Computational Simulation as a Principle, a Tool and a Method for a Future-proof Design Strategy

Interview with Cosimo Accoto

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Abstract
The interview with Cosimo Accoto starts with a question: how can design move into "critical uncertainties"? Through an overview of Accoto's fields of investigation and a focus on the latest ongoing research, he presents the concept of "simulation", as a new design horizon and a new ontogenetic vector in the imagination and production of our future.

Keywords
Computation
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In their paper "Design Principles for Virtual Worlds" Chaturvedi, Dolk and Drnevich (2011) try to extend the design science paradigm by developing a set of design principles applicable to the context of virtual environments, particularly those that use agent-based simulation. Following Wand and Weber's (1994) framework of information structure, they segment design principles in two main categories: the first affecting the "deep structure" (DS), related to the dimension of modelling and simulation, and the second affecting the "emergent structure", referring to the emergent knowledge process dimension. Focusing on design principles for the DS, the authors first underline the role of PaaM – Platform as a Methodology - for "citizen programmers" to contribute content in the form of data, models, scenarios, and intervention policies and enable simulation at a larger scale. The field of "simulation", indeed, has become crucial for designing and building the "metaverse", the definition of which is not univocal even if it consists mainly of the convergence of virtually enhanced physical reality and physically persistent virtual space, being a fusion of both, while allowing users to experience it as either. Moreover, to be consistent with the consideration of time as a critical design factor, an interesting framework called *The Metaverse Roadmap* (Smart et al., 2007) considers two time horizons to explore how the metaverse can be unfolded: the "near-term" anticipation horizon of ten years and a "longer-term" speculation horizon of twenty years to discover early indicators of significant developments ahead, well aware that even the best long-range technology forecasts typically have only a 50% success rate (Schnaars, 1989). To build the two above-mentioned scenarios, the *Metaverse Roadmap* refers to a framework in which two "key continua" exist and influence the development of the metaverse. The first is related to the spectrum of technologies and applications, ranging from "augmentation" (technologies that add new capabilities to existing real systems) to "simulation" (technologies that model reality, or parallel realities, offering wholly new environments); the second is the spectrum ranging from "intimate" (identity-focused) to "external" (world-focused technologies). According to Smart et al. (2007), even trying to look beyond the specific field of metaverse and its yet-to-be-tackled challenges and opportunities, these continua are "critical uncertainties: critical because they are fundamental aspects of the coming Metaverse, and uncertainties because how they will emerge, their relative and absolute development in various contexts, is yet to be seen".

How can design move into these "critical uncertainties" and use simulation for a future-proof strategy?

Cosimo Accoto is a tech philosopher, culture innovation advisor, and MIT research affiliate. His techno-cultural research now assembles a sort of trilogy of "digital acculturation": after analysing software code and "computation" as a new experience of knowledge, design and world-building, followed by a reflection on how and to what extent neo "automation" (or algomation) becomes an inescapable and pervasive terrestrial techno-ecology for designing new experiences and experiments, his field of research is now focusing on if and why synthetic "simulation" constitutes the ultimate horizon and ontogenetic vector of our present reality, and above all, of design for the future.

VDM The goal of your latest ongoing investigation is primarily to highlight and plumb the multiple senses and modes of a world that becomes computationally simulable and synthesizable. Can you tell us more about your current research exploration and the role of design in "living by simulation"?

CA My techno-cultural programme currently assembles a sort of trilogy on "digital acculturation", an exploration on how digital technologies are terraforming Earth by designing and creating new conditions for its habitability. After having philosophically analysed, in the first volume, software code (and "computation") which is and becomes a new engine of knowledge, design and world-building, after having investigated, in the second book, how and to what extent neo "automation" (or algomation) evokes a pervasive terrestrial techno-ecology for designing new expectations and experiences, in the third essay I will document if and why "simulation" constitutes a new design horizon and a new ontogenetic vector in the imagination and production of our future. From bio-design and bioengineering (Dade-Robertson, 2021) to the revolution of new materials and their material intelligence (Tibbits, 2021), from quantum computing and quantum internet (Rohde, 2021) to emerging high-dimensional metaverses, from geo-engineering operations on Earth (Buck, 2019) to astronomical missions and landings, the operational impact of "computational simulation" is planetarily and cosmo-technically scaling. Thus, we do not live "in" a simulation - as some suspect - but we will certainly live "by" a simulation. Or better, we will live thanks to multiple and continuous engineered simulations and syntheses. How much of the design process today is the result of computational simulation? How many of the objects, products, services, environments, buildings could we trace back to the specific socio-machinal assembly that designed them in simulation first? As James Bridle (2012) wrote: "Because a line has been crossed, technology/software/code is in and of the world and there's no getting out of it. Some architects can look at a building and tell you which version of Autodesk was used to create it". But also, how many artificial and synthetic creatures have and will come into existence through the inflactive process of a computational simulation? How much of the construction of the real is generated today in a simulative form? A simulation that is and becomes crucial not only in the design process (benefiting from cost reduction, higher quality product, time to market, explorative innovation, rapid competition), but increasingly during the entire life cycle of products, processes and productions. This is already happening in the digital twin approach, for example, when design and operation are increasingly driven by the simulation of the world at its best "twinning rate". Best-in class companies are deploying a simulation-driven philosophy early in the design phase, as well as in testing and operations.

