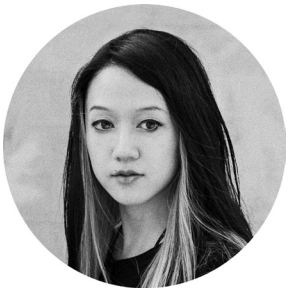
KEYNOTE EVENT

# A Conversation on Automation and Agency

Erin Bradner
Autodesk



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Stefana Parascho
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Elly R. Truitt
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Georgina Voss
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Industrial robotics and the hardware and software of automation have been at the center of the discourse on computational design and digital fabrication for more than a decade. Initially developed for the execution of repetitive tasks in the context of serialized production and manufacturing, robots and industrial machines have been repurposed, reprogrammed, and rethought for an array of new tasks, as well as new approaches to what they can do and what they can represent. However, the meaning, histories, and array of metaphors surrounding robots inform design and creative practice. This keynote conversation brought together five designers, scholars, artists, and practitioners whose work engages with robotics and automation, specifically focusing on their implications in design and creative practice, and their complex cultural and political histories.

Stefana Parascho, Assistant Professor at Princeton University and Director of the CREATE lab, began with a presentation of her work with geometrically complex construction systems, discussing the role of robotic technology and low-level tool development in architectural research, teaching, and practice. Erin Bradner, Director of Autodesk's Robotics Lab in San Francisco, followed with a talk titled "Robot Reality Check," in which


1 "I have wondered, and I've speculated, that maybe the future of human creativity may not be in what it makes, but in how it comes together to explore new ways of making, human and nonhuman alike." —Sougwen Chung
(Image: Sougwen Chung)

she identified the signal through the noise of robotics and automation, and discussed the current and future technology drivers underpinning the new ways robots are being appropriated in industry.

Artist and researcher Sougwen Chung then presented her speculative critical practice that spans performance, installation, and drawing, exploring the dynamics between humans and technical systems. Elly R. Truitt, an Associate Professor of the History of Science at the University of Pennsylvania, followed with a talk titled "Automation, Presence, and Agency," which discussed the historical and cultural contexts of automata and technical mechanical systems.

