AUTODESK **UNIVERSITY** 2015

Design Computation Symposium

December 2, 2015 | 8:00 a.m.–12:00 p.m.
Murano 3201, Level 3 | Venetian Convention Center, Las Vegas, Nevada

How are computational and generative design practices affecting the AEC industry? Advances in computational design, simulation, optimization and fabrication are happening at an astounding rate. The AEC industry is starting to change but is notoriously slow at adopting new processes. Other fields like aerospace, product design, and fashion design have been adopting computational and generative design techniques more quickly, so how can we learn from them? In this year's Design Computation Symposium we will learn from leading designers and hear how they are interconnecting design, optimization and fabrication to support new ways of working.

So where are we now? We will start with **Dave Fano** of CASE (now WeWork) giving us his view of where the AEC industry is today in its application of computational and data-driven design. We will then move to **Jessica Rosenkrantz** and **Jesse Louis-Rosenberg** of Nervous System, a generative design studio that works at the intersection of science, art, and technology. Drawing inspiration from natural phenomena, they create computer simulations to generate designs and use digital fabrication to realize products. Jessica and her partner Jesse Louis-Rosenberg have developed an amazing body of work over the past 8 years.

So where are we headed? The second session will start with **Bastian Schaefer** from Airbus and **David Benjamin** from The Living showing how generative design, optimization and new fabrication techniques are being used today in the aerospace industry. They will discuss their work on new aircraft designs and the Bionic Partition project, a new aircraft part designed via a novel optimization process and 3d printed directly in metal. We will then hear from **Gijs Van Der Velden** of MX3D talking about optimization and robotic fabrication of a bridge in Amsterdam. We will close with **Achim Menges** discussing the stunning work his group is creating at the Institute for Computational Design in Stuttgart Germany. Achim's practice and research focuses on the development of integral design processes at the intersection of design computation, biomimetic engineering and computer aided manufacturing that enables a highly articulated, performative built environment. His work is based on an interdisciplinary approach in collaboration with structural engineers, computer scientists, material scientists and biologists.

A common narrative across the speakers is how design, optimization and fabrication are intimately intertwined. New design concepts are developed than can only be realized by new fabrication techniques and materials. New fabrication techniques are developed to realize new designs. Lastly, new fabrication techniques support much more fidelity in the placement of material so optimization techniques can successfully be utilized to create more efficient structures. We will see how these techniques can be used by architects and engineers to create a better built environment.

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Session 1: So Where Are We Now? 08:00 am – 09:30 am		
08:00 am – 08:05 am	Introductions	*Matt Jezyk*
08:05 am – 08:15 am	Opening Remarks: *Generative Design: Where are we now?*	*Carl Bass*
08:15 am – 08:45 am	WeWork (formerly CASE): *Data for Galactic Growth*	*David Fano*
08:45 am – 09:30 am	Keynote 1: *Nervous System: Growing Objects*	*Jessica Rosenkrantz / Jesse Louis-Rosenberg*
09:30 am – 10:00 am	Break	
Session 2: So Where Are We Headed? 10:00 am – 12:00 pm		
10:00 am – 10:30 am	Airbus Group and The Living: *The Bionic Partition*	*Bastian Schaefer / David Benjamin*
10:30 am – 11:00 am	MX3D: *Amsterdam Bridge Project*	*Gijs Van Der Velden*
11:00 am – 11:45 am	Keynote 2: ICD/ITKE University of Stuttgart: *Integrating Design Computation and Materialisation*	*Achim Menges*
11:45 am – 12:00 pm	Closing Remarks, Q&A	*Matt Jezyk*

Session 1 | 8:00 a.m.–9:30 a.m.

Matt Jezyk: Intro and Emcee

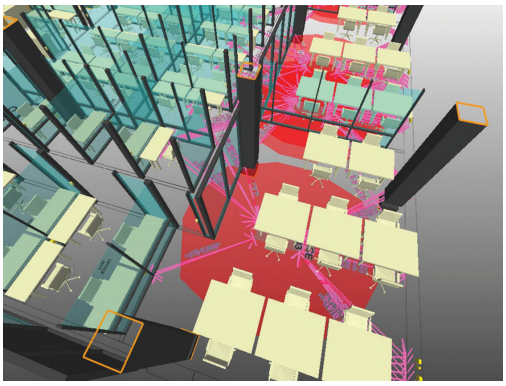
Carl Bass: Opening Remarks – Generative Design "Where are we now?"

