



GERARDO IOVANE, EMANUELE VISCUSO

FROM THE GEOMETRY OF SCULPTURE TO ARTIFICIAL INTELLIGENCE

**GRAMMARS OF FORM AND ALGORITHMS
FOR UNDERSTANDING LATENT CONTENT
BEYOND APPEARANCE THROUGH
THE SCULPTURES OF EMANUELE VISCUSO**





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Preface

To exist at the crossroads between living matter, the rigor of equations, and the vertigo of computational calculus is to inhabit one of the most fertile and mysterious realms of contemporary thought. When a work of art does not merely reflect the visible but interrogates the invisible architecture of the cosmos, it ceases to be a mere aesthetic object and becomes episteme, ontological anticipation, and the pure form of becoming. This is precisely the dimension in which the intellectual and creative encounter between sculptor Emanuele Viscuso and scientist Gerardo Iovane takes place: an intense and illuminating dialogue that this volume presents to the scientific and humanistic communities with the force of a theoretical and methodological manifesto.

The International Committee of Experts — comprising members of the Archè Editorial Board, physicists, mathematicians, and information scientists — which reviewed and oversaw the preparation of this work unanimously agrees that the path outlined here is not an exercise in aesthetic analogy or a spur-of-the-moment suggestion, but rather a rigorous structural convergence. On the one hand, there are the sculptures of Emanuele Viscuso: works in which organic matter par excellence — endowed with its own biological memory, taut fibers, and intrinsic resistances — is guided toward configurations of stunning harmonic geometry. On the other hand, there is the perspective of Gerardo Iovane, whose research in the field of artificial intelligence architectures and complex dynamic systems — think of the theoretical scope of conceptual frameworks such as Sophimatics and the exploration of nonlinear dynamics extended to complex temporal domains — recognize in those wooden forms a geometric and morphological foreshadowing of modern latent generative spaces.

For the scientist, the surface sculpted by Viscuso is never a static entity, but the visible trace of a force field. In the calculated twists, the continuous transitions, and the distribution of volumes, one senses the very same tension that governs fluids, gravitational fields, or the evolutionary trajectories of complex systems. Wood, manipulated by the artist, ceases to be a passive medium and becomes a non-Euclidean space ahead of its time, in which curvature and metrics are not imposed from above with the cold precision of CAD, but spring from a sensitive intuition that

captures the profound symmetries of nature. In this sense, the book's central thesis — namely, that Viscuso's sculpture anticipated the morphological, generative, and logics of artificial intelligence — proves to be anything but a metaphorical quip. It rests on an impeccable epistemological foundation: when the human mind explores the harmonic laws of form through artistic craftsmanship, it performs a compression of information and a topological synthesis that anticipate what artificial algorithms accomplish today in the high-dimensional vector space of neural networks.

From the perspective of art history and aesthetics, Viscuso's work fits into that noble lineage in which artistic creation coincides with an act of geometric knowledge, recalling the legacy of the great Renaissance masters while pushing it toward a contemporary sensibility that engages with cybernetics and information theory. His sculptures embody what we might call a morphological intentionality: a striving toward equilibrium that is never mere symmetry, but rather a dynamic resolution of opposing forces. This mutual reflection between the sculptural gesture and computational calculation finds a formidable interpretive key in Iovane's analysis. The scientist recognizes in wooden forms the same logic of self-organization and structural emergence that artificial intelligent systems seek to replicate through machine learning and probabilistic generation.

The book the reader is about to explore accomplishes a rare and valuable feat: it breaks down disciplinary barriers without succumbing to superficial syncretism. Each chapter unfolds along an axis of rigorous theoretical tension, where the formal rigor of mathematics meets the phenomenological density of sculpted matter. It is not a matter of applying a numerical grid to a work of art to "explain" it, nor of using sculpture to illustrate algorithmic concepts. The method adopted is one of conceptual co-evolution, where art and science engage in a mutual dialogue on the meaning of form, the nature of time, the genesis of complexity, and the role of human intentionality in an era dominated by the digital transition and artificial intelligence.

As a committee, we believe this volume represents an indispensable contribution to understanding the direction in which the international cultural debate is evolving. At a time when technology risks being reduced to mere functional automation and art to ephemeral consumption, the dialogue between a great sculptor and a scientist of profound theoretical vision restores to us the centrality of a new scientific and plastic humanism. Viscuso's harmonious geometries and Iovane's computational

models remind us that calculation and beauty are but two sides of the same coin: humanity's eternal endeavor to bring order to chaos, to decipher the secret code of reality, and to anticipate — through form and thought — the coordinates of the future.