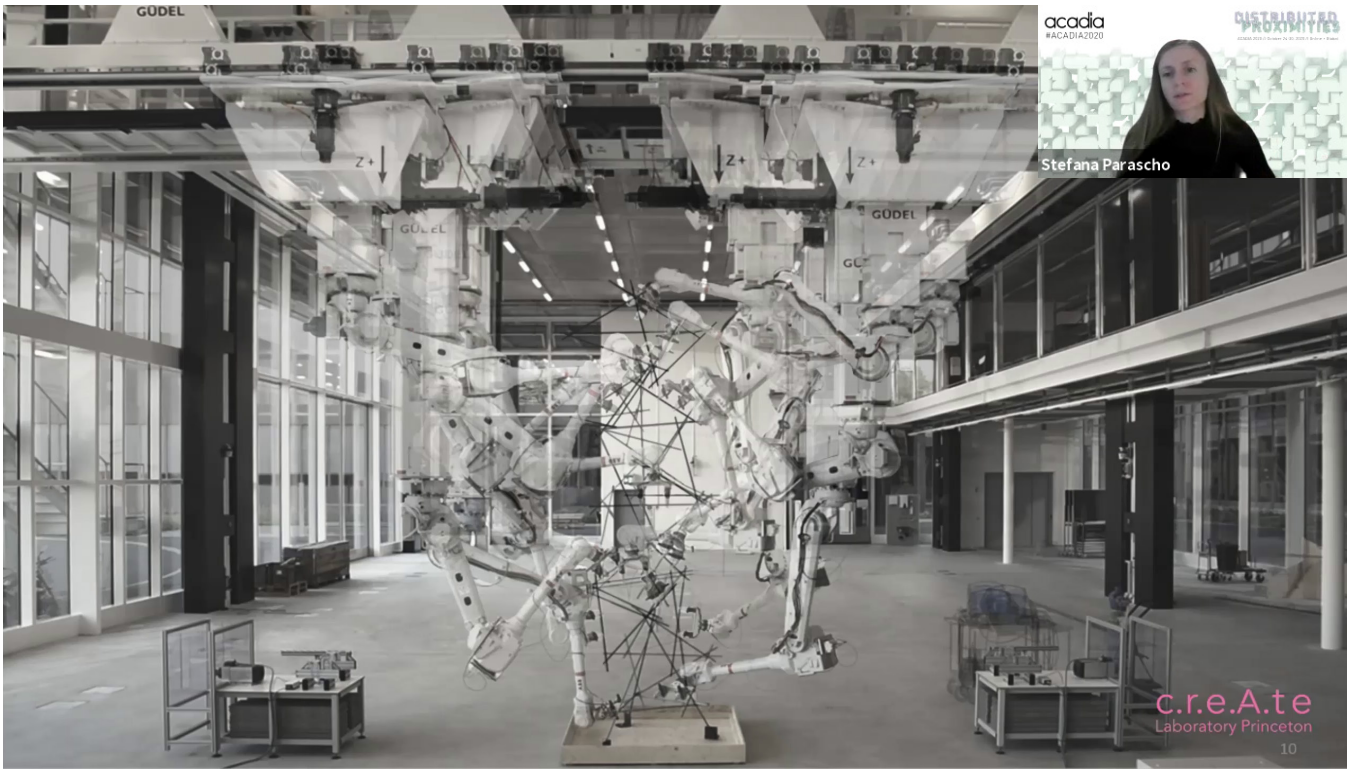
Georgina Voss, Reader in Systems and Deviance in the Design School at London College of Communication, University of the Arts London, and co-founder and lead of Supra Systems Studio, concluded the talks with a response and led a lively conversation, which is reproduced below in edited form.

For a recording of the entire event, please see this link: **https://www.youtube.com/watch?v=xMB-A5pKAcE**

**Georgina Voss (GV):** Anytime there is a panel on the ideas around automation, agency, and robotics, it always has a particular heft and weight in the public imaginaries. But it also feels, particularly in this past year, that the conversation has grown not only in the sense of technical advances that we've seen over the past decade, but also in thinking about what futures are coming, what is on the horizon.

We have been questioning our roles in building automation technologies, and investigating what they look like, and how they behave. Who constructs and who uses these systems? Words like "robotics" and "automation" have a certain buzz to them, representing really solid expectations of what they might bring into being. The idea of sociotechnical imaginaries—imagination and images of social life that might center around the development of certain technologies—is particularly potent for automation. By realizing that the senses of how these systems behave and what they do are imaginary, one can begin to tease them apart, to ask what is expected, what should we have on the horizon, what should be coming to us.

I was genuinely delighted to see in the four talks we just heard, that across history, time, and different forms of




2 "There are tensions within our own discipline over the value of technological developments when compared to the value of creativity and critical thinking. While the technical architectural field might often feel closer to engineering than to the humanities, I think we, as architects, are in a unique position to reflect on the broader implications of technical tools and design. I am convinced that we cannot do this without a very deep and thorough understanding of the underlying technical details." —Stefana Parascho
(Image: CREATE Laboratory, Princeton)

practice and engagement, there is a sense of teasing apart, tugging, questioning the ideas of how these technologies are going to work, uncovering a layer of complexity and richness that is beneath the surface and the buzz.

To start with Elly's wonderful talk on the very long history of automation, I can imagine coming to this topic for the first time, thinking that automata or robots are always in a certain shape and size. As Elly says, we can go centuries back to look at the alternative forms and behaviors that they can exist in. They might be very different than what one might expect, but they still inhabit and carry with them a lot of the power dynamics that we see working through technical systems today.

