

Guest-edited by  
ACHIM MENGE

# MATERIAL SYNTHESIS

Fusing the Physical and the Computational



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# Material Synthesis Fusing The Physical And The Computational Architectural Design

**Brendan Harmon**



## **Material Synthesis Fusing The Physical And The Computational Architectural Design:**

*Material Synthesis* Achim Menges, 2015-11-02 *Material Synthesis Fusing the Physical and the Computational* Guest edited by Achim Menges A new understanding of the material in architecture is fast emerging Designers are no longer conceiving of the digital realm as separate from the physical world Instead computation is being regarded as the key interface for material exploration and vice versa This represents a significant perceptual shift in which the materiality of architecture is no longer seen to be a fixed property and passive receptor of form but is transformed into an active generator of design and an adaptive agent of architectural performance In stark contrast to previous linear and mechanistic modes of fabrication and construction materialisation is now beginning to coexist with design as explorative robotic processes This represents a radical departure from both the trite modernist emphasis on truth to materials and the dismissal of materials by the previous generation of digital architects The issue features designers researchers and thinkers that are at the forefront of exploring new modes of material enquiry and its deep interrelationship with technology biology and culture Through their work which unfolds from multifaceted alliances between the fields of design engineering and natural sciences it seeks to trace the emergence of a novel material culture in architecture Architectural and engineering contributors include Sean Ahlquist Martin Bechthold Philippe Block Karola Dierichs Jan Knippers Achim Menges Neri Oxman Steffen Reichert and Tobias Schwinn Scientific and philosophical perspectives provided by Mario Carpo Manuel De Landa Neil Gershenfeld and Thomas Speck Features the design research of Harvard s Material Processes and Systems Group MIT s Mediated Matter Group and Stuttgart University s Institute for Computational Design

**Material Synthesis** Achim Menges, 2015-09-24 *Material Synthesis Fusing the Physical and the Computational* Guest edited by Achim Menges A new understanding of the material in architecture is fast emerging Designers are no longer conceiving of the digital realm as separate from the physical world Instead computation is being regarded as the key interface for material exploration and vice versa This represents a significant perceptual shift in which the materiality of architecture is no longer seen to be a fixed property and passive receptor of form but is transformed into an active generator of design and an adaptive agent of architectural performance In stark contrast to previous linear and mechanistic modes of fabrication and construction materialisation is now beginning to coexist with design as explorative robotic processes This represents a radical departure from both the trite modernist emphasis on truth to materials and the dismissal of materials by the previous generation of digital architects The issue features designers researchers and thinkers that are at the forefront of exploring new modes of material enquiry and its deep interrelationship with technology biology and culture Through their work which unfolds from multifaceted alliances between the fields of design engineering and natural sciences it seeks to trace the emergence of a novel material culture in architecture Architectural and engineering contributors include Sean Ahlquist Martin Bechthold Philippe Block Karola Dierichs Jan Knippers Achim Menges Neri Oxman Steffen Reichert and Tobias Schwinn Scientific and philosophical

perspectives provided by Mario Carpo Manuel De Landa Neil Gershenfeld and Thomas Speck Features the design research of Harvard s Material Processes and Systems Group MIT s Mediated Matter Group and Stuttgart University s Institute for Computational Design Post-industrial Robotics Angelo Figliola,Alessandra Battisti,2020-07-01 This book highlights the concept of informed architecture as an alternative to performance based approaches Starting with an analysis of the state of art the book defines an operative methodology in which performative parameters lead to the generation of the shape becoming the design s input rather than being mere quantitative parameters It then uses case studies to investigate the methodology Lastly the book discusses a novel way of conceiving and using the manufacturing tool which is the basis for the definition of informed architectures in relation to data usage and the optimization process *The Second Digital Turn* Mario Carpo,2017-10-20 The first digital turn in architecture changed our ways of making the second changes our ways of thinking Almost a generation ago the early software for computer aided design and manufacturing CAD CAM spawned a style of smooth and curving lines and surfaces that gave visible form to the first digital age and left an indelible mark on contemporary architecture But today s digitally intelligent architecture no longer looks that way In *The Second Digital Turn* Mario Carpo explains that this is because the design professions are now coming to terms with a new kind of digital tools they have adopted no longer tools for making but tools for thinking In the early 1990s the design professions were the first to intuit and interpret the new technical logic of the digital age digital mass customization the use of digital tools to mass produce variations at no extra cost has already changed the way we produce and consume almost everything and the same technology applied to commerce at large is now heralding a new society without scale a flat marginal cost society where bigger markets will not make anything cheaper But today the unprecedented power of computation also favors a new kind of science where prediction can be based on sheer information retrieval and form finding by simulation and optimization can replace deduction from mathematical formulas Designers have been toying with machine thinking and machine learning for some time and the apparently unfathomable complexity of the physical shapes they are now creating already expresses a new form of artificial intelligence outside the tradition of modern science and alien to the organic logic of our mind