VDM Assuming we are now in the "age of simulation" what role can designers play in it and what are the main signals/areas they should prioritise?

CA To me, signals heralding this new "age of simulation" are clear and continuous. The perimeter of this advent is already very wide. Today the list includes artificial faces and cultivated meats, digital twins and virtual currencies, biosynthetic creatures and saturative metaverses, quantum machines and neuroprosthetic implants. What is significant, however, is not only the extent of the simulational design paradigm in various products, industries and markets, but also the innovation in the design of knowledge that is generated: from the memorable success of AlphaFold artificial intelligence in predictive simulations of three-dimensional structures of proteins to the exceptional first-simulated image of a black hole obtained by Event Horizon, a network of coordinated and planetarily distributed telescopes. The first feat was recognised by scientist Eric Topol in a recent tweet as the equivalent for protein knowledge of the creation of the Google search engine. The 3D structure of proteins had been an unsolved problem in biology for more than fifty years and now it is opening a promising and oxymoronic future for "proteinic design". Indeed, in common sense, designing "natural" sounds like an oxymoron. For the second event, philosopher Benjamin Bratton (2019) recalled the comparison with the iconic photo of the Earth taken by the Apollo crew. In 1972, for the first time, humanity was awed to see our planet light up like a multi-coloured blue "marble"' (Blue Marble is the name of this iconic image). And in another first in 2019, humanity was confronted with the dark abyss of a black hole, an image-simulation of an astronomic object. Paradoxically we don't have a unified definition of black hole, but we now have a shared visual simulation. Simulation instantiates a new catalogue of the real and a new form of knowledge. Computational simulations actually give life to a planet designed, recreated and populated by entities, experiences and ecologies generated, in diverse modes, through (increasingly) computational simulations. A sudden design and production (no longer mere prediction) of the future that leaves many in awe, and deserves to be investigated. The latest news of DeepMind's acquisition of the MuJoCo "physics simulator" for robotics, and its decision to make it available to all in an open and free form will further expand the pervasiveness of machinal simulation techniques in economy, society and design. Lastly, the future (market) design of metaverse. Beyond Meta's current metaverse hype, I think it's fascinating to explore the new volumetric (no longer merely reticular) internet made of digital identities (avatars and more), markets, communities and services using cryptographic consensus (in/fungible tokens) and more-than-human transactional techno-ecologies (from direct-to-avatar ecommerce to robotics meta-mobility design).

VDM You say simulation is fundamentally a multiscale phenomenon where designers need to become familiarised with scale theory and scale thinking to best deal with uncertainty and complexity beyond the human-scale Anthropocene. What difficulties of investigation does simulation pose for designers?

CA As Zachary Horton (2021) wrote about the ontogenetic power of scale, we are in the same condition as Alice in Wonderland. "Curious Alice falls down a hole. Hurled into a radically unfamiliar world, she must quickly adapt to its alien logic. Ingesting certain substances, she discovers, causes her to change size. This revelation provides both a challenge and an opportunity. Each shift of scale alters her perspective on and relationship to Wonderland, complicating her quest to map its terrain and logics. Yet these very shifts in perspective expand her possibilities for apprehending and interacting with the environment's strange features". So, in my view scale is one of the key dimensions in exploring and exploiting simulation. From the design of subatomic scales of nanotech and biotech objects to the terrestrial and cosmological scales of geoengineering and space design, simulation is called upon to address ontological and ontogenetic issues in the construction and design of the "artificial" at multiple and different scales. At the same time, it precisely questions, evokes and revokes the historical distinctions we are familiar with between natural and artificial within increasingly more-than-human, diasporic and algomated ecologies. New design paradigms such as technology-beyond-human and ecology-beyond-nature are emerging. The simulative computational method, theoretical and practical, is a "style of reasoning" borrowed from mathematical modelling - philosophers say - that privileges, in particular, two cognitive-operational dimensions: iteration and exploration. It is, therefore, an epistemic practice that addresses the complexity of the world (planetary) with new instruments and methods. Thus, it forces us to expand the idea of intelligibility and buildability. As the science philosopher Johannes Lenhard explains in his *Calculated Surprises* (2019), to put it flatly, the general characteristic of the "simulational method" is the ability to shorten the distance between model and world (with an epistemic positive gap with respect to experimenting and the "experimental method"). In fact, while traditional mathematical modelling has marked this distance with idealisation, simplicity and transparency - says Lenhard - computational simulation instead collapses this distance by privileging plasticity, iterativity and explorativeness with an autarchical vocation. In a sense, it is a surprising inflactive and saturative design technique.