There is a similar shift in assumptions in Stefana's teaching and practice that sits in the context of certain expectations around robots and off-the-shelf computational tools in architecture. In fact, what she is proposing is that we need to overhaul these expectations and rethink the tools, often from scratch, to allow more control, more agency, more knowledge, and a deep understanding of what it is we are doing, rather than defaulting to what existing tools allow us to do. Stefana challenges us to create a holistic image of the richness and the complexity of connections between technologies beyond the fixed form of what the automatons in these spaces might be.

Sougwen also challenges the idea of cultural expectations and norms, both about drawing practices and about technical forms. With her own very specific form of practice, she clearly demonstrates that this is not a dry conversation, but rather people who are doing this, people having fun, and people butting against the systems we are building. As she beautifully puts it, this practice is about actively shaping a cultural imagination. Her work is also tapping back into and sitting within a very rich history of automation and robotics, acknowledging that none of these technologies are really new; they have been around for a long time, have taken, and might yet take many forms.

And finally, coming to Erin and her work in looking towards the future—or rather, multiple possible futures, instead of just one that is specifically robot-driven. Again, there is a

set of societal expectations about what roles we are going to have, what jobs, and what technological areas will exist. However, Erin is suggesting a broader space that is much more open to being shaped and discussed, rather than something that is coming down the train tracks at us.

What I loved about these talks was that everyone here explored and challenged assumptions baked into a lot of discussions and representation around automation, robotics, and technical systems. Moreover, you all have said, "Well, this is what we can do about it." The conversation goes beyond discourses and moves into making, into practice, into teaching, and ultimately into new forms of engaging with technical systems. As we return to the initial principles of automation, querying what robotics might be, we are also cracking that space open. Unfortunately, given the times we find ourselves in, we are not in Elly's courtly pageant space having water spat on us by irate automatons, but we are in a space that, as many of the panelists talked about, is rich with emergent new technologies of machine learning and sensor-rich environments, which transform machines we work with and ourselves into parts of a much wider network with expanded modes of practice.

I would like to revisit the idea of sociotechnical imaginaries, the idea that there is often a public imagination of what automation is, what AI is, what a robot is. I want to emphasize that these imaginaries have power for a reason. They can be seductive, as Elly talked about. They can be impressive, amazing, they can discomfort us, they can terrify us, they have affect, they do things to us, we buy into them. I speak for myself here, but we have 146 people in the audience, and I imagine that you all are here for a reason as well, because you are excited and want to know about all these facets of automation and computational systems. We think they are really fascinating and great, but it is also necessary to reflect on ourselves and the choices we are making in why we choose to engage with them. We can choose to both think, "Wow these things are really fascinating," and simultaneously reflect on the power dynamics that run through them.

I will wrap up my introduction there, and move on to a round of questions, one for each panelist, just like Christmas.

Stefana, I am really fascinated about the work you showed around building your own tools. I was wondering, what challenges have you encountered in doing that, and at what point did you realize that the tools available to you just weren't going to work off-the-shelf? How does that work in teaching, for students who are given this wide-open space to play with, rather than something that is more constrained by the design environment of something more rigid?

**Stefana Parascho (SP):** The challenges that I've encountered are pretty much everything you can imagine, from just not knowing where to start, to learning to dive into technical areas that every time are completely new. There is no such thing as doing the same thing twice in research, particularly when engaging with new technologies and new fields of inquiry every single time. In every project, it feels like I'm a beginner and I have to figure out where to start, what to aim towards. It takes some time to build the confidence to just dive into new concepts and new methods, but it also gets more fun and fruitful with every new project.

In terms of building my own tools, I wouldn't say that I have tried all of the existing tools and figured that they weren't enough. The necessity of custom-built tools for custom processes was almost implied when I began working with these machines, maybe partially because there weren't many software tools available at the time. So, I dove into making my own tools and developing solutions early on—partially because I was curious, and it was fun, and partially because I wanted to do new non-trivial things with the machines, so the solutions weren't really there.