We hope this book will gain the international reach and critical attention it deserves, confident that it will inspire not only mathematicians, artists, computer scientists, and physicists, but anyone who believes that knowledge is a unified, indivisible, and deeply poetic journey.

Introduction

Every great epochal shift brings with it the urgency to redefine the boundaries of the languages through which human beings interrogate reality. We live in an age in which artificial intelligence and advanced computing are no longer merely tools for calculation or automation, but true ontological spaces within which creativity, form, and thought are redefined. Within this landscape of accelerated transition, this volume arises from a radical and fruitful question: how can sculptural intuition, wood sculpture, and harmonic geometry not only engage in dialogue with algorithms but may even have anticipated their generative structures?

Answering this question required an investigation that rejects facile metaphorical suggestions in favor of the rigor of a transdisciplinary analysis. The convergence between Emanuele Viscuso's artistic practice and Gerardo Iovane's scientific and computational research charts an unexpected and rigorous course, in which matter and code mirror one another. Viscuso's wooden sculptures — objects in which the living fiber of the material is guided toward configurations of extraordinary topological purity — are not merely the products of an isolated aesthetic sensibility; they embody a principle of self-organization and a morphological tension that foreshadow, with astonishing precision, the geometric logics underlying the latent spaces of neural networks and contemporary generative models.

For its part, the theoretical and mathematical framework offered by Iovane — rooted in the exploration of complex dynamic systems, Sophimatics architectures, and complex-time geometries — provides the epistemological keystone for decoding this anticipation. Wood does not act as a passive medium, but rather as a non-Euclidean force field in which form is already latent, governed by harmonic laws that the human mind intercepts before the machine formalizes them computationally. In this book, art and science merge into a single act of cognition, demonstrating how the sculptor's gesture and the mathematician's equation share the same profound urgency: to give form to chaos, decipher nature's hidden symmetries, and anticipate the coordinates of a new computational aesthetic.

The journey the reader is about to undertake through these pages is structured as a rigorous and well-articulated itinerary. From the genesis of form at the intersection of matter and algorithms to the morphological analysis of Viscuso's

sculptures, through a direct comparison with the topologies of artificial intelligent systems, and on to the prospects for a new Humanism of form, this volume aims to offer not only an innovative critical reading but a true manifesto for the future of contemporary culture. An invitation to rediscover, beyond all disciplinary boundaries, the profound unity that links the beauty of sculpted matter to the vertigo of intelligent computation.

Chapter 1 - The Genesis of Form Between Matter and Algorithm

1.1 The Field of Inquiry: Matter, Form, Computation

A block of wood resting on the workbench of an artist's studio already possesses, even before a tool touches it, a set of properties that define what it may become. The grain runs in a specific direction, which causes the wood's resistance to vary depending on the axis along which force is applied. Density varies between the inner heartwood and the outer sapwood. Knots mark the points where a branch once attached, introducing discontinuities that alter the cut. Residual moisture governs future shrinkage — and thus the deformations the piece will undergo over the years. None of these properties was chosen by the sculptor. Together, they establish the boundaries within which the sculptor's decisions can be exercised.

A formally analogous situation arises at the other end of our field of inquiry. Before producing anything, a generative model possesses an architecture that determines which configurations can be represented. The size of the representation space establishes how many independent degrees of freedom the system can control. The structure of the function that transforms those coordinates into an object determines which transitions are continuous. The distribution of the data on which the system was trained defines the densely populated regions and those where generation becomes erratic. Again, none of this was decided at the moment of generation. Everything contributes to establishing the scope within which the choice can be exercised.

The juxtaposition of art and artificial intelligence might seem like a rhetorical device. It is not, for a reason that should be stated right away, since it underpins the entire volume. In both cases, the form produced is not the result of a will exerted upon an indifferent material, but rather the point of equilibrium between an intention and a system of constraints that precede the intention itself. It is this shared structure — not a superficial resemblance between sculpted objects and generated images — that justifies treating sculpture and computation together. From this perspective, form belongs neither to the material nor to the design, but is precisely what emerges from their interaction.

The tradition of art studies has articulated this condition with a certain precision. When Henri Focillon writes that form does not exist until it exists in matter and observes that art is not merely a fantastical geometry but is linked to weight, density, light, and color, he is asserting something stronger than a mere praise of concreteness [1]. He is arguing that the conceived form and the realized form are not the same thing in two different states, but rather two distinct entities, since the passage through matter introduces determinations that thought did not contain. A design drawn on paper theoretically admits of infinite realizations; the successful realization, however, will be only one: the one chosen from among all others in an irreversible manner. It is this choice that constitutes the work.