WeWork (formerly CASE): *Data for Galactic Growth*

David Fano

Data flows from nearly everything we do. From the buildings we occupy to the phones, toothbrushes and even toilets we use, they all produce data. Thanks to the shift towards BIM-based project delivery, AECO firms are now producing data in vast amounts. Unfortunately, the rate at which it's being produced means potentially valuable data is discarded to makeroom for more, and an opportunity to make sense and gain insight from this information rich content is lost.

In this presentation, David Fano looks at the way leading technology firms are utilizing data in their business. He talks through some of the key examples of big data and considers how these can be applied to the AECO industry. Using a range of case studies from WeWork and his former firm CASE, Dave examines how data can be a renewable resource that firms should harness to deliver value, generate knowledge, and drive performance.

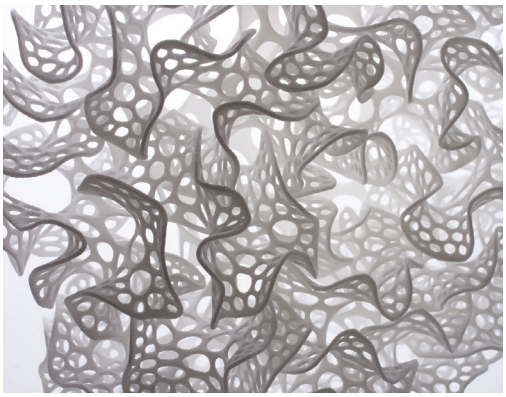


■ *WeWork: Occupancy Data Visualization*

Nervous System: *Growing Objects*

Jessica Rosenkrantz / Jesse Louis-Rosenberg

Jessica and Jesse will discuss Nervous System's unique approach to product design through generative techniques, 3d-printing and interactivity. Along the way, they will take several detours into the realms of natural pattern formation, simulation, and biology. The talk will focus on some of Nervous System's latest projects including a 4D printing technique that creates complex, foldable forms for 3D printing and an exploration into the morphogenesis of plants.



■ *Nervous System: Differentials Test*

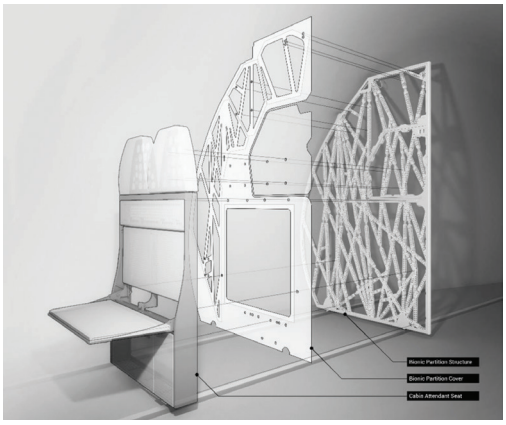
Session 2 | 10:00 a.m.–12:00 p.m.

Airbus Group and The Living: *The Bionic Partition*

Bastian Schäfer / David Benjamin

Bastian Schaefer from Airbus and **David Benjamin** from The Living will show how generative design, optimization and new fabrication techniques are being used today in the aerospace industry. They will discuss their work on new aircraft designs and the **Bionic Partition** project, a new aircraft part designed via a novel optimization process and 3d printed directly in metal.

The Bionic Partition is one of the largest 3D printed metal components worldwide and the largest 3D printed component for a commercial aircraft cabin. The generative design approach combines design algorithms with the power of cloud computing to generate, evaluate, and evolve thousands of design options according to the objectives of low weight and low structural deformation. Structural analysis and optimization allow for the creation of novel, high-performing designs beyond those that engineers would typically produce. This procedure makes it easy to identify the best performing structure which is then subjected to further detailed investigation.



■ *Airbus: The Bionic Partition*

The Bionic Partition combines the latest material and production trends with the most sophisticated design and optimization technologies to create a new baseline technology for the aviation industry.