With teaching, I will admit that it is often challenging. Many times students come with expectations of quickly implementing a robotic process, but then they realize: Wait a second, why aren't you giving us a magic plugin where we can click a button and things just happen? I put a lot of emphasis on exactly not falling for that one-click solution and having them engage with the low-level knowledge that is behind the systems, which often is not the easiest way. But this knowledge is necessary to meaningfully work with new technologies. I hope what they get out of it is the confidence that these tools and technologies aren't something that we as designers and architects don't have control over, but they are something we can engage with at every level, which in turn opens up more possibilities than working with black-box tools. I don't think they would have ended up developing or even imagining the processes and projects they've made if they hadn't engaged with all of the underlying challenges and troubleshooting at the early stage.

**GV:** It's something I think about a lot with my teaching work, and it's really nice to hear that a lot of the same issues

come up. I also appreciate that particular idea of doing it through practice, where a bounded space only gives you so much to play with. But when you crack it open, you're suddenly dealing with much wider expectations, and that's so lovely.

Elly, thank you for a brilliant talk on the history of technology. You locate, particularly in this talk, the historical figure of the automaton put to use by power in different ways, whether through the court or a type of showmanship. Given that to create an automaton, one requires a lot of resources—time, money, wood, metal, etc.—I was wondering, are there examples you can think of, or interesting stories where people with maybe fewer resources than those you've talked about were able to either push back, make something, or create a counternarrative in some way?

I am curious if there are some fascinating alternative imaginaries that come through history?

**Elly Truitt (ET):** There are a few examples where individuals push back against automata. For example, a common trope across cultures is the story of the learned man (philosopher, sorcerer, or scholar) and his automaton-child. In the Latin West, these stories have been attached to Albert the Great, a medieval bishop and natural philosopher; to René Descartes; and to Thomas Edison. In some of these examples, like in the stories of Albert the Great and Descartes, the automaton is destroyed. But it's destroyed by people who are presented as being ignorant. They don't understand the true technology, and so they are afraid and let their fear speak for them.

Your question makes me think also about these moments in the historical record where you can get a sense of the other people involved, a sense of where these objects are appearing and the larger ecologies they appear as a part of. Even though, for example, the duke or the count may have been the one who says, "This is what I want, this is what I want it to do, this is what I want it to look like," we see in the historical record other people who were involved. For instance, the mechanical monkeys had to be sent to the refurbisher or the repelter every year or two. And you begin to imagine this person in that job thinking every year, "Oh, here it comes. Again, it's the monkeys." I think it's important to remember that even though those artisans may not speak to us as directly, in some ways, they're there in the records. We have to remember the ways in which they are contributing to the process or changing it in some way. I unfortunately haven't come across many examples of the truly liberatory automata or servants that I might hope for. But I continue to hope that people like Erin and Sougwen and Stefana will help get us there.

**GV:** That brings to mind the idea of a wider network of production that exists around technical systems. I've been thinking a lot about how the current critical discourse around technical systems is often heavily weighted towards people who work in senior management or technical roles. There is an entire range of other people who are involved historically, working in those processes, and who may be more marginalized and have less power, as you say, comparable to the pelt manager, but also have a valuable part to play in the network. I would love to read whichever fiction writer picks up that guy's story and turns it into great historical science fiction.

Sougwen, it is always lovely to hear you talk about your practice and see it as well. In the beginning, you talk about how over the past decade in your work you have been challenging and questioning your own expectations of what your drawing practice is in relationship to the idea of computational systems and engagement. At the end of your talk, you mentioned how you are reframing and rethinking this idea in relationship to what is happening now, and how that gets embedded into your practice and life. What are the challenges you're facing, and are the questions you are asking now comparable to the ones that belong to the longer thread of ideas that began 10 years ago around your drawing practice? How have those ideas evolved, where are you now, and how do you feel about it?

**Sougwen Chung (SC):** That's a big series of questions. And of course, they're ones that I've been thinking about a lot, given that I'm spending a lot of time in my studio recently, and acknowledging how much the world has changed.