On the technical front, a similar shift has taken place in the philosophy of the technical object. Gilbert Simondon argued that the technical object is defined not only by the use we make of it, but by the way it functions and by the process through which it came into existence. For this reason, he recognized a distinct status for it, alongside that of the aesthetic object, inviting us to understand it starting from its genesis [2]. This idea is directly relevant to us. If a technical object must be understood through the process that generated it — and not merely through its use — then a generative system, too, must be judged by the way it produces forms, and not merely by the images it produces. Similarly, a sculpture must be understood through the process that generated it, not through its silhouette. In both cases, the pertinent question concerns the process; therefore, the two objects are comparable in this respect.

This leaves the third term: computation. We must clarify from the outset in what sense we are using it, since the word encompasses very different meanings. We do not mean computation as the execution of arithmetic operations — a sense that would add nothing to our discussion. We understand calculation as the regulated manipulation of structures — that is, as a procedure that, given a set of elements and a set of transformation rules, produces new configurations without each one having to be specified individually. In this sense, a sculptor who arranges modules according to a rule of increment is calculating, even though he does not use numbers. The distinction between those who work with symbols and those who work with matter concerns the medium, not the nature of the operation.

This conception has a well-defined philosophical tradition. Contemporary reflection on information has shown that informational concepts do not merely describe the devices that implement them, but constitute an analytical tool applicable to much broader domains, from biology to epistemology [3]. We adopt this approach with a strict limitation: we will use it only where it yields verifiable statements about the subject under examination, never as a general framework within which to place just anything. The risk of such a broad notion is precisely that of explaining everything, and thus explaining nothing.

The field of inquiry can thus be delineated with some precision. We are not studying digital art — that is, art produced with computer tools — which constitutes a distinct and widely explored field. Nor are we studying the computerized representation of existing works, which is a matter of documentation. We are not studying the aesthetics of generated images, a matter that would require tools of visual criticism that we do not employ here. We are studying something more narrowly defined: the way in which a generative rule produces a family of forms, by comparing two independent realizations of this same scheme — one in solid material created by an artist, the other in computational structures generated by a trained system.

This restriction comes at a cost, which we acknowledge. By excluding the aesthetics of the generated images, we forgo taking a stance on the question the public considers most urgent: whether machines make art. We believe that question, posed in those terms, is poorly formulated. The concluding chapter of this volume will explain why. In the meantime, we prefer to work on a smaller problem, with the ambition of solving it rather than merely touching on a larger one.

Wood, which opens this section, will recur frequently in the following pages alongside copper, aluminum, Plexiglas, polymers, and paper. The variety of materials featured in Emanuele Viscuso's work is not a biographical detail, as it constitutes experimental proof of the thesis we are about to present: if the same generative principle produces recognizable results in materials that behave so differently, then that principle does not depend on the material and therefore possesses an autonomous formal status. It is this autonomy that makes it possible to compare it with a system that has nothing material about it.

1.2 Origami-City, 1985: The Fold as a Foundational Act

The first work in Emanuele Viscuso's catalog is a paper construction from 1985, titled Origami-City, held in the artist's collection. The material is the simplest among those he would use; the scale is modest; and the technique requires no special equipment. Precisely for this reason, the work is instructive: it reveals the formal vocabulary in its nascent state, before the challenges of the material introduce compromises in execution.

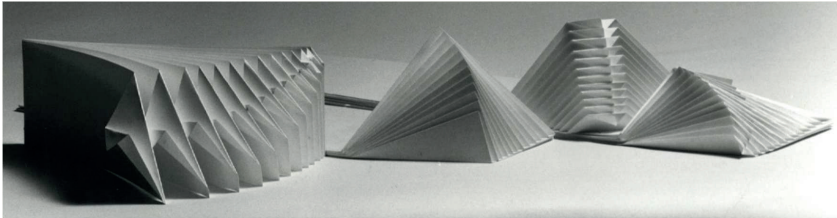


Figure 1.1 — Origami-City, 1985, paper, the artist's private collection. Image from the artist's archive; credit to be provided. Sheet folded along parallel lines in an alternating accordion pattern. The height of the folds increases in regular increments along the direction of development, so that the side profile evokes an urban skyline. No cuts, gluing, or internal supports; viscuso.com/sculptures_photos/various_materials/index.html.

