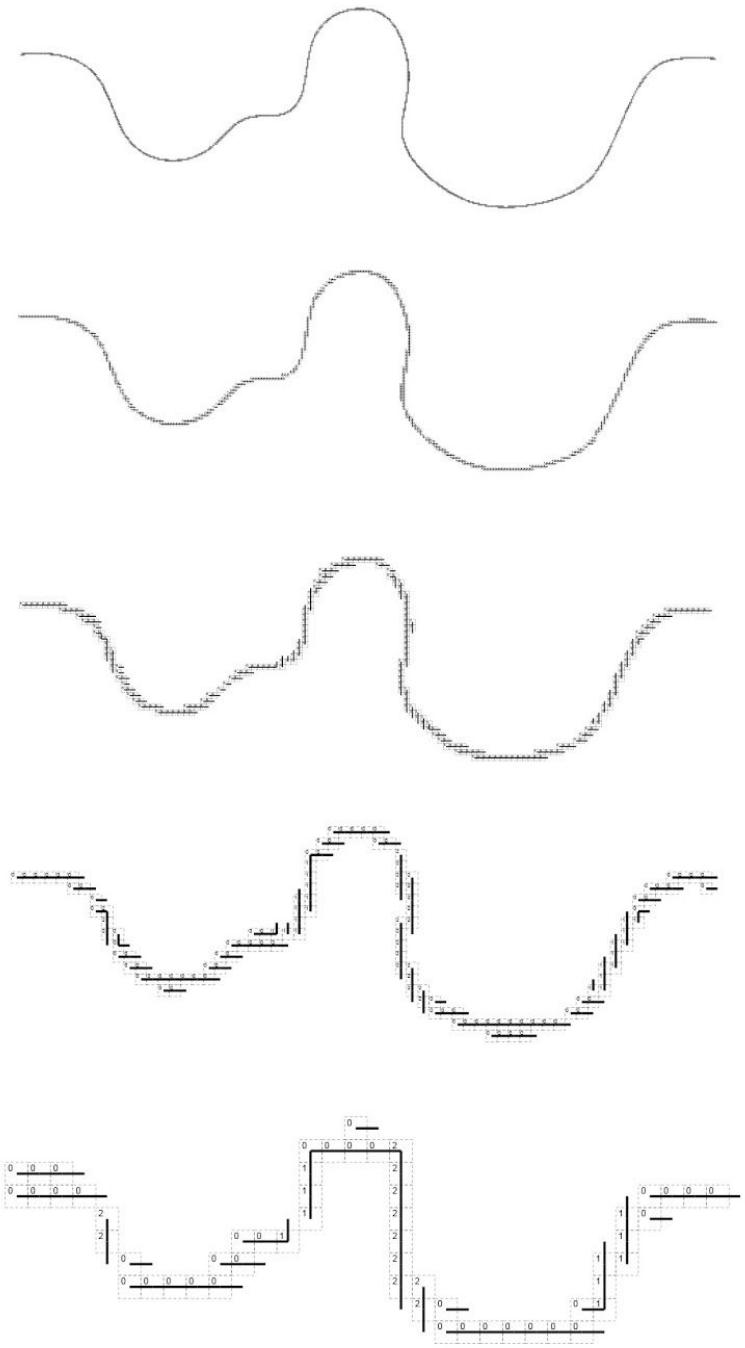


Fig 7, Digital and Discrete version of Greg Lynn’s NURBS curve, Gilles Retsin ( 2016)

