CATIA® xGenerative Design

ALGORITHMIC GENERATIVE DESIGN ON THE CLOUD

Create complex & bio-inspired shapes with stunning generative patterns providing automated alternative exploration from the very beginning of design.

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WHAT IS GENERATIVE DESIGN?

Computation-based approaches in design such as Generative Design have emerged in the last decades and have rapidly become popular among design professionals. It is a design exploration process, which is defined by the principle of **generating complex forms and patterns** from a simple specification; ie: finding easy solutions to complex problems.

Generative Design systems allow the formation of complex compositions, both formal and conceptual, through the implementation of a simple set of operations and parameters. Changing a parameter will regenerate your design automatically, offering a new set of elements and geometries to work with.

Here, parametric tools are algorithmically based, and therefore offer increased computational control over design geometry during design activity. Their adaptability and responsiveness to changing design criteria make parametric models especially useful for design exploration in complex and dynamic design settings.

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DRAWING INSPIRATION FROM NATURE

In recent years, generative systems in nature have become a source of inspiration for architects and designers. More designers are taking interest in organic shapes and patterns, looking into complex, irregular and repetitive forms and trying to emulate nature's algorithms. Computer-aided design tools, and more specifically generative parametric design tools, make it possible to achieve these goals and get more responsive and adaptive modeling techniques.

> **[Designers] seek to understand underlying rules and principles of natural systems, which produce structural order and material organization of high complexity, efficiency, and beauty.**
>
> *- Suez Canal University Article, Parametric Patterns Inspired by Nature for Responsive Building Façade*

In architecture, for instance, buildings inspired by nature (this process is often called "biomimicry") may be characterized by sustainability, survival, energy efficiency, structures and optimization of materials, as well as interaction with the environment.

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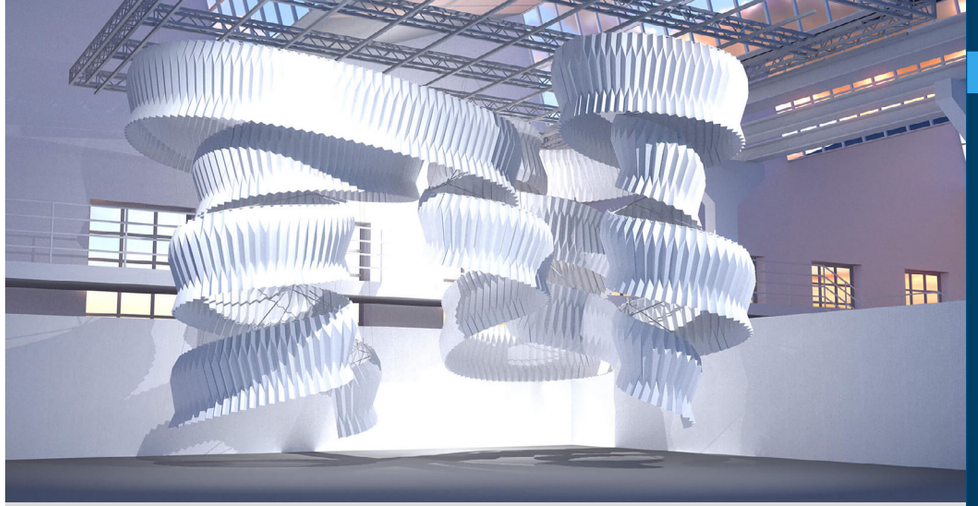
MAKING COMPLEX TECHNOLOGY AVAILABLE TO ALL

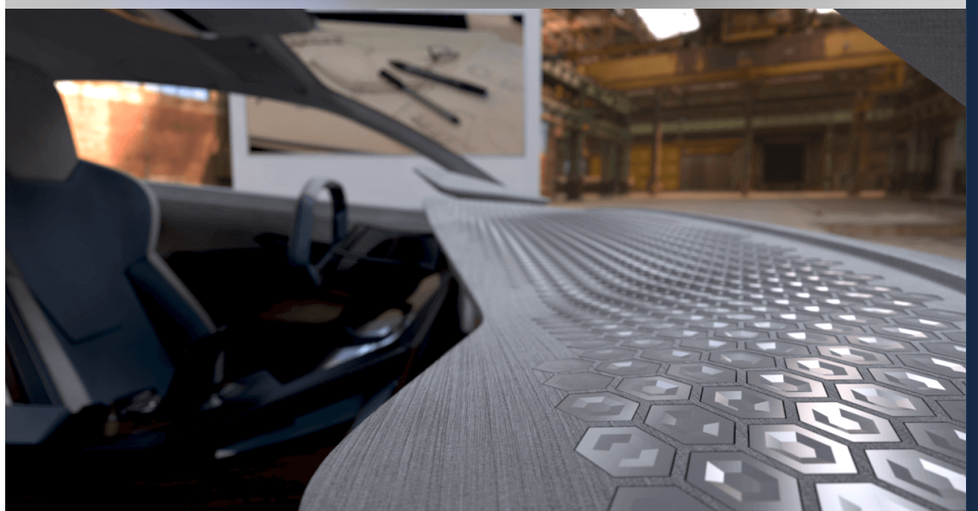
To unleash the creative potential of designers, regardless of their programming experience and skills, it was important for us to create a generative design tool that would produce very complex designs, very fast, for all designers, **beginners and experts alike**.

The tool is powerful and easy to use, enabling a new design approach. By simply changing a parameter in your design, the entire design regenerates automatically, offering you new possibilities in shape creation. Before, changing patterns and motifs would have had to be done manually, cell by cell, and would have been time consuming. Now, you can design complex objects, with powerful tools, in no time.

OFFERING PERSONALIZATION AND DIFFERENTIATION

CATIA xGenerative Design is conceived to meet the needs of creative designers, mechanical designers and architects. Each design expert will be able, with our parametric generative design application, to optimize their designs and automate the creation of shapes to find their desired pattern not only quickly, but also in a unique and differentiated fashion and in their own field. Each of their works will be original creations, which is a strong marker of differentiation from competition.