Let us describe what we see. A sheet of paper is folded along a set of straight lines in an alternating pattern, so that the folds follow one another in opposite directions, like the bellows of an accordion. The height of the folds varies along the direction of development, increasing in regular increments. The result is a jagged profile that, when viewed from the side, evokes an urban skyline — hence the title. The structure has no internal support: its rigidity derives entirely from its geometry, since a flat sheet yields under its own weight while the same folded sheet supports it. There is no cutting, no gluing, and no addition of material. The only operation is folding.

This description — which any attentive observer could verify by standing in front of the piece — already contains the three elements on which the volume will focus. The first is the repetition of an elementary operation. The second is the regular variation of a parameter throughout the repetition — in this case, the height of the fold. The third is the emergence of a recognizable figure — the city — which no single

fold contains and which the artist did not arrive at through imitation, but as an effect of the rule.

It is now worth asking what geometry has to say about this configuration, since it has something specific to say. A surface obtained by folding a sheet of paper without stretching it preserves all the lengths measured on the sheet: two points that were one centimeter apart when traversing the unfolded paper remain one centimeter apart when traversing the folded paper. Transformations of this type are called isometries. The classical theory of surfaces associates two principal curvatures with each point — that is, the extreme values of the curvature of the normal sections — whose product $K = \kappa_1 \kappa_2$ defines the Gaussian curvature [4]. For a surface obtained by folding a plane, we have $K \equiv 0$ at every point: along the fold's generatrix, one principal curvature is zero, so the product vanishes, regardless of how pronounced the fold itself is.

This statement has a consequence worth highlighting, as it is counterintuitive. From the perspective of intrinsic geometry — that is, the geometry that a hypothetical two-dimensional inhabitant of the surface could measure without leaving it — Origami-City is indistinguishable from a flat sheet of paper. All the volumetric richness of the work — the shadows, the reliefs, the urban skyline — belongs to the extrinsic geometry, that is, to the way in which the surface is embedded in space. The artist has produced a spectacular transformation without altering the internal structure of the material in any way.

This circumstance clarifies a methodological point. One might think that geometric formalism serves to measure the work by quantifying some of its properties. This is not the case, at least not primarily. It serves to distinguish: it provides criteria for determining what, in a configuration, is a property of the material and what is a property of the arrangement. Without the distinction between intrinsic and extrinsic curvature, it would remain unclear why folding allows us to obtain volumes from a plane but does not allow us to obtain a spherical shell. The reason is that a sphere possesses positive Gaussian curvature; therefore, no isometry can map a plane onto it: this is why maps are distorted, and this is why a tailor must cut and sew to fit a shoulder.

Viscuso's vocabulary arises within this constraint, not in opposition to it. Works constructed from sheets, plates, or juxtaposed flat elements respect the limits of folding; those featuring double curvature require other processes — cutting from solid material, molding, or casting. Tracking throughout the volume which families of works belong to one or the other regime allows us to reconstruct the logic of his production using an objective criterion, rather than stylistic impressions.

Then there is the question of the fold as an act. Focillon observes that form in matter involves a relationship with weight, density, and light [1]. The fold is exemplary in this sense, since it is simultaneously a geometric operation and a physical event. Geometrically, it is a straight line along which the surface changes orientation; physically, it is a plastic deformation that exceeds the material's elastic limit and is therefore irreversible. Folded paper retains the memory of the fold even when unfolded: a trace remains — a local weakness, a tendency to close again along the line. The form has entered the material; the material has recorded the event.

This dual nature has an instructive counterpart in the realm of calculus. A transformation applied to a digital representation is normally reversible, since the previous state can be preserved or recalculated. In a system of this type, there is no equivalent of the irreversible fold, unless it is deliberately introduced. This is one of the fundamental differences between the two domains. The book will return to this in the chapter dedicated to temporality. Pointing it out here serves to show that the comparison we are establishing does not reduce one term to the other: it works precisely to the extent that it recognizes where the two diverge.

One final observation concerns the variation in the height of the folds. If all the folds were the same height, the work would be a regular accordion — a technical object devoid of tension. The progressive increase introduces a direction: the eye travels across the piece from bottom to top, since the succession of increments indicates a direction of reading. With a minimal intervention, the artist has transformed a periodic motif into a narrative. Chapter Three will show that this transition from identical repetition to progressive repetition constitutes the core of Viscus's entire grammar. It is precisely the point at which it intersects with the functioning of generative systems.