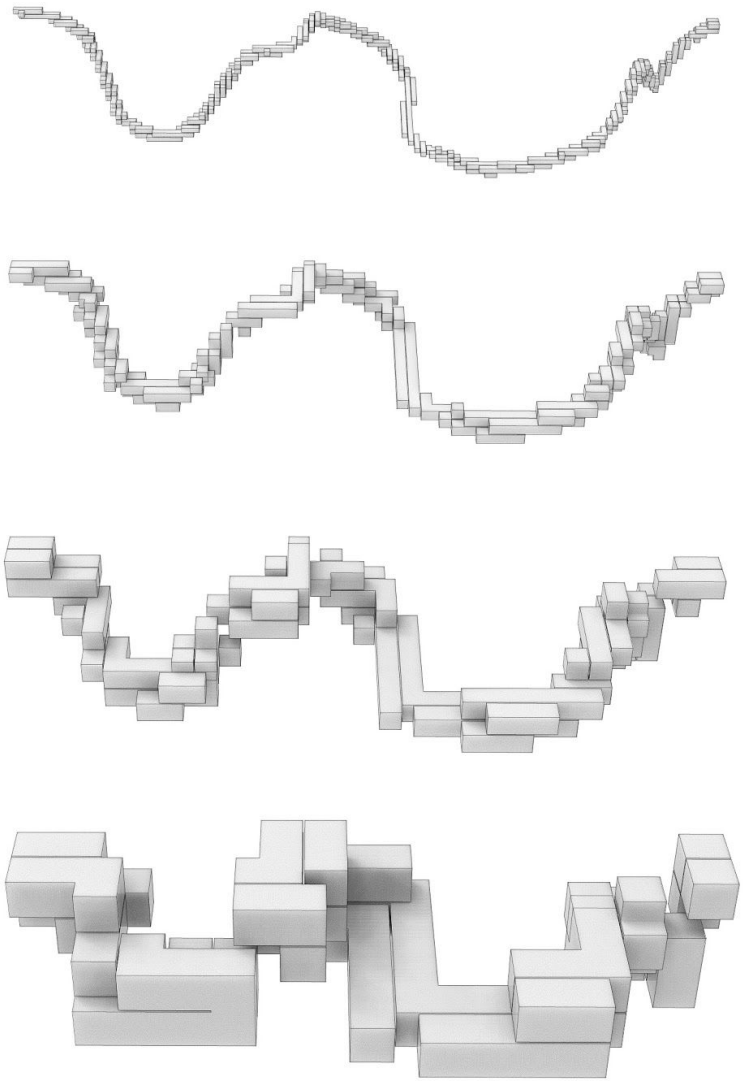


Fig 9, Digital and Discrete version of Greg Lynn's NURBS curve, Gilles Retsin ( 2016)

This digital syntax is independent of resolution - it remains the same on different scales. The Diamond house could be constructed with smaller elements, or with large ones. Fundamentally, a shift in resolution does not affect the syntax and part to whole relations. This idea is shown in a series of diagrams where we change the resolution of Greg Lynn's curve - from a line that seems perfectly smooth, down to a rough and low-resolution arrangement of straight lines. ( Fig 10 ) This change in resolution puts into question the digital's affiliation with the idea of increased resolution, or ever larger amounts of

elements and smaller scales of operation. In the end a change in resolution is a quantitative argument - while the syntax, the relations between the elements is a qualitative one. On a more pragmatic level, lowering the resolution can also result in more efficiency and feasibility. How far can we drive the resolution down before the object becomes something truly different? As a kind of provocation, the last diagram shows how Greg Lynn's curve is reduced to a single, straight line - still syntactically the same as the more complex high-resolution assemblies. This approach is explored in the competition proposal for the Suncheon Art Platform (2016), which uses large-scale building blocks. These blocks are made of timber panels, with internal stiffening frames. In total, the building consists of 237 blocks. (Fig 11) ) Services such as ventilation and museum lighting are integrated in the blocks. The competition proposal explores the implications of this lower resolution, arguing that the most important aspect is the syntax. So although the resolution is low, and the building may at times seem almost minimal - it's still a digital material organisation, syntactically the same as the Diamond House. The Suncheon Art platforms argues that resolution or scale is not as important as syntax. The lower resolution syntax in the Suncheon Art Platform emphasizes the shift from an emphasis on whole to an emphasis on parts. The building has a strong and clear figure, but at the same time this figure remains diffused and open - it could expand, contract etc. There is a blurry, albeit pixelated boundary between the outside environment and the inside. So instead of a subdivision of the whole, sliced into a large amount of customised parts - we now have a building form that is in conversation with the part and whole - these are democratically situated on the same plane (Bryant, 2014). This could be described as an "In part whole" or "unfinished whole" - a play on the seemingly contradictory mutual autonomy of part and whole. Jose Sanchez uses the term "Open Whole" to capture the adaptability and democratic quality of this type of design ( Sanchez, 2016)