**International Journal for Digital Art History: Issue 3, 2018** Liska Surkemper,Harald Klinke,Justin Underhill,2019-02-18 Art History is centrally concerned with a vast array of three dimensional objects such as sculptures and spaces such as architecture Digital technologies allow the creation of virtual spaces which in turn allow us to simulate and compare aspects of a visual culture s three dimensional timespace that cannot be communicated as a single still image The third issue thus focusses on the third dimension in Art History and the digital realm that continues to mediate and transform it **Biomimicry in Architecture** Michael Pawlyn,2025-09-01 Regenerative design requires transformative approaches Biomimicry provides a perspective that radically rethinks architecture from the materials we use to the cities and systems we create Biomimicry harnesses not just natural beauty but the remarkable array of adaptations that species have perfected

over millennia With the climate crisis escalating biomimicry is no longer just an inspiration it is an imperative It recognises that we are nature and rather than viewing the living world as separate to us to be plundered for resources and pollution we are intrinsic to it While industries such as manufacturing transportation and product design have embraced biomimicry as a driver of sustainability architecture has yet to unlock its full potential This must change Nature holds the key to designing buildings and systems that can be net positive and show that humans can become responsible stewards of planet Earth The adaptations that have evolved in the living world can inspire radical game changing solutions self repairing structures air conditioned termite mounds and the extraordinary water harvesting abilities of a desert beetle These innovations have been tested through 3 8 billion years of evolution offering architects the chance to revolutionise the way we build and live Biomimicry in Architecture explores how nature s ingenuity can transform everything from structural efficiency and material innovation to water conservation energy systems and even the design of entire cities Featuring awe inspiring biological strategies this book presents urgent real world solutions for a sustainable future Completely rewritten and updated with new content and illustrations this edition puts forward a transformative case for biomimicry as a discipline that shows how to design as nature and integrate everything we do as humans into the web of life that supports us The future depends on it

Architectural Sciences and Technology Murat DAL,2021-04-15 Architectural Sciences and Technology **Machine Hallucinations** Matias del Campo,Neil Leach,2022-07-05 AI is already part of our lives even though we might not realise it It is in our phones filtering spam identifying Facebook friends and classifying our images on Instagram It is in our homes in the form of Siri Alexa and other AI assistants It is in our cars and our planes AI is literally everywhere Artworks generated by AI have won international prizes and have been sold at auction But what does AI mean for the world of design This issue of AD explores the nature of AI and considers its potential for architecture But this is no idle speculation Architects have already started using AI for architectural design and fabrication Yet astonishingly there has been almost no debate about AI within the discipline of architecture so far Surely nothing can be more important for the profession of architecture right now The issue looks at all aspects of AI its potential to assist architects in designing buildings so that it becomes a form of augmented intelligence its capacity to design buildings on its own and whether AI might open up an extraordinary new chapter in architectural design Contributors Refik Anadol Daniel Bolojan Alexa Carlson Sofia Crespo and Feileacan McCormick Gabriel Esquivel Jean Jaminet and Shane Bugni Behnaz Farahi Theodoros Galanos and Angelos Chronis Eduard Haiman Wanyu He Damjan Jovanovic and Lidija Kljakovic Immanuel Koh Maria Kuptsova Sandra Manninger Lev Manovich Achim Menges and Thomas Wortmann Wolf dPrix Karolin Schmidbaur and Efilena Baseta M Casey Rehm and Hao Zheng and Masoud Akbarzadeh Featured architects Alisa Andrasek Coop Himmelb l au Lifeforms io Nonstandardstudio SPAN Kyle Steinfeld Studio Kinch and Xkool Technology *Soft Living Architecture* Rachel Armstrong,2018-09-06 *Soft Living Architecture* explores the invention of new architectures based on living processes It crafts a unique intersection between

two fast developing disciplines biomimicry and biodesign in architecture and bioinformatics and natural computing in the natural sciences This is the first book to examine both the theory and methodology of architecture and design working directly with the natural world It explores a range of approaches from the use of life like systems in building design to the employment of actual growing and living cell and tissue cultures as architectural materials creating architecture that can change learn and grow with us The use of living architecture is cutting edge and speculative yet it is also inspiring a growing number of designers worldwide to adopt alternative perspectives on sustainability and environmental design The book examines the ethical and theoretical issues arising alongside case studies of experimental practice to explore what we mean by natural in the Anthropocene and raise deep questions about the nature of design and the design of nature This provocative and at times controversial book shows why it will become ever more necessary to embrace living processes in architecture if we are to thrive in a sustainable future