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A WEB APPLICATION AVAILABLE INSIDE THE 3DEXPERIENCE PLATFORM

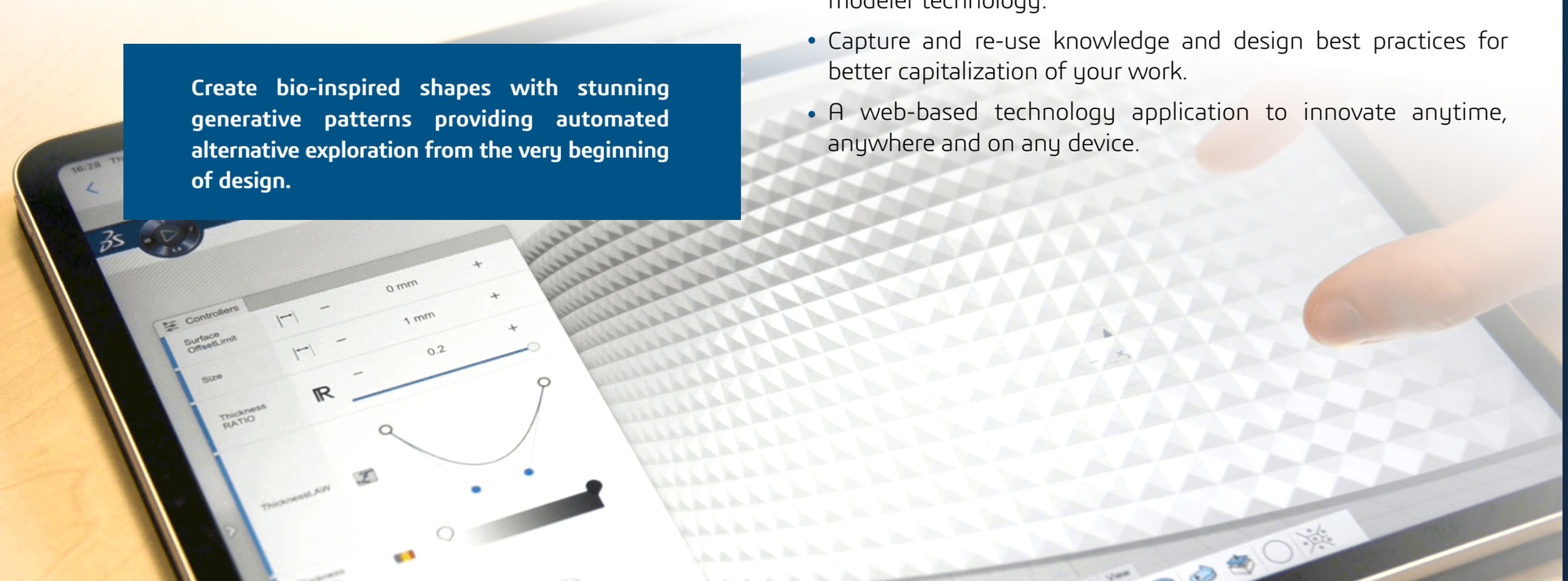
CATIA xGenerative Design is our new Dassault Systèmes web application that enables all designers, engineers and architects to easily and quickly design **simple and complex shapes**.

It is fun, powerful, and very accessible.

This application is included in a number of roles, such as:

- 3D Pattern Shape Creator
- 3D Shape Designer
- Computational Designer for Construction

Create bio-inspired shapes with stunning generative patterns providing automated alternative exploration from the very beginning of design.



EASY TO USE:

- As it is a full web application, there is nothing to install and no update to download. All you need is to connect to the web, on the device of your choice (workstation, laptop, tablet, etc.)
- Geometry Computation is done on the **cloud**, and all the data is stored on a **secure cloud server**.

BENEFITS:

- Explore and generate styling patterns and shapes inspired by nature with an intuitive and powerful algorithmic generative modeling approach.
- Beginners and experts benefit from a progressive user experience combining 3D modeling and graph-based visual scripting.
- Generate multiple geometric shapes by managing collections of objects with geometry quality and accuracy thanks to CATIA modeler technology.
- Capture and re-use knowledge and design best practices for better capitalization of your work.
- A web-based technology application to innovate anytime, anywhere and on any device.

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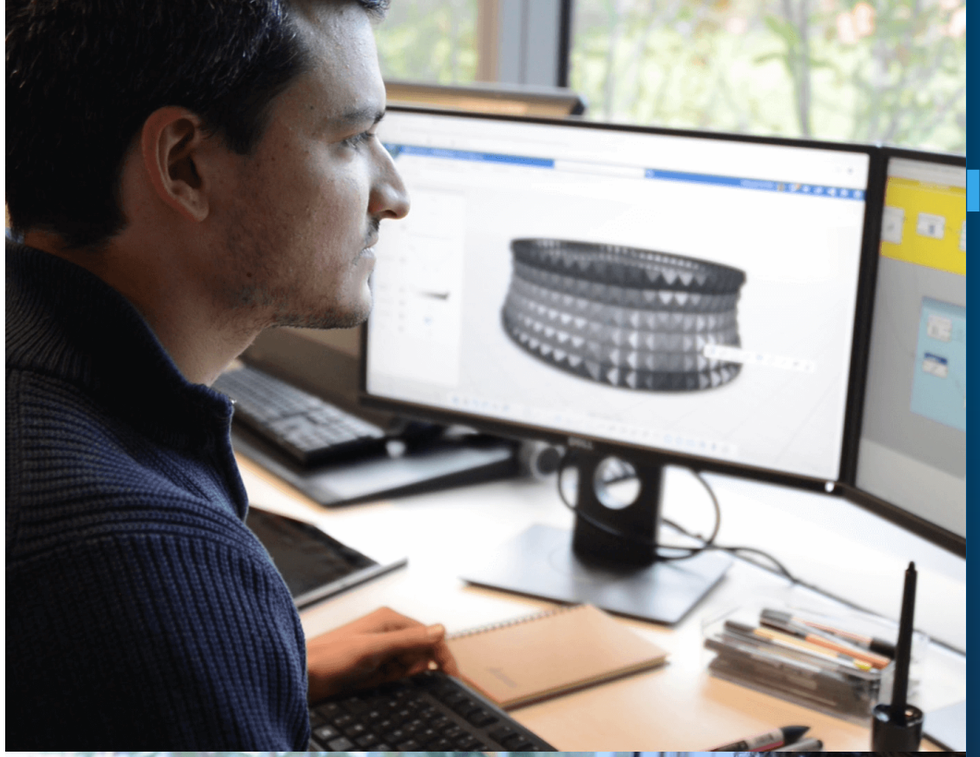
FOR CREATIVE DESIGNERS, ARCHITECTS AND MECHANICAL ENGINEERS

Designers, architects and engineers can easily design shapes and patterns thanks to the many different use cases in various industries and disciplines that the web application offers.

- For **creative designers** to explore design patterns.
- For **architects** to explore different configurations within a design space.
- For **mechanical designers** to create faster intelligent adaptive designs.

Main industries of interest:

- Architecture, Engineering & Construction
- Transportation & Mobility
- Aerospace & Defense
- Home & Lifestyle
- Technology
- Industrial Equipment



