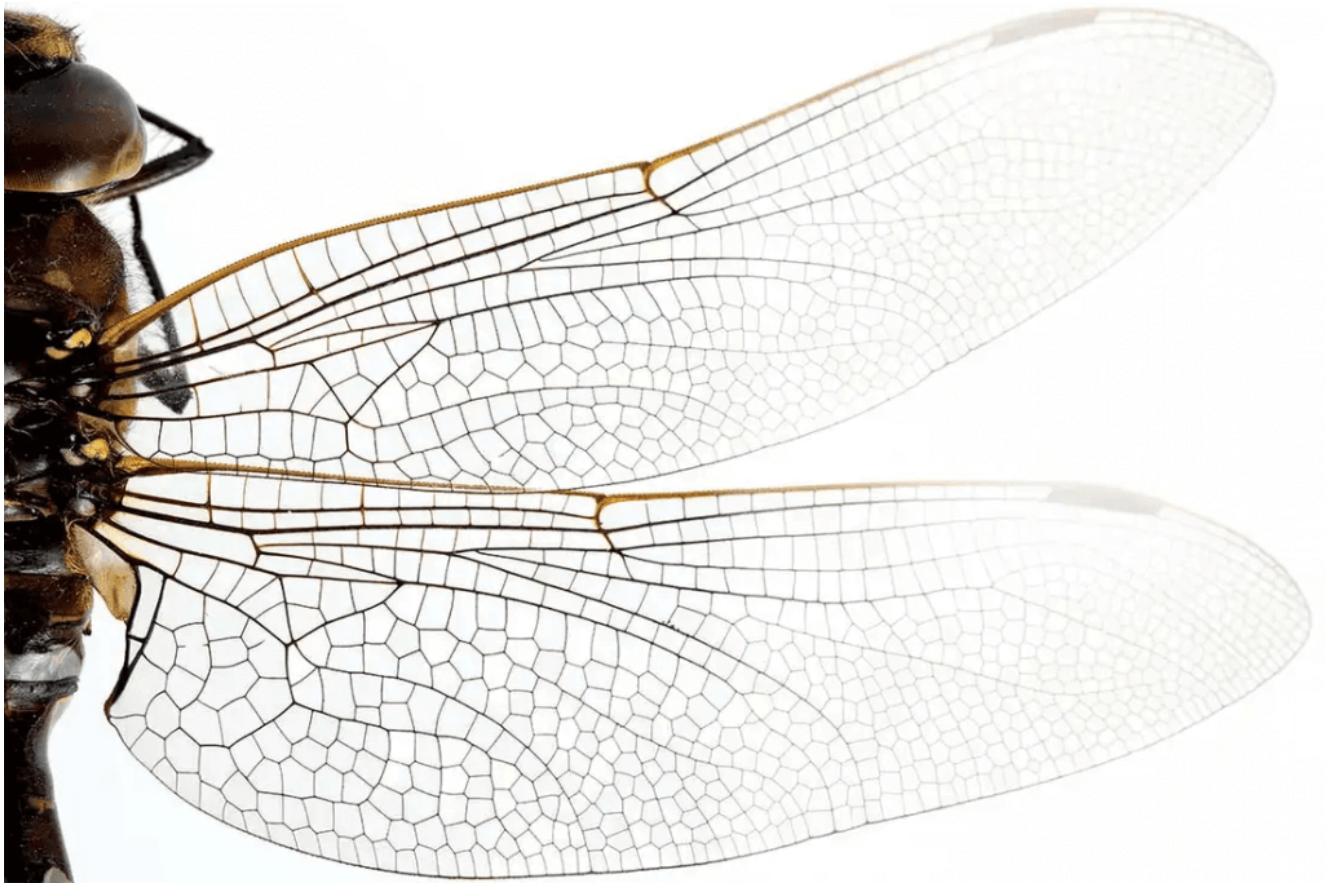


Live LLM Data to SubD Geometry: A Biomimetic Workflow in Rhino 8

The project began as an exploration of [Li: Dynamic Form in Nature](#), a seminal text that defines organic patterns not as static shapes, but as “frozen markers of a flow.” Inspired by this idea, Malvina Stamatiadi set out to translate the high-performance venation logic of a dragonfly wing into a functional designer object.



Source of inspiration, dragonfly wings.

CONCEPT & DESIGN LOGIC

One of the core challenges in biomimetic design is avoiding the stiffness that often results from manual tracing. While traditional modeling can replicate visual patterns, it rarely captures the stochastic distribution and structural intelligence embedded in

biological systems.

To overcome this, Malvina introduced a live generative process into her workflow. Using [Swiftlet](#), a [Grasshopper](#) plugin developed by Sergey Pigach, she established a live REST API connection within the Grasshopper canvas to access the Gemini 2.5 Flash LLM. Instead of manually placing seed points, she prompted the AI to generate a JSON object containing 1,000 unique [x, y] coordinates within a defined 1800 x 2200 unit rectangle, optimized for dragonfly-wing cellular distribution.

