

Under the Algorithmic Microscope

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Through the use of generative adversarial networks (GANs), Berlin-based artist Sofia Crespo creates artificial yet realistic biological ecosystems filled with creatures that look like insects, jellyfish, or other complicated organisms. Albertus Seba's legendary 18th century masterpiece, *Cabinet of Natural Curiosities*, takes on a 21st century twist, thanks to machine learning.

"I've always been fascinated with how we can see and change our perception of the world," Crespo said, adding that she has several microscopes, which, as tools, allow her to gain a deeper understanding and connection with the surrounding world.

Before she began working with deep learning as a creative tool, 3-D rendering was her preferred environment. In particular, she spent a lot of time replicating textures from jellyfish and aquatic life. The inspiration came from her father, who was a ship captain for many years when Crespo was growing up.

"Now I strive to explore how we can use other, newer tools to look at the natural world and gain a deeper empathy, appreciation, and care for the natural world we are in," she said.

As such, GANs, computer vision, and machine learning enable Crespo to operate on a different type of scale than she could do when working by hand. She curates datasets, trains neural networks on those datasets, and generates thousands and thousands of outputs. She can then explore patterns inferred by the algorithms that underpin the neural nets, allowing her to navigate through the "essential essence" of the original dataset.

"Being able to generate outputs at such a scale allows for a far quicker feedback loop from creation to experience, allowing me to work more intuitively with my subjects and concepts," she said.

NEURAL ZOO

The cover image, *Organic Resonance*, is indicative of Crespo's Neural Zoo project. GANs are trained on real-life imagery from the natural world—aquatic ecosystems, plants, and various organisms—and are then

subsequently reimplemented over and over to produce imaginary and often disarming results. We recognize the textures and the components—all of which "resemble" nature—but everything has been rearranged and recombined. Crespo takes our brains into the creative process at its very core—the recombination of known elements into novel ones—all aided by the process of machine learning. Neural network routines, thus, become a tool for creation, allowing for new understandings of the familiar, all through the process of data remapping.

Organic Resonance is a personal image for Crespo. She created it the day after meeting her partner.

"It was a meditation upon resonating with another person and how that felt," she said. "That feeling of conversing with a person one has just met that somehow feels like an old connection, that sense of familiarity. What I like about the image is how the parts come together, the patterns extracted by the algorithm form connections and become interlinked."

The resulting Neural Zoo imagery runs a gamut from the fantastic to the alarming. Figure 1, *Synthetic Optimism Ecosystem*, could be straight from a fantasy novel about synthetic biology, while *Realisation*, Figure 2, might be understood as a cross between Dada photomontage and Monty Python's Dead Parrot sketch. Figure 3, *On the Seabed Gazing Up*, shows what might happen when the algorithms allow a combination of previously separate organisms, coral, and sea anemones, for instance.

Since Crespo does not have an engineering background, she built her algorithms on top of Leon Gatys' previous work on texture synthesis with convolutional neural networks.

"Hardware-wise I have a couple of desktops with beefy GPUs that do the heavy lifting for the series," she said. "Occasionally I'll also expand into cloud computing to be able to process larger works. Honestly I can never get enough VRAM when working with deep learning."

However, Crespo uses her algorithms as tools, first and foremost, just like an analog artist might use a pencil or a paintbrush, so there is no instance where a machine truly "generates" the creative process. Most algorithms can only produce results from what they have themselves learned. At the end of the day, the algorithms are fed by datasets she has created or curated by hand.

Crespo's algorithms are better suited to work in specific ways, and will tend to output in a certain



FIGURE 1. *Synthetic Optimism Ecosystem.*



FIGURE 2. *Realisation.*

manner if she feeds them with datasets that she shaped in one way or another. After working with these tools for years, Crespo had developed an intuitive sense of how data and algorithms will interact and what potential outputs are most likely to happen, although just like with analog tools, there will be moments of serendipity, when happy accidents occur.

In any case, digitizing cognitive processes and then using them to feed new inputs back into the biological world, and then over again, provides new insight into reality. When the viewer is confronted with imagery he or she can recognize, but not recognize, then maybe a new degree of empathy with the natural world just might emerge.

NATURAL CURIOSITY

At the moment, Crespo is also working on a lot of projects, including a book that builds upon Neural

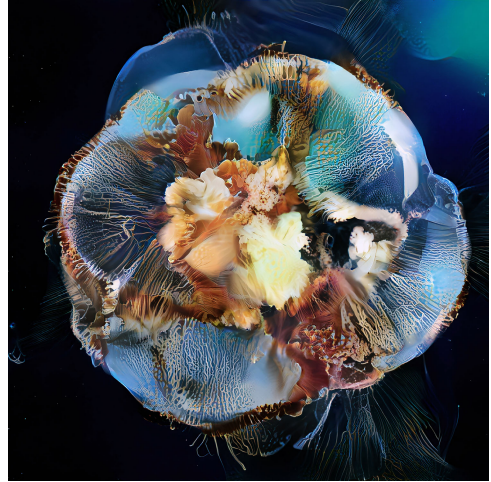


FIGURE 3. *On the Seabed Gazing Up.*

Zoo, but that dives even deeper into how we represent nature and the natural world. Titled *Artificial Natural History*, the project takes us back to the time before cameras were prevalent, that is, when scientific and public understanding of the world was based on sketches, paintings, and drawings provided by scientists and explorers. For Crespo, there is a certain “good old days” flavor of curiosity to that era, a flavor she wants to recapture and taste all over again.

“Their approach to representing and cataloguing the world has been profoundly influential in how we see and understand the natural world today and I find it fascinating to explore the essence of that period,” Crespo said.

Similar to Neural Zoo, this “natural history book that never was” takes inspiration from Seba’s *Cabinet of Natural Curiosities*, and other more recent experiments in surrealistic botany diagrams.

Ultimately, moving forward, due to its digital nature, generative art has produced many small yet diverse communities and mediums, so Crespo believes if we can build more compassion for the natural world, then generative art will go in many new and fascinating directions.

“I really hope that we can as a generative arts community nurture further diversity going forwards and that it can lead us to developing greater empathy, curiosity and inspiration from each other and the natural world,” she said.

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