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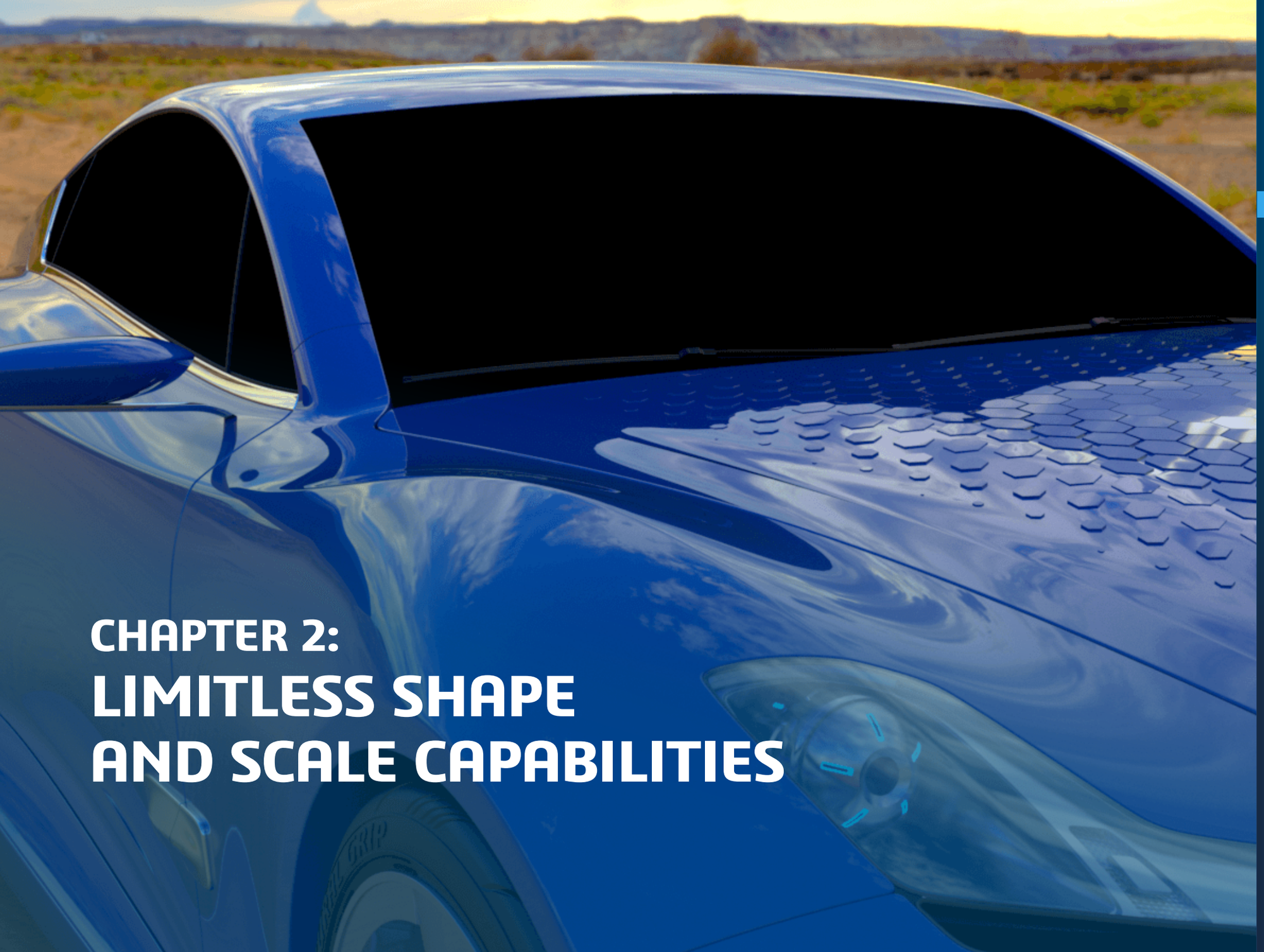

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LIMITLESS SHAPE AND SCALE CAPABILITIES

HIGHLIGHTS:

- Design and update all types of wireframes and surfaces through logic operations.
- All geometric elements created are directly available for use in design and manufacture.

BENEFITS:

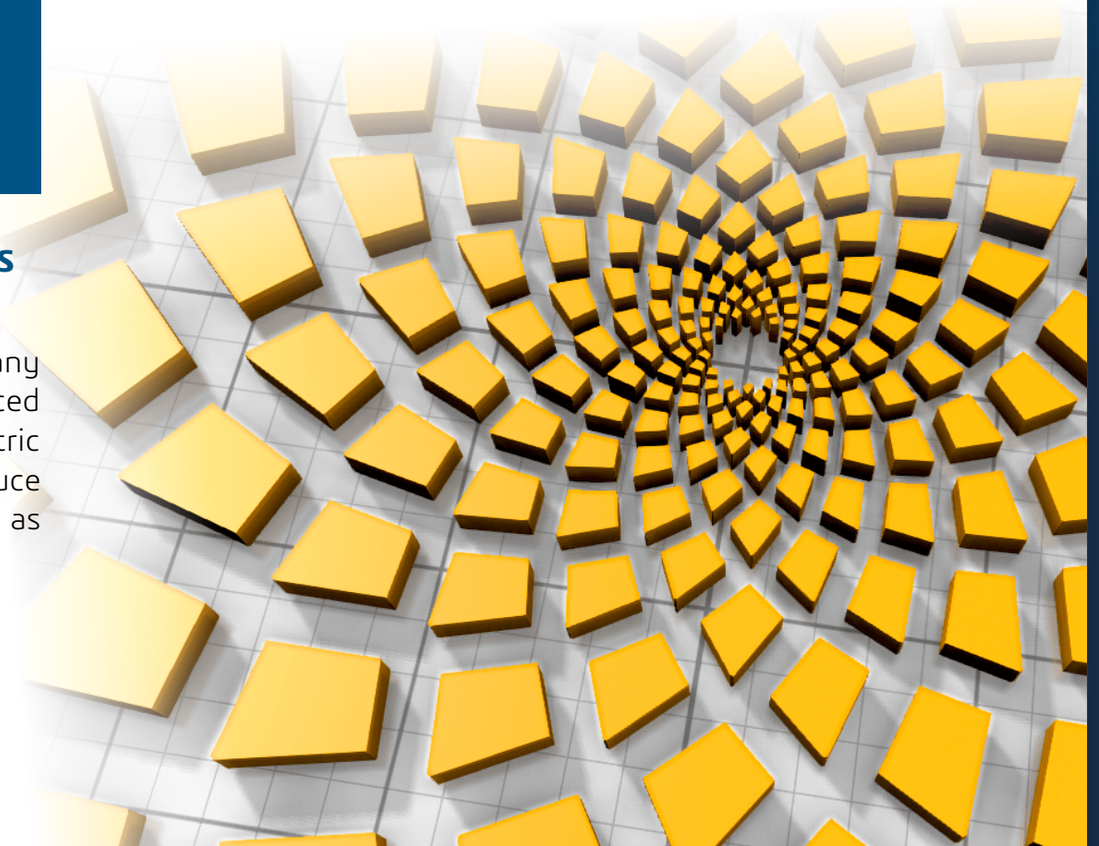
- Quickly generate simple to complex and non-regular shapes and patterns.
- Extend styling capabilities by creating 3D innovative patterns and bio-inspired shapes.
- Guarantee the best quality and most accurate geometry for downstream detailed activities.

BEST GEOMETRY QUALITY AND ACCURACY THANKS TO CATIA MODELER TECHNOLOGY

CATIA xGenerative Design allows you to design any creative shapes and patterns (including advanced wireframes and surfaces) using CATIA parametric modeling technology with high automation. Produce a collection of objects and create geometries such as points, lines, surfaces and volumes.

The generated geometry is immediately reusable for downstream activities like detailed design, template instantiation and manufacturing preparation. Whether you work in the 3D immersive view or in the graphical scripting interface, you can design accurate geometry through a **set of logic operations** defined by input and output parameters.

- Create objects of any shape or type
- Design unique 2D or 3D patterns in preferred unit scale
- Model small components to full scale buildings
- Best in class modeler to create complex shapes



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ALGORITHMIC GENERATIVE DESIGN

Algorithmic Design allows for the modelling of highly complex geometry that would pose challenges for manual design tools. Algorithmic Design entails a parametric modelling philosophy, meaning the design can be manipulated through **variable parameters**. This allows the designer to explore a wider range of possibilities rapidly and with little effort.