**Dimensions. Journal of Architectural Knowledge** Nicolai Bo Andersen, Victor Boye Julebæk, Eva Sievert Asmussen, 2024-11-22 Dimensions Journal of Architectural Knowledge is an academic journal in on and from the discipline of architecture addressing the constitution of architectural knowledge It explores methods genuine to the discipline and architectural modes of interdisciplinary methodological adaptations Processes and results of knowledge creation and practice are esteemed coequally with particular attention to the architectural design in practice and research Making Sense Thinking through Making Architecture Issue 06 2023 investigates how the production of architectural knowledge involves the interaction of the body the material reality and the environmental world Making sense here is defined as the production of architectural knowledge through the physical act of making The contributors to this issue show how making architecture may be understood as a way of thinking

*Humanizing Digital Reality* Klaas De Rycke, Christoph Gengnagel, Olivier Baverel, Jane Burry, Caitlin Mueller, Minh Man Nguyen, Philippe Rahm, Mette Ramsgaard Thomsen, 2017-09-15 This book aims at finding some answers to the questions What is the influence of humans in controlling CAD and how much is human in control of its surroundings How far does our reach as humans really go Do the complex algorithms that we use for city planning nowadays live up to their expectations and do they offer enough quality How much data do we have and can we control Are today's inventions reversing the humanly controlled algorithms into a space where humans are controlled by the algorithms Are processing power robots for the digital environment and construction in particular not only there to rediscover what we already knew and know or do they really bring us further into the fields of constructing and architecture The chapter authors were invited speakers at the 6th Symposium Design Modelling Symposium Humanizing Digital Reality which took place in Ensa Versailles France from 16-20 September 2017

*Digital Property* Wendy W. Fok, Antoine Picon, 2016-11-07 Even more than authorship ownership is challenged by the rise of digital and computational methods of design and production These challenges are simultaneously legal ethical and economic How are new methods of fabrication and manufacture going to irreversibly change not only ways of working but also designers

ethics and their stance on ownership In his 2013 second term State of the Union address President Obama stated that 3D printing has the potential to revolutionize the way we make almost everything Nowhere will the impact of 3D printing be felt greater than in the architectural and design communities When anyone can print out an object or structure from a digital file will designers still exert the same creative rights or will they need to develop new practice and payment models As architecture becomes more collaborative with open source processes will the emphasis on signature as the basis of ownership remain relevant How will wider teams working globally be accredited and compensated This issue of AD explores this subject it features the work of designers who are developing wholly new approaches to practice by exploring means of commercialising process based products rather than objects Contributors Phil Bernstein Mark Garcia Antoine Picon Carlo Ratti and David Ruy Featured architects Francis Bitonti Marjan Colletti Wendy W Fok Panagiotis Michalatos Jose Sanchez Thibault Schwartz Aaron Sprecher Feng Xu and Philip Yuan

**Designing the Rural** Joshua Bolchover, John Lin, Christiane Lange, 2016-08-15 The rural is not what it used to be No longer simply a site for agricultural production for the city the relationship between the rural and urban has become much more complex Established categories such as rural urban and village city no longer hold true Rural and urban conditions have become increasingly blurred so how can we identify and distinguish their specific characteristics Where is the rural and what role does it play in an urbanised world In developing countries the countryside is a volatile and contradictory landscape legally designated rural areas look like dense slums factories intersect fields and farmers no longer farm In contrast in developed regions the rural has become a highly controlled landscape of production and consumption industrialised agriculture coexists with leisure landscapes for tourism retirement and recreation This issue of AD investigates how architects and researchers are critically engaging with the rural as an experimental field of exploration Contributors Neil Brenner Christiane Lange Charlotte Malterre Barthes Sandra Parvu Cole Roskam Grahame Shane Deane Simpson and Milica Topalovic and Bas Princen Architects Anders Abraham Joshua Bolchover and John Lin Rural Urban Framework Ambra Fabi and Giovanni Piovene Piovenefabi Rainer Hehl Stephan Petermann OMA Huang Sheng Yuan FieldOffice and Sandeep Virmani Hunnarshala

*French Gothic Ivories* Sarah M. Guérin, 2022-09-08 This volume is the first to consider the golden century of Gothic ivory sculpture 1230 1330 in its material theological and artistic contexts Providing a range of new sources and interpretations Sarah Gu rin charts the progressive development and deepening of material resonances expressed in these small scale carvings Gu rin traces the journey of ivory tusks from the intercontinental trade routes that delivered ivory tusks to northern Europe to the workbenches of specialist artisans in medieval Paris and ultimately the altars and private chapels in which these objects were venerated She also studies the rich social lives and uses of a diverse range of art works fashioned from ivory including standalone statuettes diptychs tabernacles and altarpieces Offering new insights into the resonances that ivory sculpture held for their makers and viewers Gu rin s study contributes to our understanding of the history of materials craft and later medieval devotional