Prior to this year, I was thinking a lot about automation as not just a technical challenge but one that has considerable social implications and emotional responses. The role of machines in society, and their role in displacing large swaths of the workforce—that creates a very real anxiety, and a fear of being replaced. So, I see it as part of my practice to address, reframe, and rethink the dynamic between the human and the machine and what it can mean. To address the role of imagination in human agency alongside machines. Simply put, not as *either/or*, but *and*.

This has developed into broader investigations into the


3 "In considering agency, I am going to examine the links between automation and enslavement over about 900 years, from 950 until the middle of the 19th century. Both artificial servants and enslaved persons appear as liminal objects that glorify the individual at the center of the court,comment on a spectrum of humanity, and embody the use of technology to articulate power over nature." —Elly Truitt
[Iamge: A ceremonial "Kammermoor," early 18th century.]

intertwining of human and machine: How can we expand beyond interactions towards relation, towards a co-creation with machines, AI systems, and even VR technology, to really expand our model of singular authorship, in regards to the notion of a Copernican awareness, and the decentering of the human subject as that sole node of authorship, the center around which the world revolves?

I think we've come to this expanded awareness in part due to the prevalence of synthetic sensory technologies, cobbled together as a kind of sensory apparatus that allows us to observe beyond ourselves. We are able to actually connect in new ways and see through machine learning algorithms as they provide feedback to our process. Observing the mass amounts of information we have at our disposal and thinking about what that does to the human subject is really interesting.

In my practice, I explicitly bring in machine feedback systems because it helps with my own anxiety about potential futures. The practice of co-creation with machines also helps us imagine new futures through embodied making, which I not only narrativize, but also design, think about, and write about.

For me, part of the practice results in the creation of visual artifacts with two functions. The first function is that the artifacts exist as visual representations of a developing recurrent neural network model. The second, a painting, is an artistic artifact that grounds modes of speculation and contemplation. The dual interpretation of the results of this human-machine process excites me in that it engages fields of science and art in tandem. As a painting, it exists within a cultural practice that can engage the larger narrative of art history. This is important to me because I feel that a lot of the time, I've seen conversations about art and technology ignore and de-historicize what came before, that erase cultural histories in the name of progress and innovation.

I'm interested in works and approaches to art, AI systems, and robotics that facilitate larger conversations about our collective potential, and the continued evolution of cultural


4 "If there is anything that these advances in synthetic sensing technologies have shown us, it is that we are undergoing a certain Copernican trauma. What I mean by that is a recognition that the self is not at the center of the process, and that we are all interconnected. This realization becomes a profound decentering of the human subject." —Sougwen Chung
(Image: Sougwen Chung)