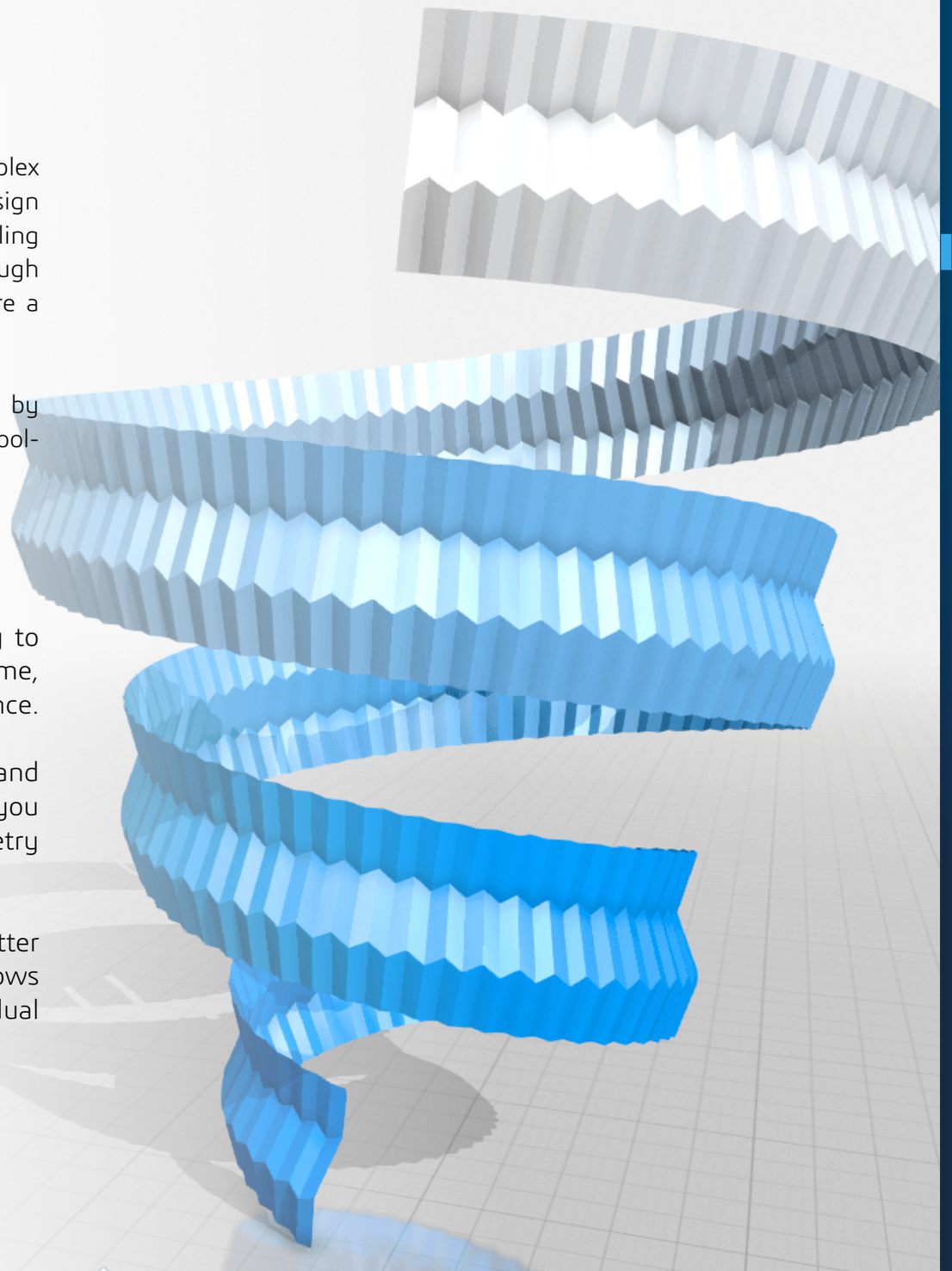
The degree of control over modeling systems offered by programming enables the normal tool-user to become a tool-maker.

SIMPLE TO COMPLEX SHAPES AND PATTERNS

CATIA xGenerative Design gives you the possibility to collect and manage multiple objects at the same time, which we believe is essential to the modeling experience.

As you can collect objects and points very easily and quickly, and manage your entire collection at once, you also have the possibility to generate several geometry over the entire collection in one operation.

Additional tools are available in the panel to better visualize the detailed list of lines you create. This allows you to maintain the list, but also to access individual items in the list.



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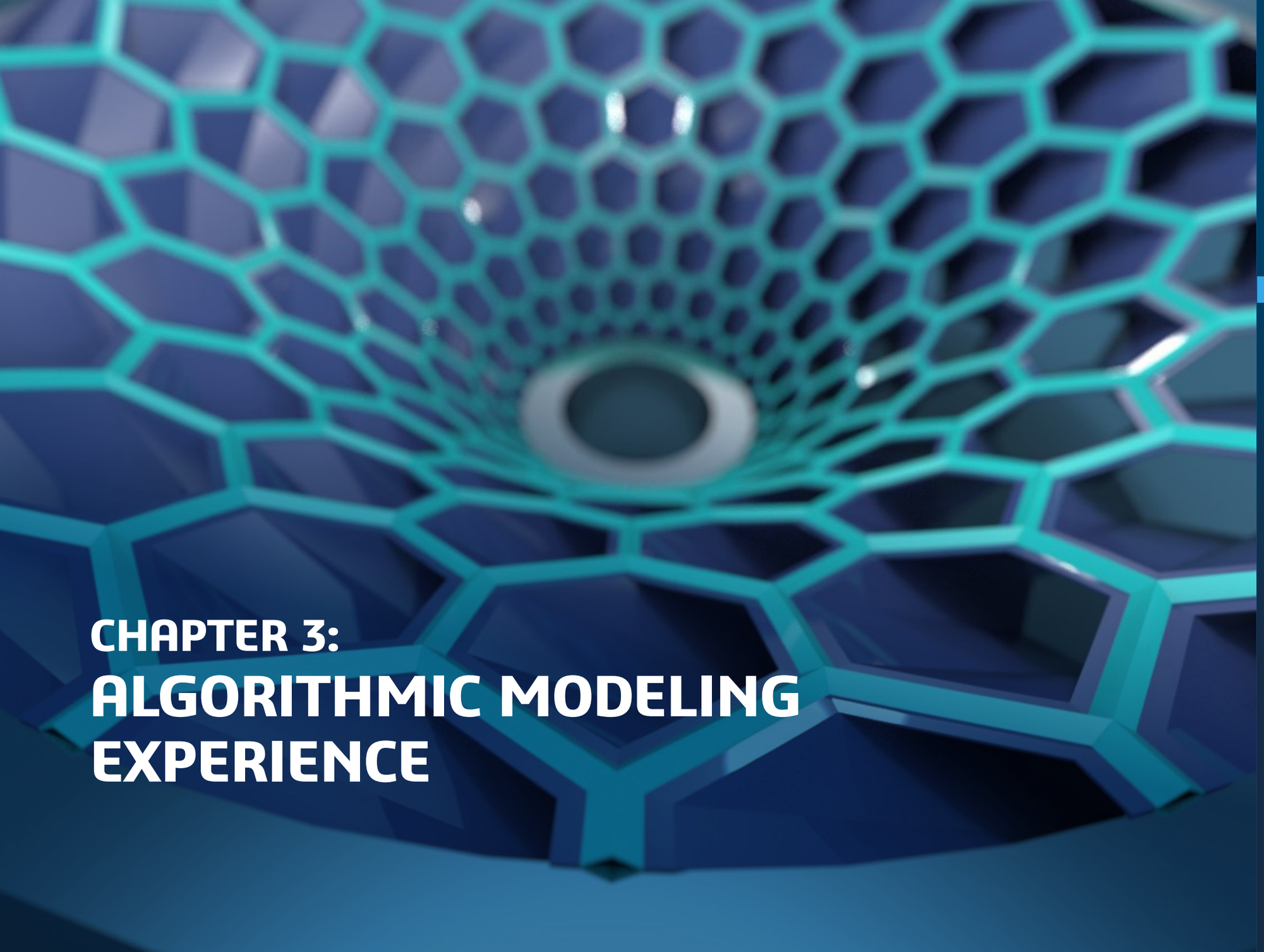