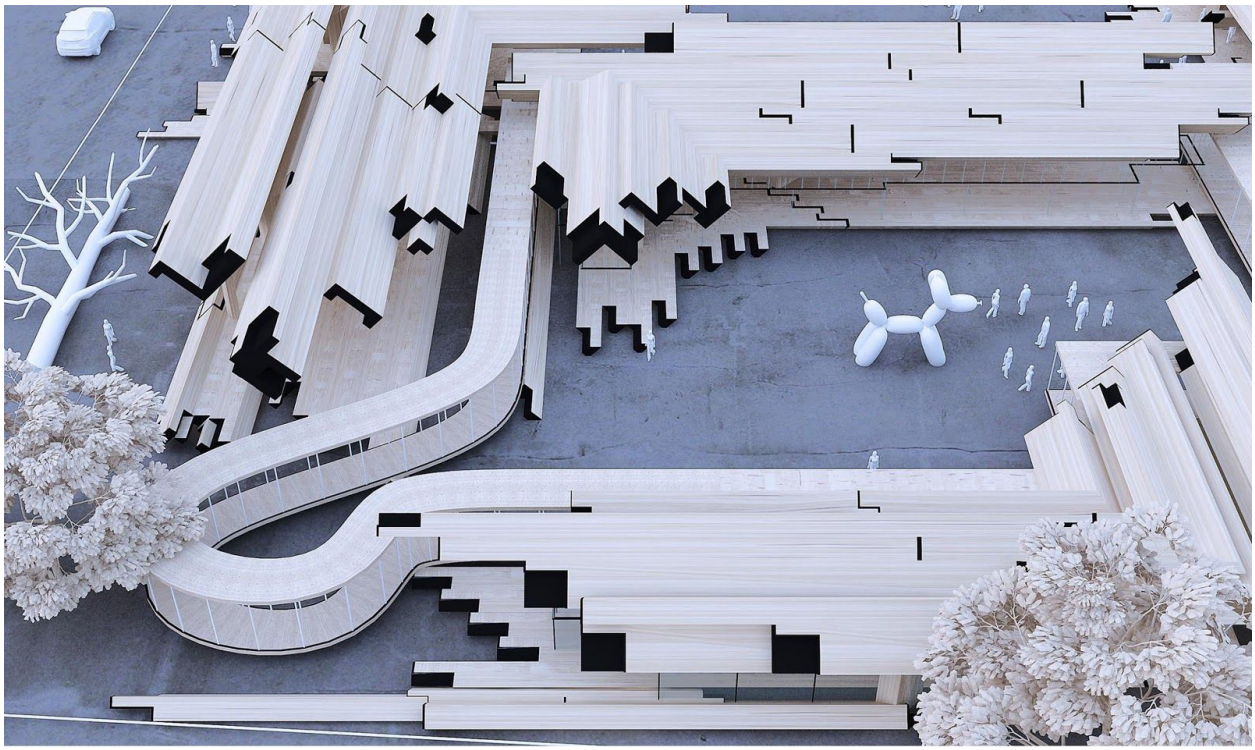


Fig 11, Suncheon Art Platform, Gilles Retsin Architecture( 2016)