In this setup, the LLM functioned as a computational biologist, producing the raw “genetic data” that would seed the form.

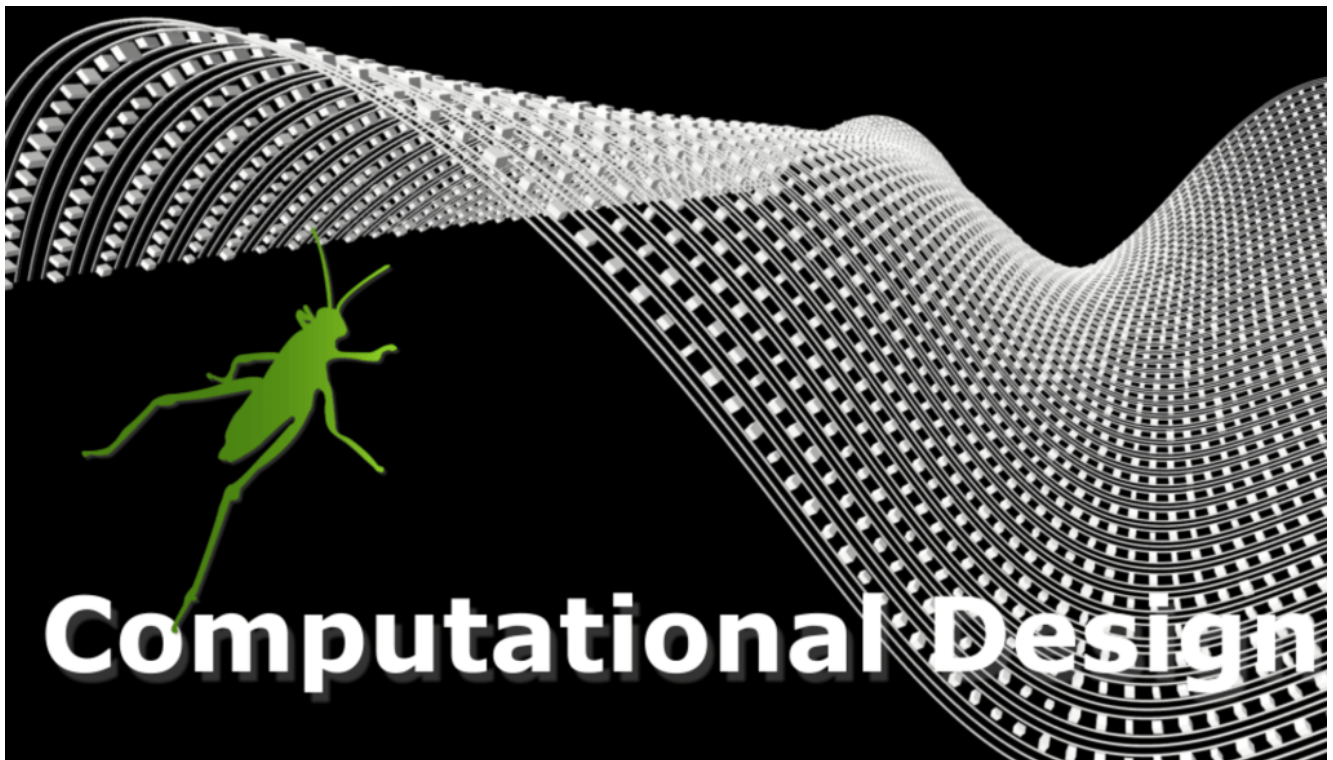


The finished lamp panels in Rhino environment ready for slicing and printing.

COMPUTATIONAL STACK

The workflow demonstrates a clear transition from abstract data retrieval to high-fidelity geometry.

Once parsed in Grasshopper, the JSON coordinates formed the foundation for a planar Voronoi diagram. However, rather than leaving the system at the level of a purely mathematical construct, the geometry evolved into an organic structural lattice using the [MultiPipe](#) (SubD) component in [Rhino 8](#).



[See Also:](#)

[COMPUTATIONAL DESIGN WITH GRASSHOPPER](#)

Instead of applying uniform piping across the network, Malvina developed a radius logic that assigned unique values to each node based on spatial hierarchy. This strategy created a differentiated vein network: robust primary branches connect to the outer frame of the lamp, while secondary and tertiary branches taper into delicate inner cells.

