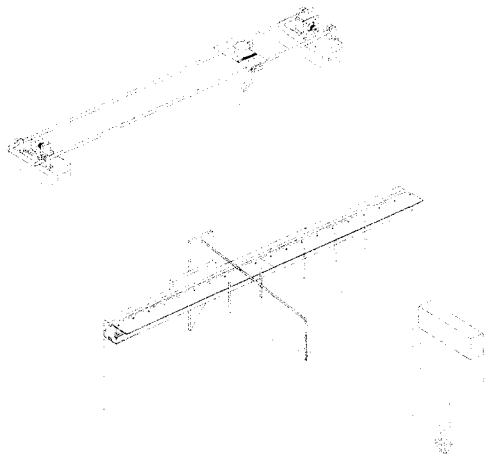
EDITED BY RYAN DEANE, ASLA, AND DANIEL TAL, ASLA



FOLLOW THE SCRIPT

COMPUTATION RESHAPES LANDSCAPES—AND THINKING.

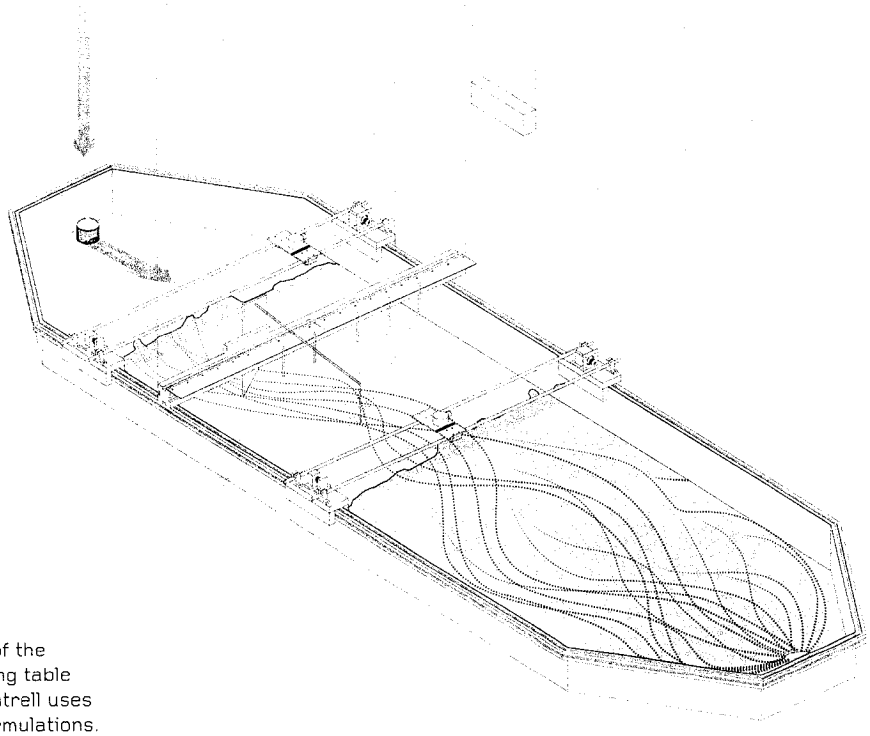
BY CHRIS BENTLEY

In a basement at Harvard, a river is burbling along the lab bench of Bradley Cantrell, ASLA. A fluid modeling table simulates a river delta using colored grains of sand and a Microsoft Kinect that tracks the sand's movement. He can program pulses of water with precision, or scoop out new geographic features by hand for an experiment.

"We can pinpoint moments of change and how they play out," he says, sweeping his hand over a miniature riverbank as it crumbles into the water.

One day, Cantrell hopes, sensors could embed real ecosystems for real-time feedback from the landscape. It may even be possible to "print" a landscape with programmable sediment barriers positioned along a river to control soil deposition in a delta. Cantrell believes that such a system could help better manage erosion and land subsidence, and also begin to repair broken relationships with nature.

"We think about nature as being bound in this one place, humans being bound in another. My take is that we should celebrate the connections between those two," says Cantrell, who is the director of the Harvard Graduate School of Design's MLA degree program. "It's not my goal to put computation into everything. But my work uses computation to set up this set of interconnected relationships in a more advanced way."