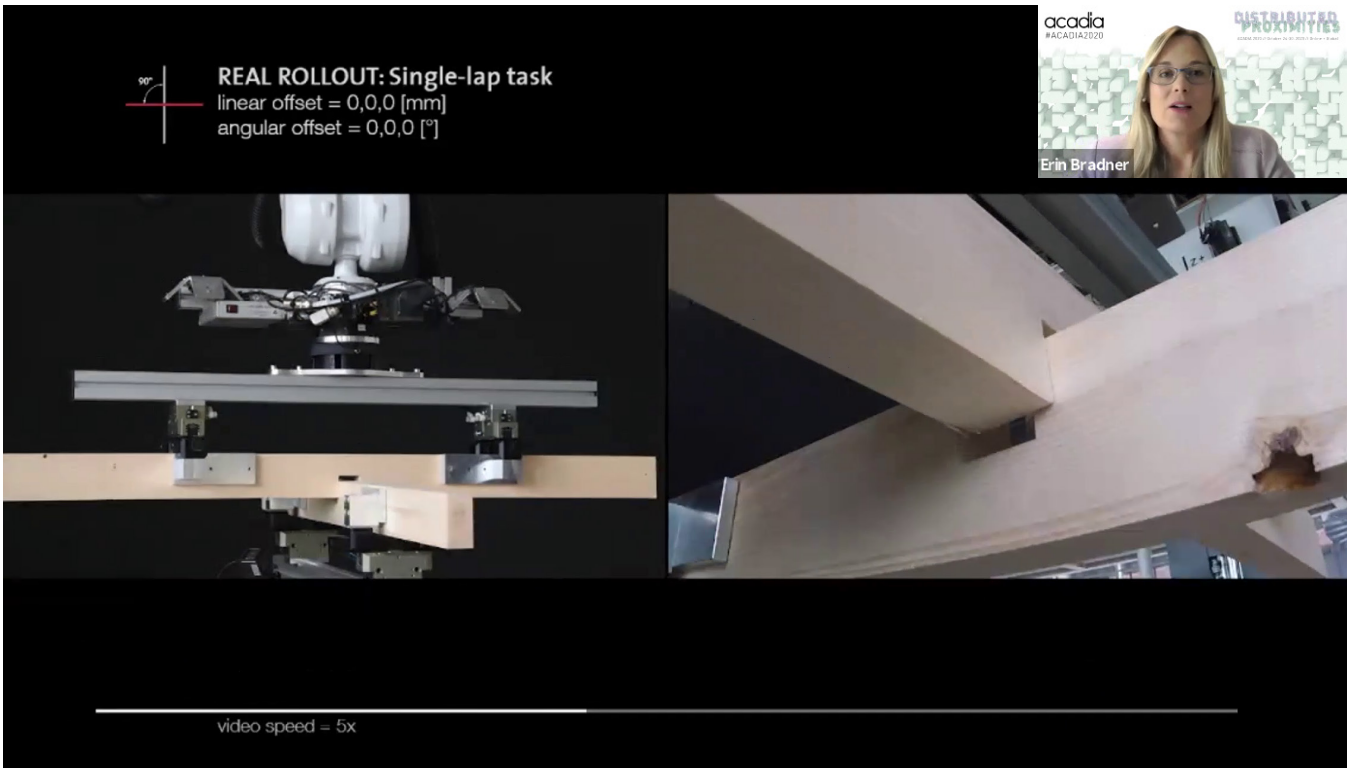
practices like mark-making. That's what excites me about imagining potential futures with machines or AI.

**GV:** Your last statement beautifully articulates something I know a lot of us have been thinking about: we see whenever there is a narrative around computational technologies, it can be very ahistorical, like a giant shiny wall moving forward with nothing behind it. It is just always there, always new, and always shiny. And that is particularly surprising in the art space, given that the history of art, as much as the history of technology, is so fascinating and so rich. I think it is a very useful articulation of how by gluing onto the computational technologies, or even by breaking them apart, suddenly the richness of a historical practice becomes a thing that exists now, in this moment.

And since we are talking about futures, it brings me to my question for Erin. What I found fascinating about your talk is that you explicitly stated in the very beginning that you are not a futurist. You presented a very rich and intriguing range of ideas in a very pragmatic way, basically saying that the future is not this blinding thing that is going to terrify us, but something we can and should take a look at, and maybe discover that it is not what one expects.

I am curious to know how this version of the future, not as jetpacks on the moon, but rather something that is more complex and layered, is received—whether you present it internally at Autodesk or externally to larger audiences? Is there a sense of pushback against the preliminary expectation? And to add to that question, what has surprised you in your own work as you have been researching and developing this area of technological futurity?