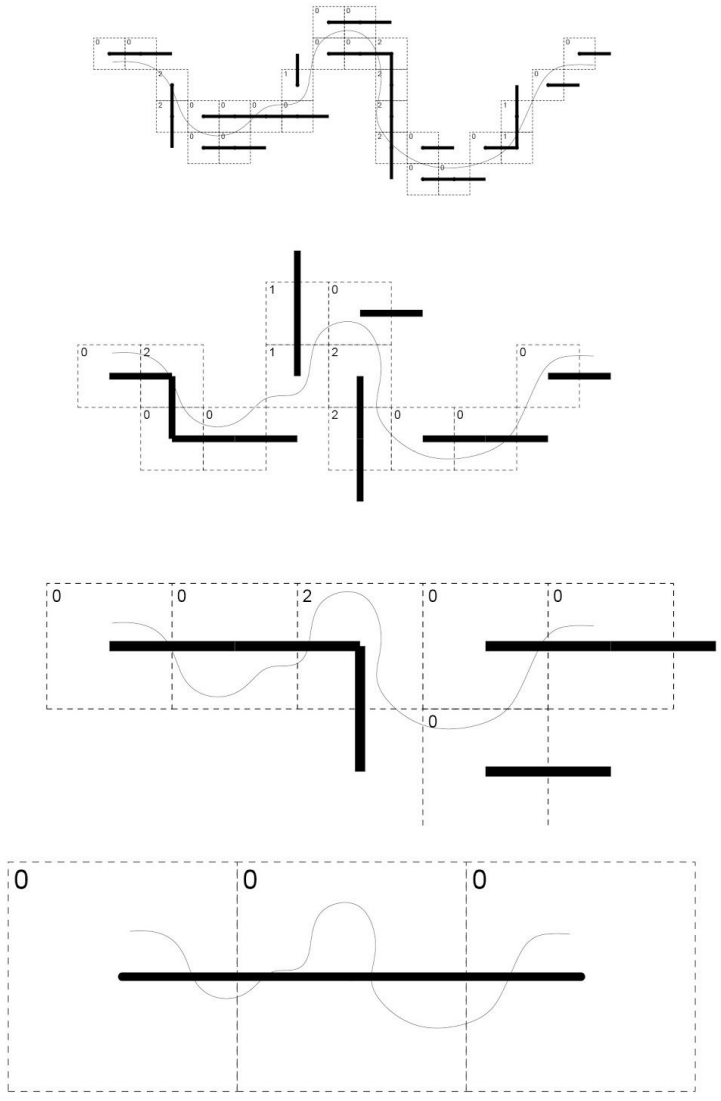


Fig 12, Digital and Discrete version of Greg Lynn's NURBS curve, Gilles Retsin Architecture ( 2016)
"How Low Can You Go ?"

The Diamond House and Suncheon Art Platform are fully digital - both in the design process, as a material organisation, a syntax, and as an economic model or production. Similar to the Wikihouse, these building blocks could be understood as elements which can be fabricated without the need for a large production chain. They can be cut and assembled out of small sections of sheet materials, using widely available tools such as CNC machines. The use of a single element radically reduces the complexity of building. Instead of large amounts of different suppliers and subcontractors, there is only one building element. As Gerschenfeld points out, these digital materials are inherently more efficient for robotic

assembly (Gerschenfeld, 2015). Research by UCL the Bartlett RC-4 into robotic assembly of discrete elements has further explored this point. The research has explored additive manufacturing with versatile, serialised building blocks, similar to the ones in the Diamond House. (Fig 14) (Retsin, Jimenez, Soler, 2017) The Diamond House is prototypical for this approach to discrete robotic assembly. The high degree of serial repetition, and limited set of connectivity problems makes it feasible for a fully automated robotic assembly process (Retsin, 2016)