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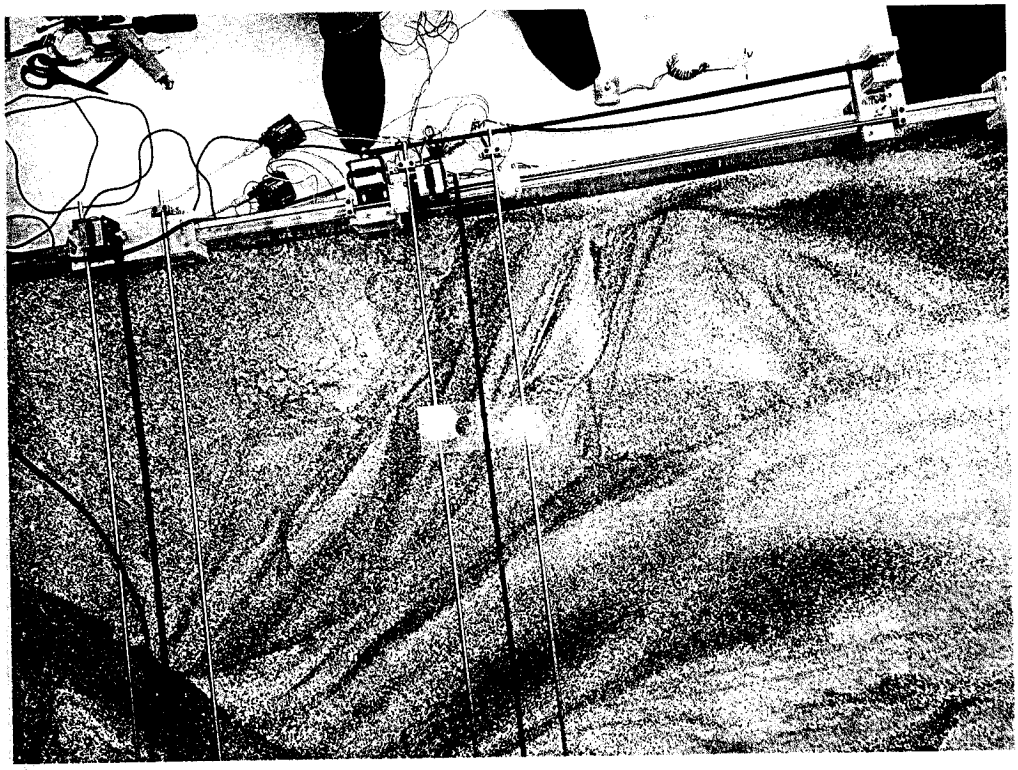
RESPONSIVE ENVIRONMENTS AND ARTIFACTS LAB/BRADLEY CANTRELL, ASLA; JUSTINE HOLZMAN, ASSOCIATE ASLA; LEIF ESTRADA



ABOVE
Cantrell's simulator allows users to model river delta flows with colored sand.

Cantrell is one of many people hacking the field of landscape architecture today. Coding and computational logic have become so interwoven into the practice of design that it's easy to take them for granted. Even if landscape architects don't code themselves, they are embracing visual parametric design tools like Rhino, Grasshopper, and CityEngine—the same ones that revolutionized building design and development over the past 15 years. As a result they're thinking differently about what landscape architecture could be.

Stephen Ervin, FASLA, a self-styled computer guy since 1978, has been working with scripting and programming since their inception. Today, he is the assistant dean for information technology at the GSD and teaches landscape architecture's core studio course. Coding is currently an elective at the GSD. Some students skip programming and graduate with knowledge only of Rhino's visual coding language, Grasshopper. But, Ervin says, some dig deeper and learn languages such as Processing, Java, Python, PHP, or C.

At first, Ervin says, so-called computer-assisted design was about making things more efficient. There was no joy.

"Coding is not just another grammar," he says. "It's a different way of seeing the world."

Walking around the GSD's tiered, loftlike studio space, you get a glimpse of what he means. The students' desks are fortified with long slabs of foam core, 3-D printed with wavy hills and scraggly craters. On some, you can see the evidence of parametric design where several computer commands intersect—evenly spaced divots get shallower across one axis while clawlike valleys stretch out along another. Through architectural play and exploration, Ervin says, young designers can use code to capture the complexity of the natural world, incorporating variables such as drainage and wind speed, but also programming landscapes to change over time.

"You can write a tiny chunk of code that can generate acres and acres of landscape with parametric design," he says. "Four lines of code can generate an almost infinite variety."

Ervin says we can expect to see an increase in the number of landscapes designed through parametric input, similar to how architecture has adopted parametric design for buildings.