**Erin Bradner (EB):** I intentionally explain that I am not a futurist primarily because that word often throws folks off. It creates this image of someone gazing into a crystal ball, and more importantly implies that there is only one future to be seen, and a certain continuum that can be extrapolated along a linear trajectory. Within our organization, we have come to a point where we acknowledge that there are many parallel possible futures, depending on what lens we are looking through: a social lens, a technical lens, or an economic lens. In that sense, this notion of multiple futures




5 "Rather than stand in the dark and stare into the unknown, let's extrapolate what we know and look at the technologies underpinning advances in robotics and see where they are headed. My team and I have identified five drivers: Inherently Adaptive, Sensor Rich, Automatically Programmed, Highly Connected, and Easy to Use." —Erin Bradner
(Image: Research into machine learning for timber assembly, by ETH Zurich and Autodesk)

is well received and incorporated within the organization. And it is important to outline that this multiplicity of futures is not a dichotomy between either a dystopian or a utopian future. There are desirable futures and there are undesirable ones, and it behooves all of us to analyze all of the possible scenarios, as many as we can imagine. We need to imagine first and then identify what it is we need to do to navigate towards the desirable futures: desirable for the environment, desirable for society, desirable for the economy, and so forth.

To answer your question about what surprises me in my work, I am fascinated by how profoundly interdisciplinary the act of looking into the future around technology is. This is especially true in robotics. Stefana's work, with her embrace of custom toolmaking, is a great example of this. Everyone who is pushing the boundaries of robotics is operating this way, soldering and wiring new systems, literally and metaphorically, from the ground up. At the same time, they need to understand the implications of how it is applied, for instance in Stefana's case, in architecture, investigating the interplay between design and fabrication, developing new ways of crafting not just a pragmatic design but also an aesthetically pleasing one. This interdisciplinary nature of robotics is what surprised me most when I first joined this team.

**GV:** I think we are all on team interdisciplinarity here. We may not be able to necessarily pronounce it, but we certainly believe in it.

For me, as someone who has looked at imaginaries and socioeconomic futures, the plurality of futures feels so important. It sometimes feels like there's one steering force, and you can strap yourself to the engine in order to get that future somehow. But what we are talking about here is the future being a broader, messier array, where there are active choices. It is not about being sucked into a vortex of a 30-year time horizon, but rather about the choices that are made along the way and who gets to make them.

We have a question from the audience. Shelby Doyle asks: "As architectural robots have evolved into many species of design collaborators rather than human proxies or perfect

slaves, does this shift in thinking change us? Does rejecting frameworks of enslaving technology shift our thinking about ourselves as designers and how we locate and value human labor or how we engage with computational labor practices?"

**EB:** I can answer as a computer scientist rather than as an architect. What we look to do with our technology development is not to automate the process of designing and making, but to produce tools that allow this interplay between the technology and the designer. Sougwen described this well as interdependence. We are striving towards a design characteristic, and a relationship between our robots and our designers, that is interdependent and collaborative, rather than dependent on automation.

**SC:** Even though terms like "enslaving technology" are very loaded, I do think that certain human skills become atrophied through a linear approach of engaging with robots, where the machine is a task-execution device. By framing my work as a collaboration, I create a space where not only are both human and machine processes evolving, but where the self-limiting engagement of the two deepens the connection between human and machine collaborators. That is the future I would like to be heading towards, one where it is not about control or execution, but about catalyzing new types of knowledge through interaction and entanglement.

**SP:** This understanding of the machine as a collaborator rather than task executor can be seen as an alternative route for the architectural profession, away from the image of an architect as a lonely creative genius who generates something that is later executed by someone else. Our relationship to the labor of making and executing processes, be it machine labor or human labor, must inform and shape our design process at its earliest stage.

**ET:** Speaking more broadly, but to take up the points that Erin, Stefana, and Sougwen have made, I wonder if taking the view of a spectrum from augmented human abilities and autonomous intelligent machines, rather than a binary of human/robot, might allow us to humanize our machines, and lead to new areas for growth and creativity.