practices *Computational Design for Landscape Architects* Brendan Harmon, 2024-05-31 This book is a guide to computational design for landscape architects replete with extensive tutorials It introduces algorithmic approaches for modeling and designing landscapes The aim of this book is to use algorithms to understand and design landscape as a generative system i e to harness the processes that shape landscape to generate new forms An algorithmic approach to design is gently introduced through visual programming with Grasshopper before more advanced methods are taught in Python a high level programming language Topics covered include parametric design randomness and noise waves and attractors lidar drone photogrammetry point cloud modeling terrain modeling earthworks digital fabrication and more The chapters include sections on theory methods and either visual programming or scripting Online resources for the book include code and datasets so that readers can easily follow along and try out the methods presented This book is a much needed guide both theoretical and practical on computational design for students educators and practitioners of landscape architecture

*Utopia Computer. The "New" in Architecture?* Bredella, Nathalie, Dähne, Chris, Lausch, Frederike, 2023-05-31 The critical concern of the book *Utopia Computer* is the euphoria expectation and hope inspired by the introduction of computers within architecture in the early digital age With the advent of the personal computer and the launch of the Internet in the 1990s utopian ideals found in architectural discourse from the 1960s were revisited and adjusted to the specific characteristics of digital media Taking the 1990s discourse on computation as a starting point the contributions of this book grapple with the utopian promises associated with topics such as participation self organization and non standard architecture By placing these topics in a historical framework the book offers perspectives for the future role computation might play within architecture and society Die Publikation *Utopie Computer* thematisiert die Euphorie und die Erwartungen die mit der Einf hrung des Computers in der Architektur im fr hen digitalen Zeitalter verbunden sind Mit dem Aufkommen des Personal Computers und der kommerziellen Nutzung des Internets in den 1990er Jahren werden utopische Ideen die bereits den Architekturdiskurs der 1960er Jahre pr gten aufgegriffen und an die spezifischen M glichkeiten der digitalen Medien angepasst Ausgehend vom Diskurs eines computer basierten Entwerfens der 1990er Jahre setzen sich die Beitr ge dieses Buches mit Entwurfskonzepten der Nachkriegszeit auseinander Es werden Themen wie Partizipation Selbstorganisation oder Non Standard Architektur in einen historischen Kontext gesetzt und Perspektiven f r die zuk nftige Rolle des Computers in der Architektur und Gesellschaft entwickelt

*Design Transactions* Bob Sheil , Mette Ramsgaard Thomsen , Martin Tamke, Sean Hanna, 2020 *Design Transactions* presents the outcome of new research to emerge from Innochain a consortium of six leading European architectural and engineering focused institutions and their industry partners The book presents new advances in digital design tooling that challenge established building cultures and systems It offers new sustainable and materially smart design solutions with a strong focus on changing the way the industry thinks designs and builds our physical environment Divided into sections exploring communication simulation and materialisation



Design Transactions explores digital and physical prototyping and testing that challenges the traditional linear construction methods of incremental refinement This novel research investigates the digital chain between phases as an opportunity for extended interdisciplinary design collaboration The highly illustrated book features work from 15 early stage researchers alongside chapters from world leading industry collaborators and academics *Architecture Research Building* Achim Menges, Jan Knippers, 2020-12-07 How can the fundamental digital change taking place in design and construction be actively used to bring about cultural change in architecture By exploring robotic production methods and innovative material developments Achim Menges and Jan Knippers have succeeded in developing genuine digital building systems that combine architectural elegance with effective construction The book provides an insight into ten years of joint research at the ICD and ITKE Institutes of Stuttgart University Taking completed pavilions and buildings as examples the authors demonstrate the viability of the underlying hypotheses that impressively push the limits of construction Articles from international experts contribute to the current debate on architecture [Lineament: Material, Representation and the Physical Figure in Architectural Production](#) Gail Peter Borden, Michael Meredith, 2017-08-29 This comprehensive catalogue of contemporary work examines the renewed investment in the relationship between representation materiality and architecture It assembles a range of diverse voices across various institutions practices generations and geographies through specific case studies that collectively present a broader theoretical intention *Mass-Customised Cities* Tom Verebes, 2015-12-21 What happens when computational design and fabrication technologies ramp up to the urban scale Though these innovative production processes are currently now largely limited to small scale design projects what will happen when they are applied to the vast scale of the 21st century world city Could new technologies enable an important shift away from mass production to increasingly bespoke and custom designed systems The introduction of standardisation and mass production processes in the 20th century saw the industrial city take on a repetitious and homogeneous quality through the duplication of component parts Today non standard bespoke systems hold out the promise of realising a distinctive urbanism characterized by the differentiation of serial production and the variation of simple parts that should lead to a more complex and compelling whole Given the current pace and rate of urbanisation in Asia the mass customization of the city is set to have imminent and far reaching practical consequences for the rest of the developing and developed world

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