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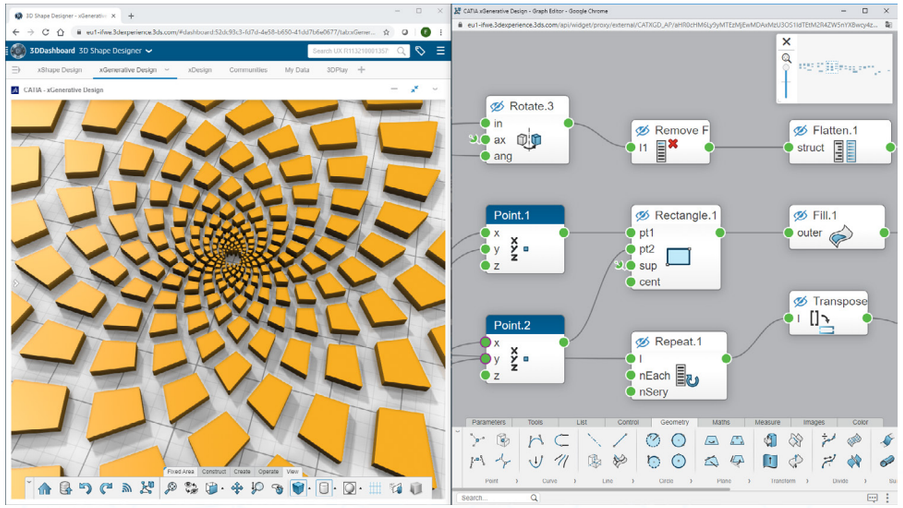
HIGHLIGHTS:

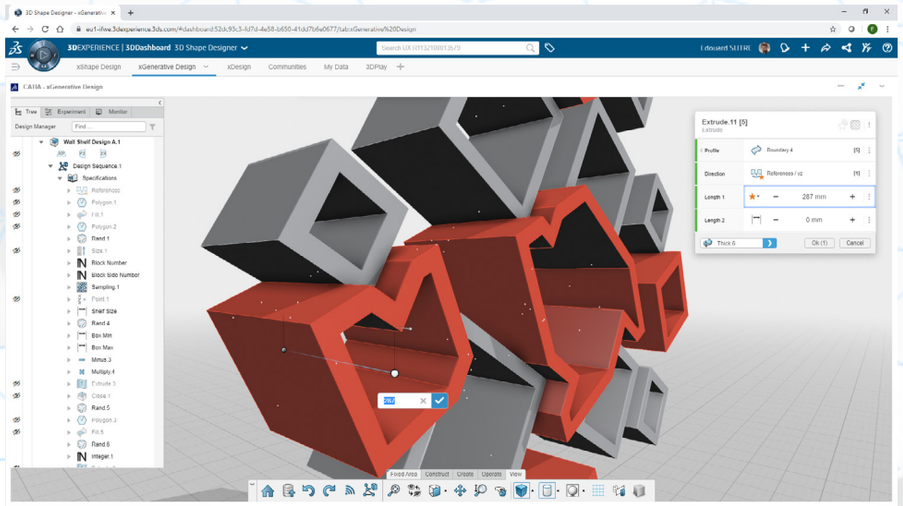
- A unique single environment that interactively combines a generative 3D modeling approach and a graph-based visual scripting interface.
- A progressive and intuitive user experience for beginners and experts.
- Integrated powerful EKL (Enterprise Knowledge Language) scripting capabilities.

BENEFITS :

- Increase creative flexibility and explore more alternatives.
- Bring automation technology to a wider audience and reduce repetitive, time-consuming activities.



CATIA xGenerative Design provides you with two interfaces that can be used simultaneously and in a complementary way: **immersive 3D modeling and Graph Editor**. Expert designers in code can go a step further and create their own scripts with EKL Script Editor.



IMMERSIVE 3D MODELING

The 3D interface will be familiar to users who are accustomed to 3D designing. You will retrieve commands to create or edit geometries with a strong focus on the immersivity like manipulators to adjust your shapes or move objects directly in 3D.

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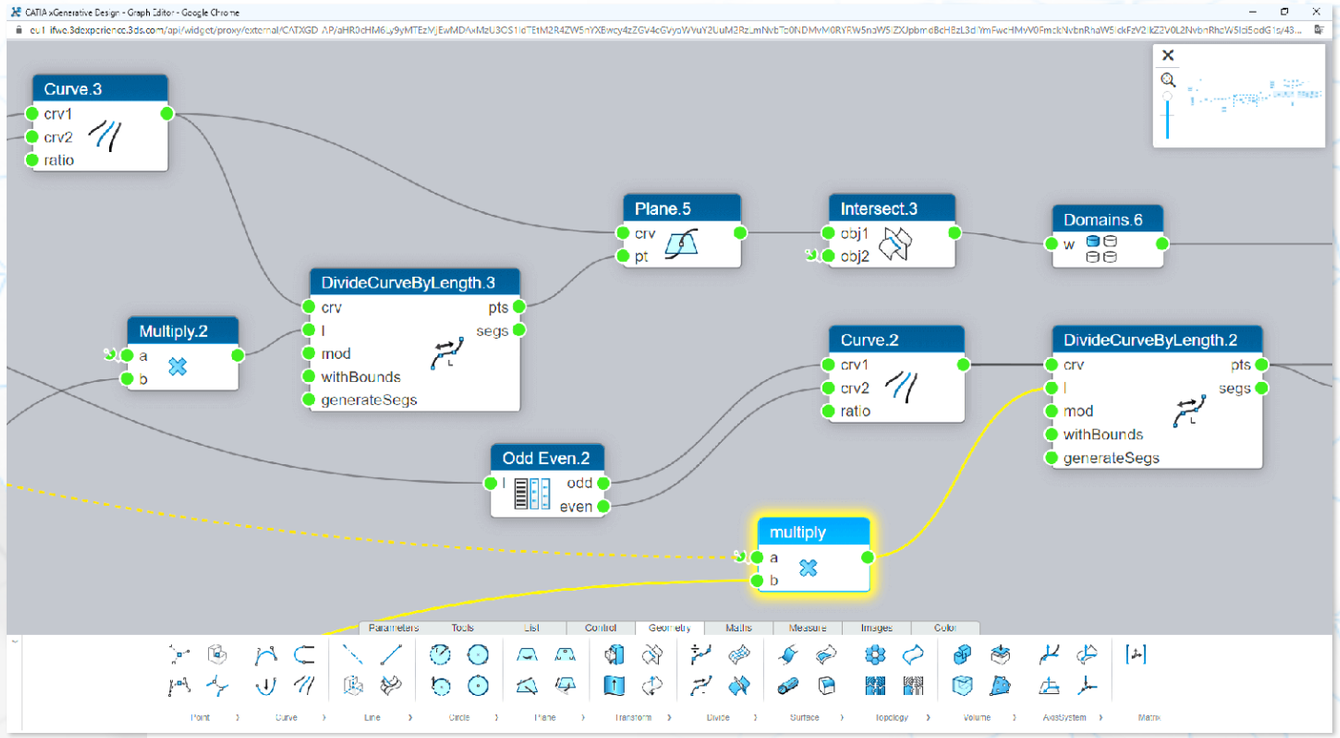
Our interface gives you freedom and flexibility in changing parameters and saving them through the "Controller" panel to simplify the design exploration process. The novelty of the 3D tool lies in the immersive experience it offers, with **automatic regeneration, shape research and new proposals**. This entirely adaptive environment allows designers to produce complex designs very quickly.