There are already examples. San Francisco's South Park, among the city's oldest, is undergoing a $2.8 million makeover its landscape architects at Fletcher Studio say wouldn't have been possible without parametric modeling programs.

RESONSIVE ENVIRONMENTS AND ARTIFACTS LAB/BRADLEY CANTRELL, ASLA, JUSTINE HOLZMAN ASSOCIATE AIA, LEIF ESTRADA

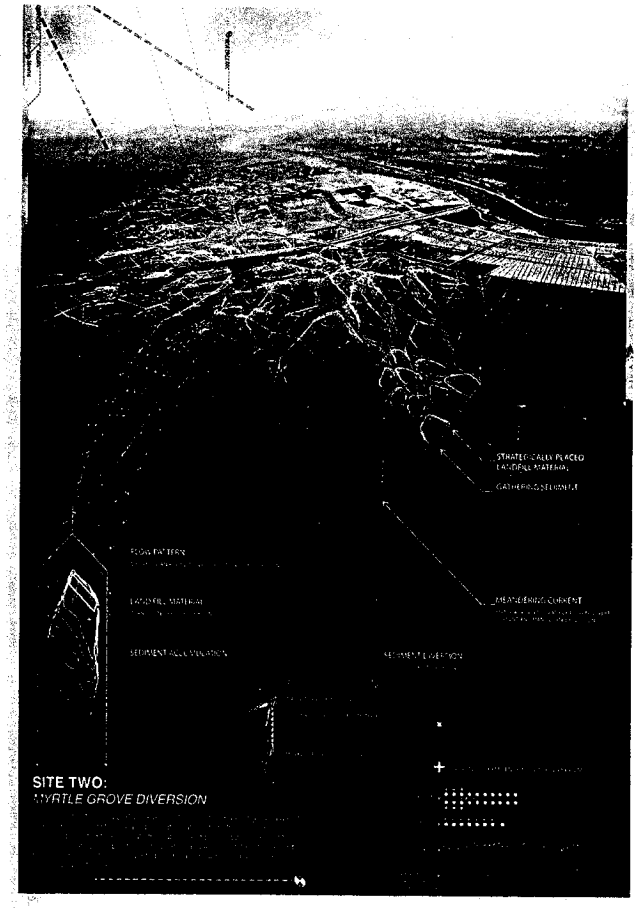
"I THINK WE SHOULD BE TOOLMAKERS, NOT JUST TOOL USERS."

—CAROLINE WESTORT

"Quite literally everything that is in the plans was generated in Grasshopper at one time," says the firm's founding principal, David Fletcher, ASLA.

South Park started as a picturesque English garden in 1852, but it has fallen apart. Fletcher and his codesigner, Cory Hallam, wanted to restore some of its historic charm as they overhauled most of the park's basic elements. Drainage, pathways, seating, and lighting were all lacking. But as they tinkered with individual elements in Grasshopper, they found small changes would ripple out. Introducing a slight slope to improve drainage in one area, for example, would create a problem on the site 200 feet away that suddenly violated the Americans with Disabilities Act. The program helped them juggle interdependent aspects of the design.

BELOW
The Coastal Sustainability Studio at Louisiana State University modeled conditions in the Mississippi River Delta.



"Sometimes, for very simple things, it brings a lot of power and time saving," Hallam says. Other times, Fletcher adds, it helps them find better solutions that they might not have discovered manually.

Contractors also like having 3-D representations of every single design element, especially on a low-bid, publicly funded project. That idea could go even further: Imagine contractors following construction documents via Microsoft HoloLens or Samsung Gear, verifying the design each step of the way with augmented reality.

"It's like an IKEA pamphlet of assembly," Hallam says. "They know exactly how many screws, exactly how many joints, exactly how many fittings, the length of rope."

It may not look futuristic, but South Park's technological underpinnings are fitting for its new neighborhood. Jack Dorsey is said to have hashed out the idea for Twitter in this park, which today finds itself in a sea of technology company headquarters in the South-of-Market, or SoMa, section of the city.

Caroline Westort, who teaches at Iowa State University, studied with Ervin at the GSD and completed her PhD in computational geography at the University of Zürich, where her work was funded in part by the U.S. Department of Defense. Combat and military training have used ValueCentric computer scripting for years, which is similar to how landscape architects are starting to visualize the implantation of concepts through simulation.

Westort identifies four components of effective landscape design software. The software should be able to display 3-D forms, the forms should be able to be updated and interact with each other, the generated forms should be linked to analysis tools, and you shouldn't have to be an expert to use them. Westort also thinks landscape architects should learn to peek under the hood of computational design software.