[illegible]

FABRICATION & TECHNICAL CHALLENGES

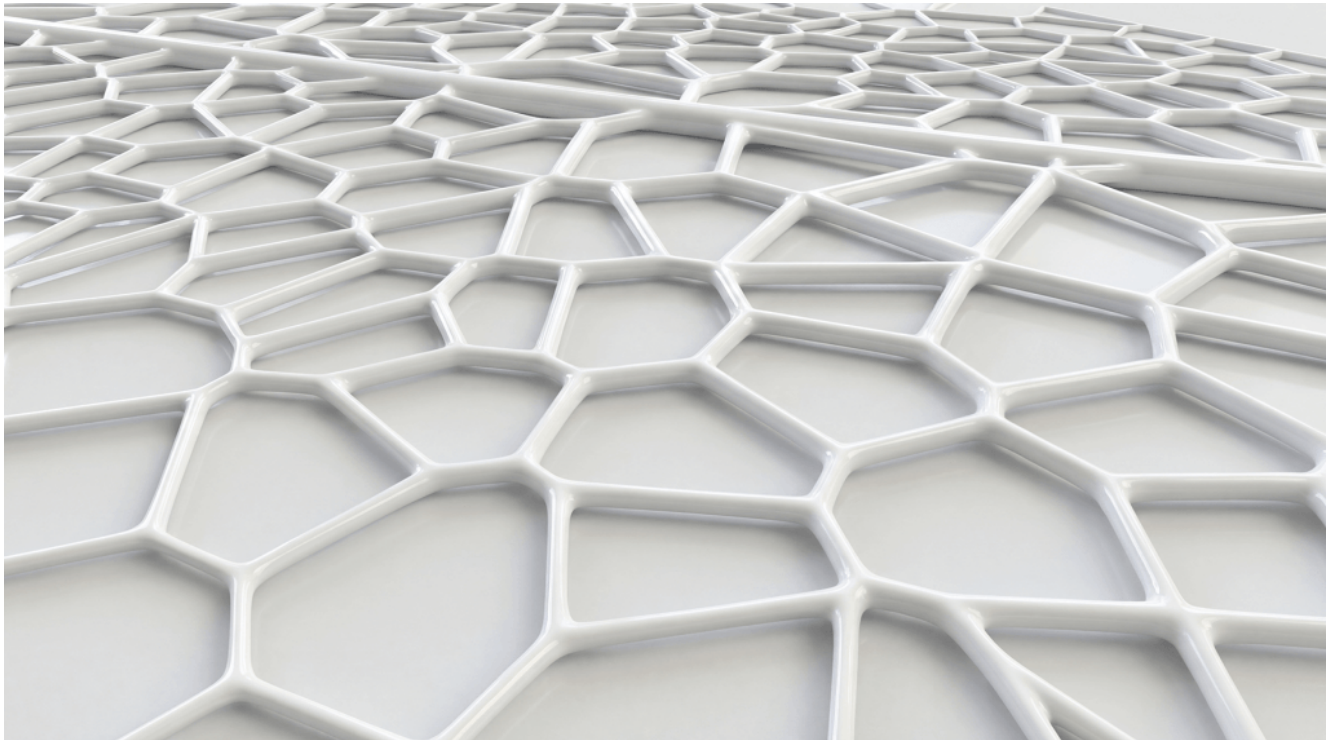
The lamp was fabricated using a [Bambu Lab P1S](#) 3D printer in white Silk PLA, without supports.

Material selection played a crucial role in the final effect. The semi-translucent, high-sheen properties of Silk PLA interact dynamically with the varying thicknesses of the SubD geometry, producing a lithophane-like light diffusion effect. To intensify this

Material selection played a crucial role in the final effect. The semi-translucent, high-sheen properties of Silk PLA interact dynamically with the varying thicknesses of the SubD geometry, producing a lithophane-like light diffusion effect. To intensify this behavior, the printing temperature was increased to 220°C, intentionally encouraging a subtle stringing effect reminiscent of spider web filaments.

A significant technical challenge involved maintaining a clean 1,000-point data stream from the LLM so that it could be processed reliably by the Voronoi solver without manual correction. To address this, Graph Mappers were implemented to remap node sizes and smooth transitions. This ensured that even highly complex branching junctions remained manifold and suitable for FDM printing.

while meeting the practical constraints of digital fabrication.



A close-up of the branching SubD network generated through a Voronoi-to-MultiPipe pipeline. Each node radius is individually parameterized based on stochastic coordinates.

IMPACT & BROADER IMPLICATIONS

This dragonfly lamp marks the first object in a broader AI-Biomimetic series. More importantly, it signals a shift in authorship within computational design.

Rather than manually constructing every geometric decision, the designer becomes an editor of algorithmic DNA. The LLM does not replace design intent; instead, it generates structured data that can be evaluated, refined, and translated into spatial logic.

For the computational design community, this project demonstrates that LLMs can extend beyond text generation. They can act as data engines for site-specific, pattern-based systems that would otherwise be too labor-intensive to produce manually. By merging live API-driven data with Rhino and Grasshopper workflows, the project bridges artificial intelligence and physical craft in a tangible, fabricated outcome.



A picture of the printed physical model and the shadows it drops on the wall.

CREDITS

Design and computational workflow: Malvina Stamatiadi

Swiftlet plugin: Sergey Pigach

Technical inspiration and workflow insights: Marijn Luijmes

3D Printing: Bambu Lab P1S

Photography: Melina Capocci