GRAPH EDITOR

The graph view is a different, more complex view of your design that can be used in parallel to the immersive 3D view.

It has inputs and outputs, like a graph, and allows you to better understand the complexity of your design and perform a number of complex actions. It is a pillar of the application.

Each box in the graph is an operation. This view therefore gives you visibility on all operations at once, and you can see all the links between the different elements. For more visibility and simplicity, you can also create 'regions' to regroup operators and organize your design. So if a group has a specific function, create a region for the group and retrieve it easily.



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The graph view gives you the possibility to better understand the complexity and the links within your model, but it also allows you to develop advanced operations within your design. Indeed, you can edit your work through the graph, change and manage links, and understand your design better. You will also be able to retrieve more operators from the graph view to perform other tasks such as list management, math formulas, logical sequence and other complex operations.

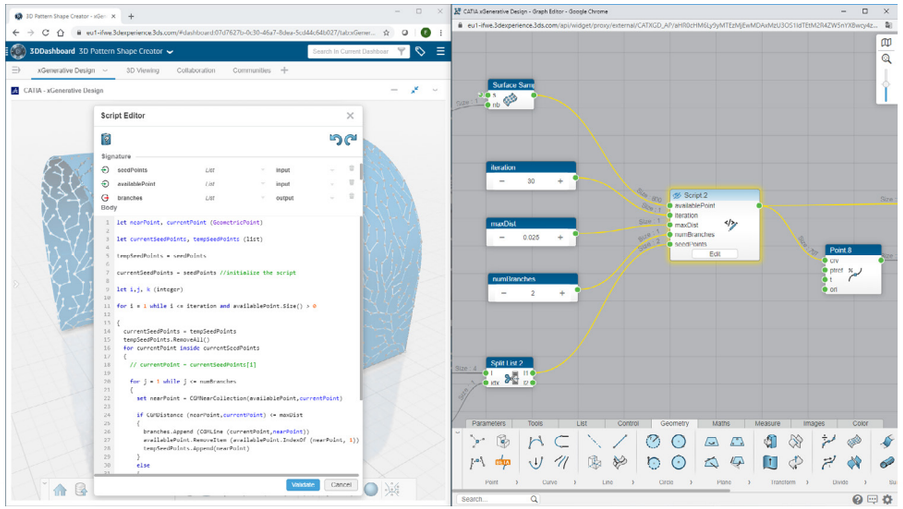
EKL: ENTERPRISE KNOWLEDGE LANGUAGE

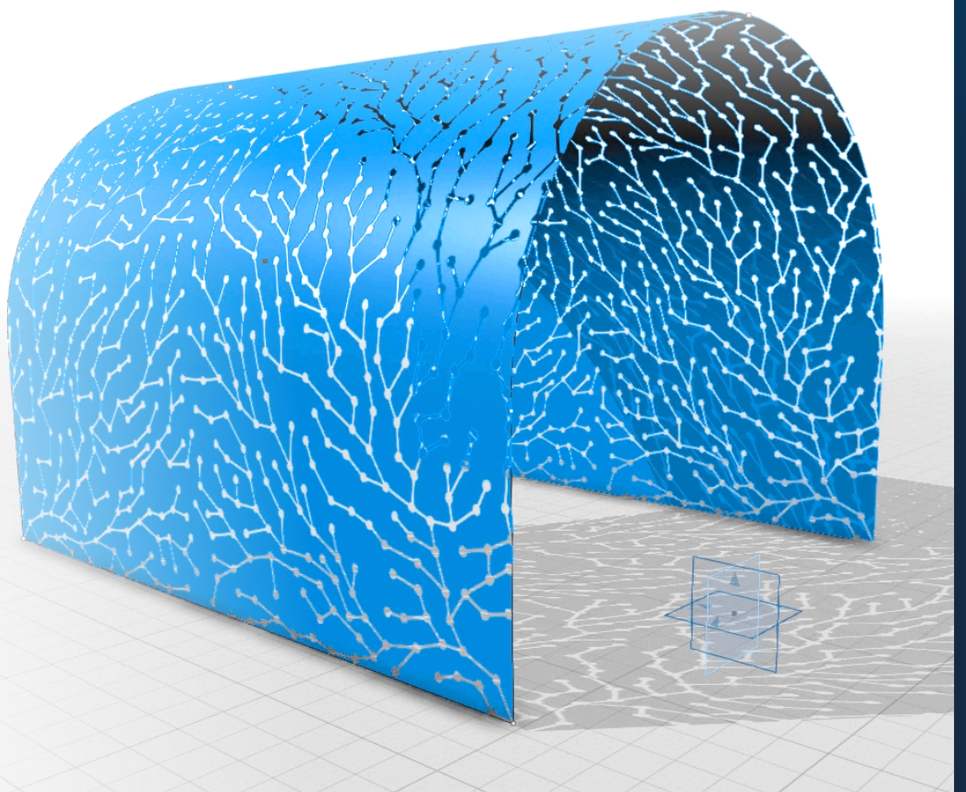
EKL is the programming language for geometry generation developed by Dassault Systemes. It allows you to define custom operators with a text-based scripting feature.

So, in **CATIA xGenerative Design** you can create your own operator in the Graph using this language in the script editor. This allows you to go even further, push the limits and address very specific use cases.

BENEFITS:

- A highly 3D-capable programming language for advanced users.
- Freedom to create highly efficient algorithms to extend the capabilities of the solution.
- Built-in error analysis and information provided in the integrated help browser (available in the script editor panel).





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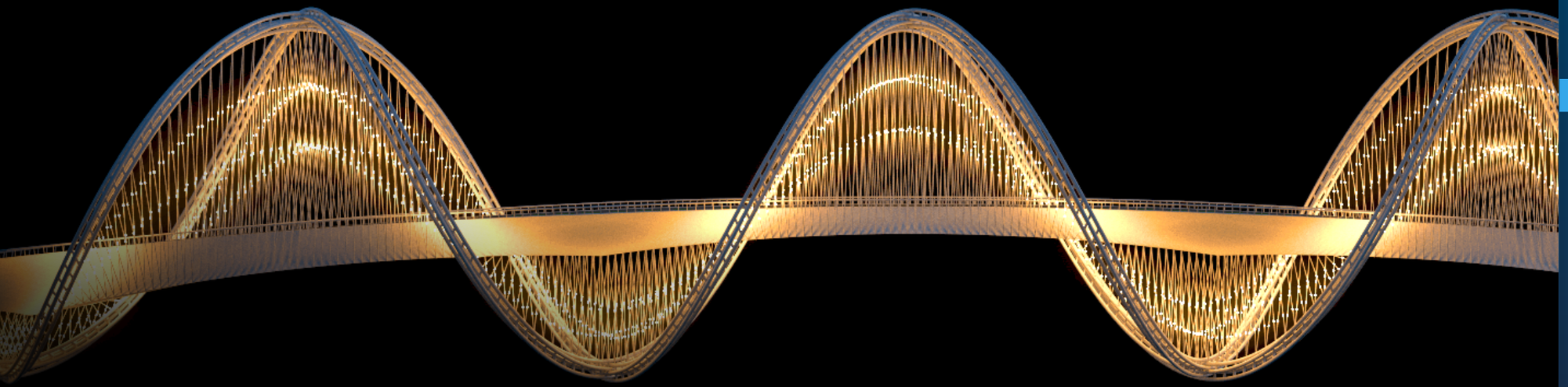

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HIGHLIGHTS:

- A progressive and intuitive user experience for beginners and experts alike.
- An embedded templating mechanism to capture and reuse intellectual property.