**Erin Bradner** is the Director of Autodesk Inc.'s Robotics Lab in San Francisco. She and her research team are developing tools to enable industrial robots to intelligently make things by sensing, responding, and adapting to new information in real time. Under Erin's leadership, Autodesk's Robotics Lab is using artificial intelligence and closed-loop controls to teach robots new workflows in manufacturing and AEC. Prior to leading the Robotics Lab, Erin co-founded the Generative Design practice at Autodesk; through research and thought leadership, she helped incubate the technology from concept to commercialization. Erin is driven to discover how to leverage intelligent software tools for smarter building, manufacturing, and design. In her past lives, Erin consulted on the first commercial intelligent agents and cloud storage systems; and contracted at IBM, Boeing, and AT&T. Erin is a co-author on patents in advanced design and publishes in academia. She holds a PhD in Information and Computer Science.

**Sougwen 筠君 Chung** is an artist and researcher whose work explores the dynamics between humans and systems. Her speculative critical practice spans performance, installation, and drawings which have been featured in numerous exhibitions at museums and galleries around the world. Chung is a former research fellow at MIT's Media Lab and a pioneer in the field of human-machine collaboration. In 2019, she was selected as the Woman of the Year in Monaco for achievement in the arts and sciences and was a featured speaker at TED in Mumbai, India. In 2018 she was an inaugural E.A.T. Artist in Resident in partnership with New Museum and Bell Labs, and was awarded a commission for her project *Omnia per Omnia*. In 2016, Chung received Japan Media Art's Excellence Award for her project *Drawing Operations*.

**Stefana Parascho** is Assistant Professor at Princeton University and director of the CREATE Laboratory Princeton, where her research focuses on computational design and robotic fabrication. Before joining Princeton University in 2019, she obtained her PhD from ETH Zurich, Gramazio Kohler Research. She received her Diploma in Architectural Engineering in 2012 from the University of Stuttgart and has worked with DesignToProduction Stuttgart and Knippers Helbig Advanced Engineering. Throughout her research, she has explored existing computational design methods and their potential role for architectural fabrication, ranging from agent-based design tools to multi-robotic assembly techniques. Her goal is to strengthen the connection between design, structure, and fabrication and the interdisciplinary nature of architecture through the development of accessible computational tools and robotic fabrication methods. Current projects include research on cooperative robotic assembly techniques for self-supporting structures, including spatial structures, bending-active systems, and masonry construction. In addition, she is currently exploring methods of further integrating different fabrication systems into the design decision-making process.

**Elly R. Truitt** is Associate Professor of the History of Science at the University of Pennsylvania and the author of *Medieval Robots: Mechanism, Magic, Nature, and Art* (University of Pennsylvania, 2015), as well as scholarly articles on medieval astronomy, pharmacobotany, the history of automata, early mechanical clocks, and premodern concepts of artificial intelligence. Her work has also appeared in Aeon, The TLS, and History Today, and she has contributed to several programs on BBC Radio Four. She is currently at work on several projects, on the topics of Roger Bacon, speculative technology, and temporality; the co-creation of the categories of "modern science" and "medieval history" in the nineteenth century; and how medieval technologies produced narratives of Christian temporality and universality. Her research has received support from the National Science Foundation, the Andrew J. Mellon Foundation, the Huntington Library, and the Max Planck Institute for the History of Science.

**Georgina Voss** is an artist, writer, and educator. Originally trained in technology anthropology and industrial economics, her work explores the politics, presence, and deviance of large-scale machines and technical systems through performance, multimedia installation, writing, and investigative research projects. Georgina's work has been exhibited and performed in spaces including Tate Modern, Auto Italia South East, STUK (Leuven), London Design Festival, and TAC Eindhoven. Her writing has been published in places including *The Atlantic*, *The Guardian*, *Science as Culture*, *Economic Science Fictions* (MIT Press, 2018), *Journal of Economic Geography*, and *Journal of Homosexuality*. She is currently working on her second book, on experiencing systems, with Verso. Georgina is Reader in Systems and Deviance in the Design School at London College of Communication, University of the Arts London, and co-founder and lead of Supra Systems Studio. She is also founder and co-director of the consultancy Strange Telemetry, and currently a resident of Somerset House Studios.