This also has major architectural consequences, it results in a form of assembly which is completely different from modernist assembly. Le Corbusier's' Maison Domino is an assembly of elements that relate to a particular function or type : a column, stair, floor slab etc. Compared to a digital syntax, there is only a limited set of possible relations between the elements. A discrete assembly as in the Diamond House uses one element, which is initially meaningless - almost like a pixel. It is only after combination with other elements that it establishes a meaning or function : a specific combination emerges as something that acts as a load bearing structure, or something we would understand as a column. So although the Diamond House articulates itself in a series of structures that *look* like columns and slabs, in fact, these do not exist. To paraphrase Rene Magritte here - “ceci n’est pas une colonne” - *this is not a column*, these are merely a number of discrete elements, which in this case may look like a column to you, as an observer. In terms of part to whole relations and syntax, there are in fact no such things as columns or slabs in the Diamond House. Also compared to structuralism or late modernism, which engaged more with prefabrication and the notion of the element, - we can see that the syntax, the mode of composition has changed. There is no more understanding of a rigid and fixed modular assembly, based on a static cartesian grid. The type of assembly we see in the digital syntax does make use of a voxel-grid, but this is a data structure, a set of relations, not a geometrical entity. Although the structuralist project is discrete, in the sense that it is an assembly, it is not yet digital.

Fig 13 Suncheon Art Platform, Gilles Retsin Architecture

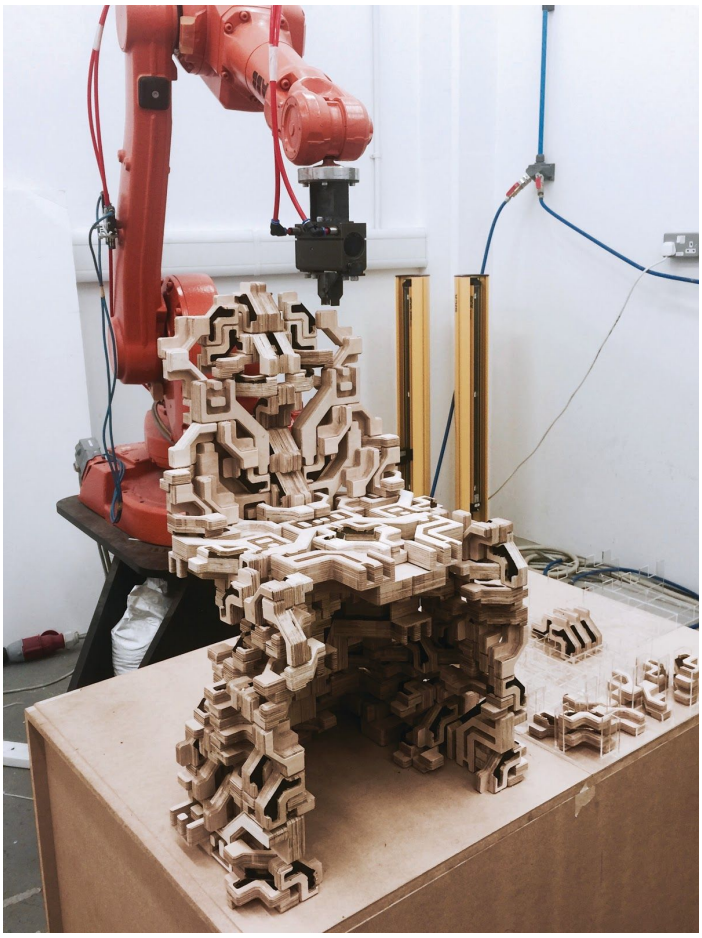


Fig 14 UCL the Bartlett RC4, Team INT, Robotically Assembled Chair (Tutors: Gilles Retsin and Manuel Jimenez, Students :Claudia Tanskanane, Zoey Hwee Ting Tan, Qianyi Li and Xiaolin Yi )

**The consequences of being digital**

This article has laid out a series of arguments and discussions about the relationship between "the digital" and architecture. The criticism that *"we have never been digital"* is not a negative, counter-argument, but is meant as something propositional, continuing the project of the digital in architecture in the long run - post 2008. This text has advanced the Digital and Discrete, as a propositional argument for another way to think about the digital and architecture, driven by the notion of a digital building block. It is an invitation to leave the surface behind, to recolonise the depth of architecture, fundamentally questioning how it is produced, distributed, and given form.