MX3D: *Amsterdam Bridge Project*

Gijs Van Der Velden

Designing an optimal bridge, suitable for 3D printing, requires serious tweaking of standard optimisation techniques. A short introduction in our previous projects will give insight in the way Joris Laarman Lab has created such code in the past. The goal? Find smart and elegant methods to generate optimal results for various additive techniques. Now the Labs' spinoff company MX3D, is experimenting with design strategies for its own robotic 3D printing technique. Time for discovery is short, next summer printing starts.

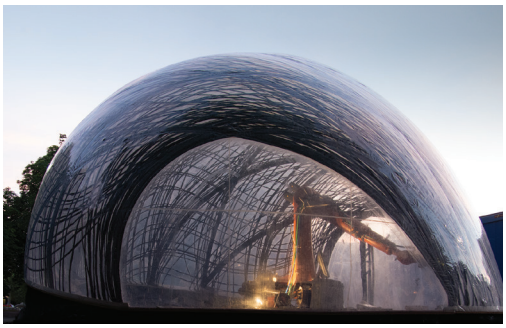
■ *MX3D: Amsterdam Bridge Project*

ICD/ITKE University of Stuttgart: *Integrating Design Computation and Materialisation*

Achim Menges

The ICD/ITKE Research Pavilion 2014-15 demonstrates the architectural potential of a novel building method inspired by the underwater nest construction of the water spider. Through a novel robotic fabrication process an initially flexible pneumatic formwork is gradually stiffened by reinforcing it with carbon fibers from the inside. The resulting lightweight fiber composite shell forms a pavilion with unique architectural qualities, while at the same time being a highly material-efficient structure.

The web construction process of the diving bell water Spider (Agyroneda Aquatica) was examined and the underlying behavioral patterns and design rules were analyzed, abstracted and transferred into a technological fabrication process. This natural production process shows how adaptive fabrication strategies can be utilized to create efficient fiber-reinforced structures.



■ *ICD/ITKE Research Pavilion 2014, Stuttgart, Germany*
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For the transfer of this biological formation sequence into a building construction application, a process was developed in which an industrial robot is placed within an air supported membrane envelope made of ETFE. This inflated soft shell is initially supported by air pressure, though, by robotically reinforcing the inside with carbon fiber, it is gradually stiffened into a self-supporting monocoque structure. The carbon fibers are only selectively applied where they are required for structural reinforcement, and the pneumatic formwork is simultaneously used as a functionally integrated building skin. This results in a resource efficient construction process.

The ICD / ITKE Research Pavilion 2014-15 serves as a demonstrator for advanced computational design, simulation and manufacturing techniques and shows the innovative potential of interdisciplinary research and teaching. The prototypical building articulates the anisotropic character of the fiber composite material as an architectural quality and reflects the underlying processes in a novel texture and structure. The result is not only a particularly material-effective construction, but also an innovative and expressive architectural demonstrator.

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David Fano is currently the Chief Development and Chief Technology Officer at WeWork, where he is focusing on his passion for combining the digital world with a physical space to create an unparalleled experience for WeWork members. Prior to WeWork, David was a founding partner and Managing Director of CASE, where he leads the firm's strategic initiatives with an emphasis on business development, knowledge capture and sharing, and data management efforts. Trained as an architect, his interests and expertise are in connecting technology and data within the building industry. David received his Master of Architecture with honors from Columbia University and has been an Adjunct Professor at Columbia University's GSAPP since 2007. He has led seminars and workshops focusing on the impact of technology on design processes at conferences such as Autodesk University, RTC North America and AIA's Technology in Architectural Practice.

Jessica Rosenkrantz / Jesse Louis-Rosenberg

Nervous System is a generative design studio that works at the intersection of science, art, and technology. Designers Jessica Rosenkrantz and Jesse Louis-Rosenberg create using a novel process that employs computer simulation to generate designs and digital fabrication to realize products. Drawing inspiration from natural phenomena, they write computer programs based on processes and patterns found in nature and use those programs to create unique and affordable art, jewelry, and housewares.

Founded in 2007, Nervous System has pioneered the application of new technologies including 3D printing, webGL, and generative systems. Nervous System releases online design applications that enable customers to co-create products in an effort to make design more accessible. These tools allow for endless design variation and customization.

Jessica graduated from MIT in 2005 and holds degrees in architecture and biology. Afterwards, she studied architecture at the Harvard Graduate School of Design. Jesse also attended MIT, majoring in mathematics.