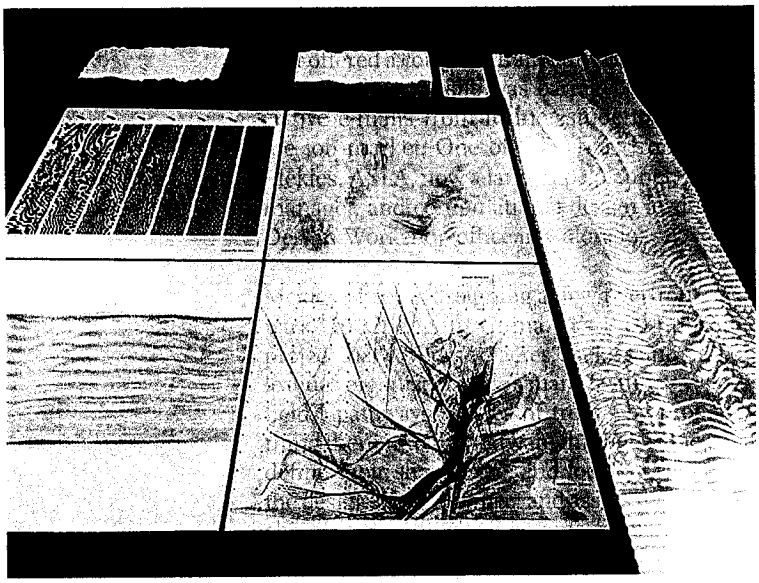
"I actually think we do lose something by not training or teaching students the basic building blocks of what's behind the black box, what's behind the software," she says. "I think we should be toolmakers, not just tool users. We are an information technology discipline, whether we like it or not."

Even if students don't learn programming languages, Westort says, it's key that they understand logical grammar—things like conditional statements, loops, and recursion structures. "Coding allows us not to be passive, and not just merely end users of software," Westort says.

LOUISIANA STATE UNIVERSITY'S COASTAL SUSTAINABILITY STUDIO/BRADLEY CANTRELL, ASLA; JEFFREY CARNEY; LIZ WILLIAMS; AND MATTHEW SEIBERT

She admits that code literacy can be a hard sell. Though landscape architects may find coding to be intimidating, Westort says, that alone is not a good reason to avoid it. The year after Westort first offered a course to train landscape architects to code, she says she was barraged with appreciative e-mails from former students entering the job market. One of them was from Adam Mekies, ASLA, now a landscape planner, project manager, and computational design lead at the Design Workshop office in Colorado.

Mekies's firm is designing a new riverfront "eco-park" in Chengdu, China. It's a complicated project that covers 500 acres. Mekies and his colleagues organize the site's many features—sports fields, pathways, groves of trees—by programming them into the software through values that define their shape, size, and location. This way the designers can connect and assess the relationships between the site programs, forms, and amenities. Rather than manually fitting together each playing field like pieces of a jigsaw puzzle, they can see how changing the position of one soccer pitch affects everything else they're trying to do. In programmingspeak, this is called scripting. In landscape design, it's a way to iterate faster and find creative solutions to complicated problems. "There's a technology saying that if you're going to do something six times or more, automate it," Mekies says.