The article points out that what we consider "digital" in architecture, may in fact be analog. Architects have consistently misunderstood the nature of the digital, and have mainly based their argument on "the affordance" of computer controlled machines to create differentiated forms. This analog approach to digital manufacturing has led to a situation where architecture is reduced to a surface and disconnected from the actual economic and political implications of digital manufacturing tools. The discretized and digital version of Greg Lynn's NURBS curve is not a curve anymore - it has left the domain of the organic, the differentiated, the geometry of curves and surfaces. This digital "curve", made of discrete building blocks shares the notion of assembly with the modernist curve Lynn refers to. However, this is a completely different form of assembly - not based on geometry and fixed types, but a digital logic of universal units. The modernist understanding of architecture as an assemblage of

prefabricated, discrete elements enters into an unexpected new domain of the digital, resulting in previously unachievable detail, materiality, structure and aesthetics. ( Fig 15)

Apart of the more architectural questions related to syntax and part-to-whole relations, the focus on digital production beyond mere formal differentiation sets up a discussion about the potential social agency of this tools. It enables for the possibility for architects to engage the digital in a larger social discussion. At the same time, the focus on parts, composition and syntax keep this discussion firmly grounded in design. In the digital-discrete, the political engagement is integrated : digital fabrication tools are understood as a way to engage with modes of production and therefore also social and political ideas. Rather than an isolated conversation about material behaviour and structural performance, architects can use their understanding of digital workflows to contribute ideas to a vivid cultural and political debate about the future of capitalism, automation, the status of the city, housing etc.

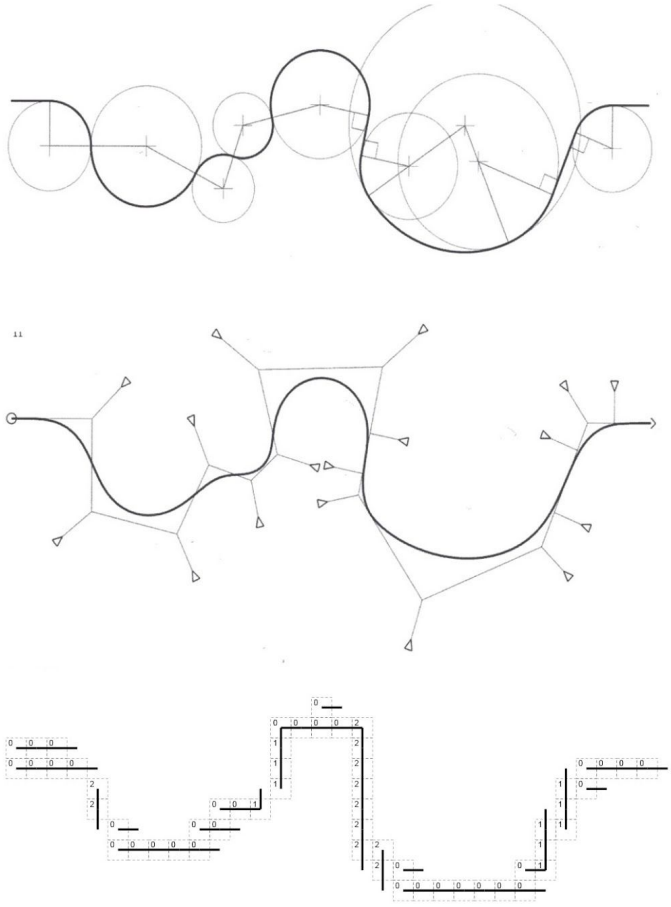


Fig 15, Digital and Discrete version of Greg Lynn's NURBS curve, Gilles Retsin Architecture ( 2016)
Modernist Assembly vs Digital Assembly

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