Nervous System's designs have been featured in a wide range of publications, including WIRED, the New York Times, the Guardian, Metropolis, and Forbes. Jesse and Jessica have given talks on their generative design process in many forums, including MIT, Harvard, SIGGRAPH, and the Eyeo Festival. Their work is a part of the permanent collection of the Museum of Modern Art and the Cooper–Hewitt, Smithsonian Design Museum and is currently on display in the exhibition "This is for everyone" at the Museum of Modern Art in New York.

Bastian Schäfer, born in 1980, is a maverick, kitesurfer, TED speaker, father of a boy and a girl and beside all of this automotive engineer. After his internship and diploma thesis on parametric associative design at Volkswagen Design Center Wolfsburg he received his diploma from the University of Applied Sciences Hamburg in 2006.

In December 2009 he joined the Cabin Innovation Strategy & Concepts team at Airbus and was member of the project team who created the mind-blowing Airbus Concept Cabin with its bionic structure.

This work resulted into talks at TEDGlobal 2013, BOLDtalks 2013 and interviews with Forbes, BBC, CNN, TheTakeaway, juri Magazin, Frankfurter Allgemeine Zeitung and VDI Nachrichten.

Bastian is the project leader of the Bionic Partition project where he is focusing on multi-objective optimization approaches combined with 3D printing technology within a joined-innovation project with Autodesk and other partners.

Since September 2014 he is part of the Emerging Technologies & Concepts team within the Airbus R&T organization. Yeah!

David Benjamin is Founding Principal of The Living and Assistant Professor at Columbia University Graduate School of Architecture, Planning and Preservation. The Living brings new technologies to life in the built environment, integrating design innovation, sustainability, and the public realm. Clients include the City of New York, 3M, Airbus, and Miami Science Museum. Recent projects include the Princeton Architecture Laboratory (a new building for research on next-generation design and construction technologies), Pier 35 EcoPark (a 200-foot floating pier in the East River that changes color according to water quality), and Hy-Fi (a branching tower for the Museum of Modern Art and MoMA PS1 made of a new type of biodegradable brick). The Living was recently acquired by Autodesk.

In 2008 **Gijs van der Velden** completed his master in International Law. During his studies he founded an art production company. After graduation his passion for the Arts won. He joined Joris Laarman Lab in 2009, assuming the general management position in 2011, becoming partner in 2014.

In this Lab the future of digital production is subject of critical and visionary research and development. After concluding the evolution of 3D printing would not bring the Lab a printer that could print big, fast and cheap enough, it decided to take matters in its own hands. It developed a robotic 3D printer that can print big object, out of the box, without support structure, in metals and resins.

In 2014 the partners of the Lab decided that their printing technique would continue as an official spin-off company named: MX3D, Multiple Axis 3D printing.

To proof the potential of its technique MX3D, together with partners like Autodesk and ArcelorMittal, set out on a journey to 3D print a metal bridge over a canal in the Red Light District of Amsterdam.

Joris Laarman Lab is an experimental playground set up to study and shape the future. It tinkers with craftsmen, scientists and engineers on the many new possibilities of upcoming technology. The work of Joris Laarman Lab has been added to the permanent collections of many renowned international museums like the MoMA, V&A, Centre Pompidou and recently the Rijksmuseum Amsterdam. End 2015 a solo exhibition of our experimental work initiated by the Groningen museum will start travelling around the world.

Professor **Achim Menges**, born 1975, is a registered architect in Frankfurt and professor at the University of Stuttgart, where he is the founding director of the Institute for Computational Design since 2008. He also is Visiting Professor in Architecture at Harvard University's Graduate School of Design since 2009.

Achim Menges practice and research focuses on the development of integral design processes at the intersection of morphogenetic design computation, biomimetic engineering and computer aided manufacturing that enables a highly articulated, performative built environment. His work is based on an interdisciplinary approach in collaboration with structural engineers, computer scientists, material scientists and biologists. He has published several books on this work and related fields of design research, and he is the author/coauthor of numerous articles and scientific papers. His projects and design research has received many international awards, has been published and exhibited worldwide, and form parts of several renowned museum collections, among others, the permanent collection of the Centre Pompidou in Paris.