STEPHEN ERVIN, FASLA

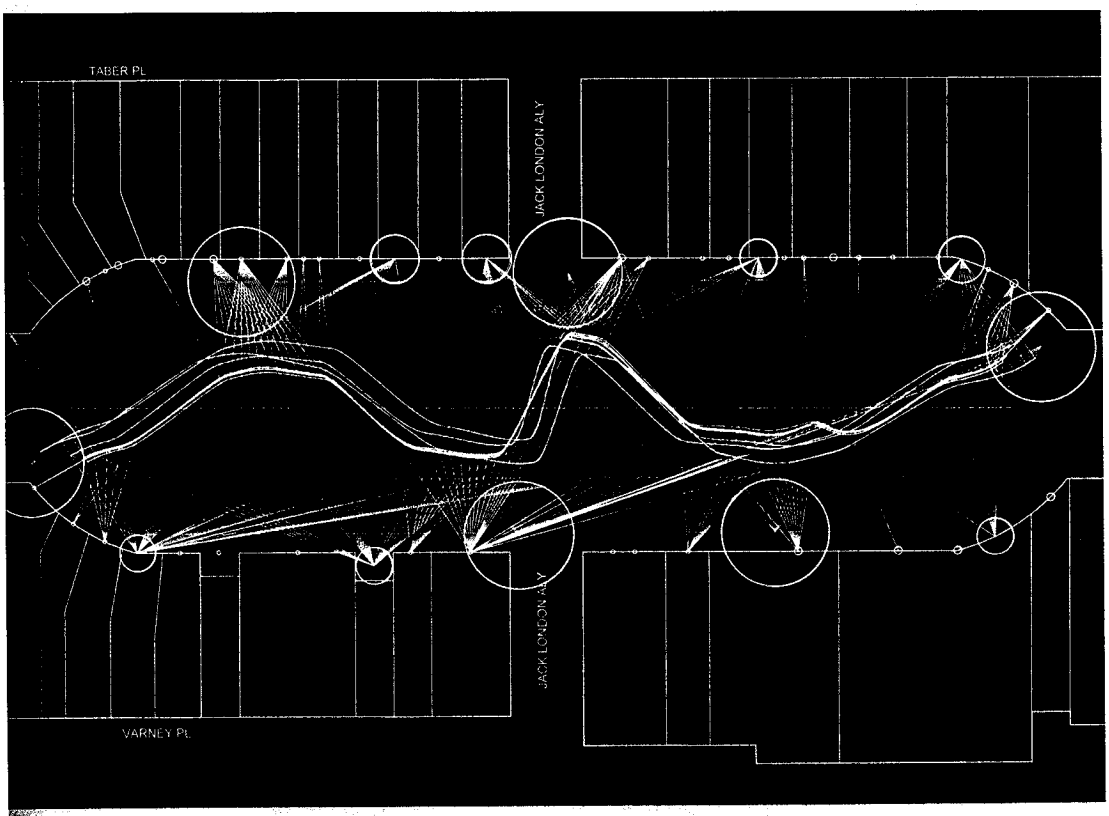
RIGHT
Parametric landforms created in Grasshopper and 3-D printed.

Mekies first became interested in computer programming in a high school robotics club, and later in a university aerospace lab. "The researchers in these positions were folks who could literally create anything they wanted," he says. "These were mentors who could not only fabricate structure and form from steel, but also electronically control these systems to interact with objects and people in amazing ways."

Nowadays, Mekies uses the programming languages Python, Grasshopper, AutoLISP, and Processing, but like many designers, he finds his work is mostly scripting—not coding from scratch. Whether they're coding or not, Mekies says, landscape architects could benefit from a "computational mind-set."

"Computation is not imperatively linked to the computer. Thinking through a problem in logical, definable, and rational steps is a skill everyone should learn," Mekies says.

Andrea Hansen is a self-taught programmer and an alumna of the coding nonprofit Code For America. Today she uses the text editor Sublime Text to enter code in Javascript, HTML, CSS, and PHP—skills she learned largely online through resources such as Codecademy, Code School, and Lynda.com, as well as the crowdsourced coding Q&A site Stack Overflow.



ABOVE
Parametric simulations for South Park by Fletcher Studio.

Hansen's firm, Fluxscape, promises "better civic spaces through technology." She urges landscape designers to remember that there are people hidden under the piles of big data becoming available to planners and designers these days. Using code, Hansen has built web applications and community engagement tools that help cities and designers collaborate with the future users of their site. One example is a method for soliciting feedback about how to develop vacant lots around Philadelphia.

"Coding is iterative in the sense that it encourages a more integrated and documented process of soliciting feedback," Hansen says, "which can then help to inform and improve the design process."

But she says the code needs to be a means to an end.

"I'm a huge advocate for tech," Hansen says, "but it's not always helping create cities that are human scale. Maybe we've reached this peak and we need to come back to where it's not about making the landscapes as complex as they could be, and using the technology to simplify."

Even Harvard's Cantrell—who talks about building "cyborg coasts" and embedding the physical landscape with tools of digital computation—cautions against relying too much on technology for technology's sake.

Henry Moll, a landscape designer at the Philadelphia firm Land Collective, is also among the evangelists of programming and parametric design who cautions that coding isn't a shortcut to good design. It's particularly useful for 3-D modeling, data research, and complex visualizations, and it's only going to get more common. But that's just the first step in creating an effective design.

"We are designing spaces for humans, and it takes human thinking to do that. At first glance, some of the super parametric projects might look cool and hip," says Moll, who primarily uses Grasshopper in his design process. "But you have to pull back the parametric veil and think, 'would this really be a great place?'" ●

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FLETCHER STUDIO