VDM World, model, simulation: what relationships are given, and what are the main challenges for designers to simulate the world?

CA Simulations are "experiments" that take place in the machine rather than in the world. This perspective is extremely compelling for designers as it further stretches the capacity of computation not only to "simulate" intelligence, but to "simulate" the world. Mainly through volumetric instantiations. It is a path that we could date as well as connect to the origins of modern computer graphics. In fact, by the early 1950s, there were already computerised representations of objects such as, for instance, signals identified by radar and displayed in a point-like way on a screen. But those representations were limited to two-dimensional objects of a referential and "symbolic" kind: these new simulative creations of the world, on the other hand, had a figurative and "mimetic" character, as Jacob Gaboury (2021) writes in his archaeology of computer graphics. "Computer graphics was first developed as a means of abstracting computational processes toward human readable modes of interaction — that is, of bringing the material logic of the sensible world to bear on the informatic logic of computational systems. Through computer graphics the image world was operationalized, made to compute and perform actions, to take up and simulate space [...] transforming the computer from a tool for procedural calculation into a medium structured by a distinct ontological claim". That is precisely the ontological, or rather ontogenetic vector that I find thrilling to study, both in the direction of a simulation-driven design that approximates the world and in that of a simulation-driven design that synthetically creates a new world. In fact, philosophers say, the relationship is complex and short-circuited: the model of the world becomes the world of the model. To the point that if the model does not unfold the world, then the world that unfolds the model is constructed. It happens in designing synthetic biologies as anthropologist Sophia Roosth (2017) suggests. To sum up, I think it is philosophically intriguing to explore the impact of computational simulation both as a pervasive design technique as well as a powerful epistemic horizon. Within the crisis of the Anthropocene, it is also a horizon of hope. Planning to build the world's most powerful AI supercomputer dedicated to predicting climate change (named Earth-2 or E-2), Nvidia is creating a digital twin of the Earth. Because, if we are at existential risk, "simulation is the answer", they wrote in announcing this news.

References

Bratton, B. (2019). *The Terraforming*. Strelka Press.

Bridle, J. (2012). *sxaesthetic. Report on New Aesthetics panel*. SXSW.

Buck, J. H. (2019). *After Geoengineering. Climate Tragedy, Repair and Restoration*. Verso.

Chaturvedi, D. R., Dolk, D. R., & Drnevich, P. L. (2011). Design Principles for Virtual Worlds. *MIS Quarterly*, *35*(3), 673-684.

Dade-Robertson, M. (2021). *Bio Design. Living Construction*. Routledge.

Gaboury, J. (2021). *Image Objects. An Archaeology of Computer Graphics*. MIT Press.

Horton, Z. (2021). *The Cosmic Zoom. Scale, Mediation, Knowledge*. MIT Press.

Lenhard, L. (2019). *Calculated Surprises. A Philosophy of Computer Simulation*. Oxford University Press.

Rohde, P. (2021). *The Quantum Internet. The Second Quantum Revolution*. Cambridge University Press.

Roosth, S. (2017). *Synthetic. How Life Got Made*. The University of Chicago Press.

Schnaars, S. P. (1989). *Megamistakes: Forecasting and the Myth of Rapid Technological Change*. Free Press.

Smart, J., Cascio, J., & Paffendorf, J. (2007). *Metaverse Roadmap*. Pathway to the 3D Web. A cross-industry Public Foresight Project. https://www.metaverseroadmap.org/MetaverseRoadmapOverview.pdf

Tibbits, S. (2021). *Things Fall Together. A Guide to the New Materials Revolution*. MIT Press.

Wand, Y., & Weber, R. 1995. On the Deep Structure of Information Systems. *Information Systems Journal*, *5*(3), 203-223.

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