BENEFITS:

- Increase creative flexibility and explore more alternatives.
- Make more informed design decisions and shape research.
- Capture and reuse knowledge and design best practices with a template approach.

A great deal of R&D work has been made to offer you an application that is both **easy to use and extremely powerful** to boost designers' productivity and meet their needs.

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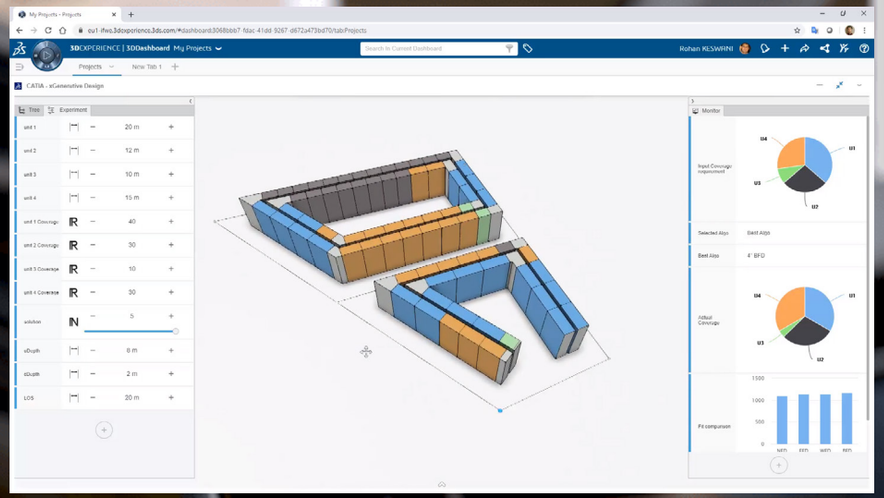

CREATE AND EXPOSE YOUR MAIN PARAMETERS

Create specific parameters, rename them and declare them as “controller”. Once you’ve created your “main” parameters, you can retrieve them to explore your work in more detail, or present it to others.
To do this, you can switch from the design view to a "controller" view for a simplified view, which allows you to display your main parameters only. This allows you to experiment and play with your model (change the size of the value for example, generate new objects and watch different alternatives unfold).

Exposing your main parameters allows you to hide the complexity of model creation and share them with anyone else who would like to experiment with your model.

OPTIMIZED USER EXPERIENCE FOR BEGINNERS AND EXPERTS

EASY TO ACCESS USER INTERFACE

The user interface is seamless and intuitive, and adapts to all levels of design expertise.

As mentioned above, you have access to several views of your design that can be used at the same time: The immersive 3D view with manipulators and direct manipulation, or the graph view with powerful accelerators and additional information. These options give you the possibility to create and design in the best possible conditions, while understanding the complexity of your designs, and the links between your collections of objects.

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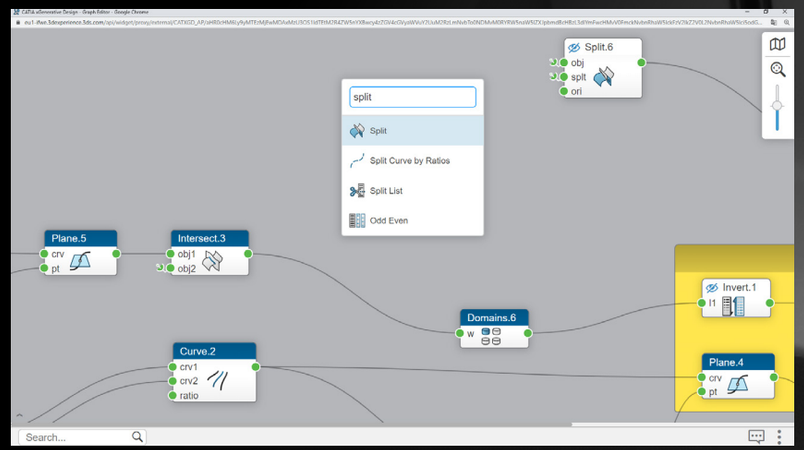
You also have at your disposal a **powerful search engine**. Simply type in keywords and retrieve all the operator related to the topic in the application. If you choose, for example, to add colors to your geometries, search for the operators related to the color and be surprised.

BEGINNERS BECOME EXPERTS THANKS TO THE PROGRESSIVE USER EXPERIENCE

The application contains many enhancements to the user experience, so that everyone can use it seamlessly, and for beginners to become design experts!

CAPTURE AND REUSE KNOWLEDGE AND DESIGN PATTERNS IN YOUR COMPANY

Additional tools are also available to maximize the knowledge sharing with your ecosystem and the reusability of previous design technics and best practices. You can regroup nodes in specific "regions" with color codes, add comments, re-layout your graph automatically and even re-use an existing graph (or just a subset) for a new design project.



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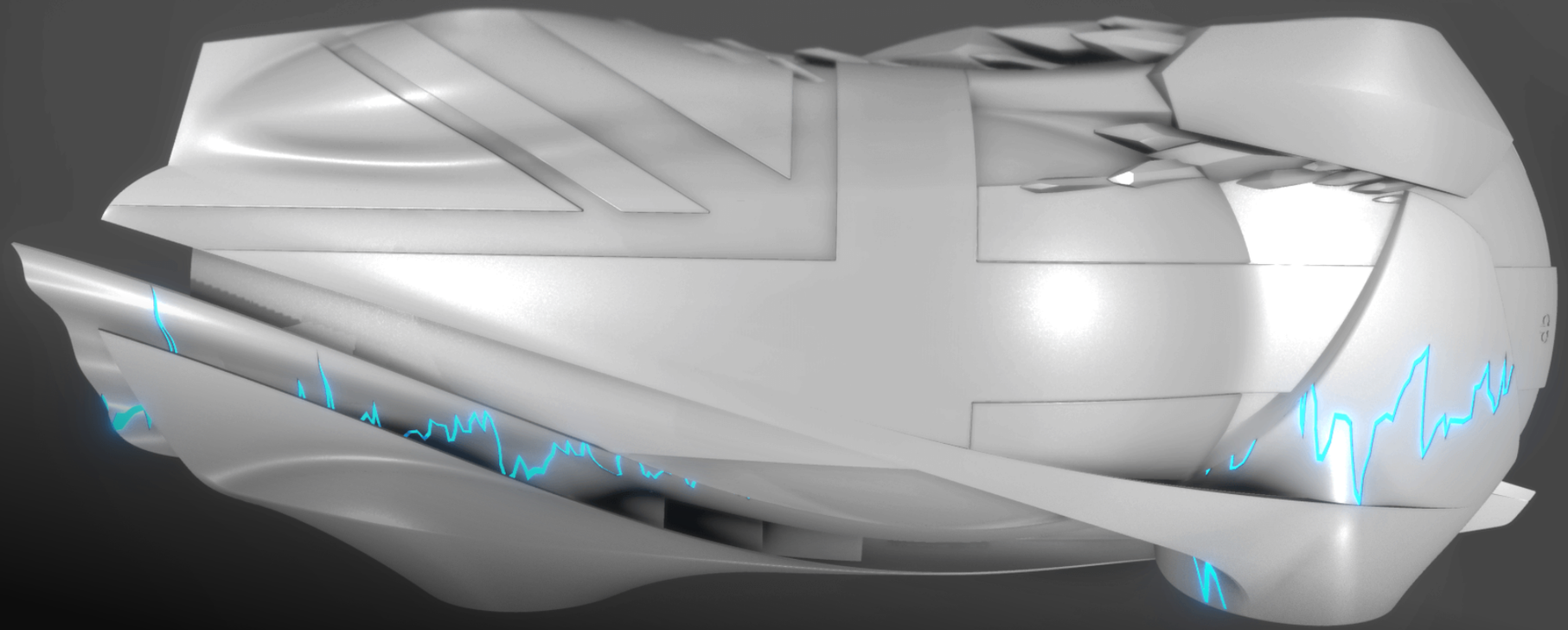

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BENEFITS:

- Ensure digital continuity with all project participants thanks to the **3D**EXPERIENCE platform.
- Web and cloud technologies: no installation for instant deployment, accessible anytime, anywhere and on any device.

DIGITAL CONTINUITY AND COLLABORATION

CATIA xGenerative Design is fully integrated in the **3D**EXPERIENCE platform with an ecosystem of applications and collaboration tools, such as 3DSpace to store and manage 3D data, 3DSwym for collaborative innovation, Collaborative Tasks to organize your work and even a marketplace for engineering, manufacturing and components as a service. With the 3D Space platform, you access apps such as 3D design, Detailing design, marketplace, and project management tools. The app is integrated by default with other Dassault Systèmes technologies, for more efficiency and coordination.

CATIA xGenerative Design is powered by the **3D**EXPERIENCE platform on the cloud: it allows all project stakeholders to work simultaneously on a single data model in a collaborative environment.

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Intellectual property protection is guaranteed by safe and simple access rights management. You manage and customize access rights, deciding who can access which parts of the project, making it very easy to open your project to other collaborators by integrating them onto the platform if you choose to.

With its growing app portfolio and secure cloud technology, the **3D**EXPERIENCE platform enables you to manage all facets of your product development process while reducing infrastructure costs, IT overhead, software maintenance and complexity. All **3D**EXPERIENCE solutions work together seamlessly to make data management and collaboration easy.

ANYTIME, ANYWHERE, ON ANY DEVICE

The web application is accessible anywhere, any time, on any device. There is nothing to install, all you need is a web browser and a connected computer to the internet.

- A web application available inside the **3D**EXPERIENCE platform as a Widget.
- No installation cost, instant deployment through immediate user access.
- Cloud-computing to reduce infrastructure expenses and hardware prerequisites.

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From Mechanical design to architecture, car interiors, furniture, or jewellery, **CATIA xGenerative Design** helps you create and deliver innovative products quickly and easily.

Let's take two examples of what **CATIA xGenerative Design** can do for you.

A COMPLEX MECHANICAL DESIGN: THE ESCALATOR

Escalators may be a common site, in shopping centers and transportation notably, but they are complex structures with hundreds of components. They must adapt to the context where they will be used.

- With **CATIA xGenerative Design**, create customized escalators by setting favorite parameters, editing and changing them with live updates to see the results in real time.
- You may include design checks in your model with color coding, to be visually notified if your escalator is not structurally compliant. For instance, the structure turns red when something is wrong. The tool checks whether your design conforms to current standards or company rules.
- **CATIA xGenerative Design** also makes it much more simple than with CAD applications to introduce formulas and make changes to them seamlessly.

> "You don't just create a visual mockup, but you also capture the intent of your design.
>
> - ROHAN KESWANI
> CATIA Knowledgeware Portfolio Management Specialist
> at Dassault Systèmes

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- The design sequence shows you the links between the elements in the design. It helps you design quickly, and collaboratively. It becomes easy to experiment with different strategies, in real time, with collaborators who can see and edit what is being done.
- Once you are satisfied with your design, it is easy to scale and generate as many adaptive escalators as per requirements: generate as many escalators as required in your model.
- Create outputs: see your results both visually and in terms of numbers and charts for the most important design KPIs.

A CHALLENGING ARCHITECTURAL ELEMENT: THE CANOPY

Designing a building's canopy is highly challenging as every panel tends to be unique, and needs to be manufactured individually.

As there are too many panels to be designed one by one, the process has to be automated: with **CATIA xGenerative Design**, you create your panels easily and they generate automatically.

Experiment live with many possible simulations on weight and balance, sun reflection, shadows, structural resistance, etc. It is a complete workflow from the preliminary surface to the detailed surface. The data created is compatible with other applications within the **3D**EXPERIENCE Platform, providing you with **full digital continuity**.

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The main strengths and benefits to retain from the CATIA xGenerative design application:

HIGHLIGHTS:

- A unique single environment that interactively combines a generative 3D modeling approach and a graph-based visual scripting interface.
- Design and update all types of wireframes and surfaces through logic operations.
- A progressive and intuitive user experience for beginners and experts.
- An embedded templating mechanism to capture and reuse intellectual property.
- All geometry created is directly available for use in detailed design and manufacture.
- Integrated powerful Engineering Knowledge Language.

BENEFITS :

- Quickly generate simple to complex and non-regular shapes and patterns.
- Extend styling capabilities by creating 3D innovative patterns and bio-inspired shapes.
- Increase creative flexibility and explore more alternatives.
- Make more informed design-decisions and shape research.
- Capture and reuse knowledge and design best practices with a template approach.
- Bring automation technology to a wider audience and reduce repetitive activities.
- Guarantee the best geometry quality and accuracy for downstream detailed activities.
- Ensure digital continuity with all project participants thanks to the **3DEXPERIENCE** platform.
- Web and cloud technologies: no installation for instant deployment, accessible anytime, anywhere and on any device.

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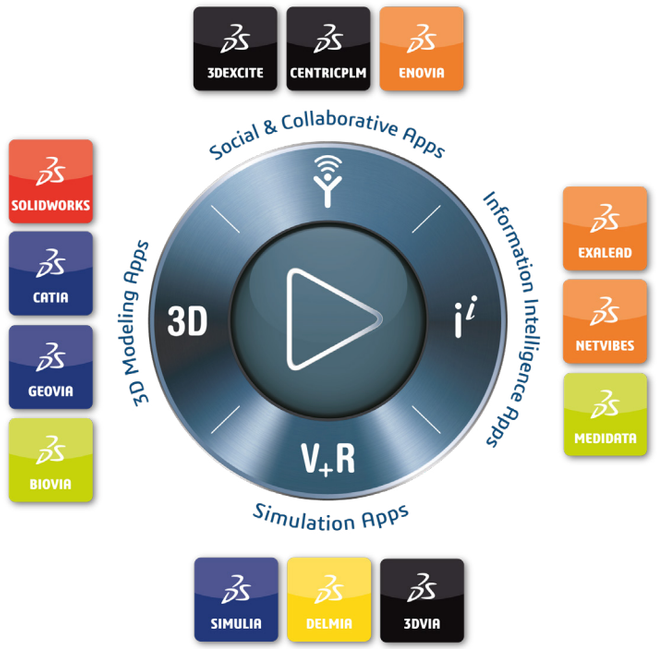
To get more information about CATIA xGenerative Design please visit our website.

Special thanks to our expert **Edouard SUTRE**, Creative Designer and Portfolio Technical Specialist at Dassault Systèmes.

Our **3D**EXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes' collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 250,000 customers of all sizes in all industries in more than 140 countries. For more information, visit **www.3ds.com**.



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