

# Computational Design

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<i>Computational Design</i>	2022-03-26
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*Computational Design* John Wiley & Sons

This book connects the different topics and professions involved in information technology approaches to architectural design, ranging from computer-aided design, building information modeling and programming to simulation, digital representation, augmented and virtual reality, digital fabrication and physical computation. The contributions include experts' academic and practical experiences and findings in research and advanced applications, covering the fields of architecture, engineering, design and mathematics. What are the conditions, constraints and opportunities of this digital revolution for architecture? How do processes change and influence the result? What does it mean for the collaboration and roles of the partners involved. And last but not least: how does academia reflect and shape this development and what does the future hold? Following the sequence of architectural production - from design to fabrication and construction up to the operation of buildings - the book discusses the impact of computational methods and technologies and its consequences for the education of future architects and designers. It offers detailed insights into the processes involved and considers them in the context of our technical, historical, social and cultural environment. Intended mainly for academic researchers, the book is also of interest to master's level students.

**Geometric Computation: Foundations for Design** Springer Nature

This book publishes the peer-reviewed proceeding of the third Design Modeling Symposium Berlin . The conference constitutes a platform for dialogue on experimental practice and research within the field of computationally informed architectural design. More than 60 leading experts the computational processes within the field of computationally informed architectural design to develop a broader and less exotic building practice that bears more subtle but powerful traces of the complex tool set and approaches we have developed and studied over recent years. The outcome are new strategies for a reasonable and innovative implementation of digital potential in truly innovative and radical design guided by both responsibility towards processes and the consequences they initiate.

**Expressive Form** Springer Nature

"With the rapid emergence and adoption of new computational design technologies in the design field, it is important to critically understand how designers response to those new environments. This book systematically explores the impact of emerging computational design environments on design and designers. It offers an unique opportunity to look into design thinking in the current digital age"--

*Computational Design Modeling* Lulu.com

Conference Proceedings of the 2015 PRACTICE Symposium of Computational Processes in Architecture and Design, chaired by Rajaa Issa and Michael Rigglin. Includes papers presented at the conference and a poster session of work. Papers included: 'Essential Education for Computational Design in Architecture' by Rajaa Issa, 'FPD: First Person Designer' by Ben Regnier, 'Dynamic Acoustics: From Parametric Design to Digital Fabrication' by Erik Luhtala, 'Immersive Environments and Gestural Modeling' by P. Casey Mahon, 'Dynamic Architectural Systems' by Anthony Mull, 'Urban Acupuncture Through Algorithmic Zoning' by Ryan Stangl, 'Computational Architecture: Quantifying the Qualitative' by Hannah Hobbs, and 'Practical Deformation: A Study of Wood Bending Techniques Through Computational Logic' by Jose Villamizar. Poster session includes work by Andrew Reeder, Erik Luhtala, Anthony Mull, Roger Flores, and student work from courses taught by Rajaa Issa and Michael Rigglin.

*Computational Materials Discovery* Springer Nature

Digital Architecture Beyond Computers explores the deep history of digital architecture, tracing design concepts as far back as the Renaissance and connecting them with the latest software used by designers today. It develops a critical account of how the tools and techniques of digital design have emerged, and allows designers to deepen their understanding of the digital tools they use every day. What aesthetic, spatial, and philosophical concepts converge within the digital tools architects employ? What is their history? And what kinds of techniques and designs have they given rise to? This book explores the answers to these questions, showing how digital architecture brings together complex ideas and trajectories which span across several domains and have evolved over many centuries. It sets out to unpack these ideas, trace their origin and permeation into architecture, and re-examine their use in contemporary software. Chapters are arranged around the histories of nine 'fragments' - each a fundamental concept embedded in popular CAD applications: database, layers and fields, parametrics, pixel, programme, randomness, scanning, topology, and voxel/maxel - with each theme examined through a series of historical and contemporary case studies. The book thus connects the digital design process with architectural history and theory, allowing designers and theorists alike to develop more analytical and critical tools with which to conceptualise digital design and its software.

**Computational Design** John Wiley & Sons

Data, Matter, Design presents a comprehensive overview of current design processes that rely on the input of data and use of computational design strategies, and their relationship to an array of outputs. Technological changes, through the use of computational tools and processes, have radically altered and influenced our relationship to cities and the methods by which we design architecture, urban, and landscape systems. This book presents a wide range of curated projects and contributed texts by leading architects, urbanists, and designers that transform data as an abstraction, into

spatial, experiential, and performative configurations within urban ecologies, emerging materials, robotic agents, adaptive fields, and virtual constructs. Richly illustrated with over 200 images, Data, Matter, Design is an essential read for students, academics, and professionals to evaluate and discuss how data in design methodologies and theoretical discourses have evolved in the last two decades and why processes of data collection, measurement, quantification, simulation, algorithmic control, and their integration into methods of reading and producing spatial conditions, are becoming vital in academic and industry practices.

*Proceedings of the 2020 DigitalFUTURES* John Wiley & Sons

Exploration and Innovation in Design is one of the first books to present both conceptual and computational models of processes which have the potential to produce innovative results at early stages of design. Discussed here is the concept of exploration where the system, using computational processes, moves outside predefined available decisions. Sections of this volume discuss areas such as design representation and search, exploration and the emergence of new criteria, and precedent-based adaptation. In addition, the author presents the overall architecture of a design system and shows how the pieces fit together into one coherent system. Concluding chapters of the book discuss relationships of work in design to other research efforts, applications, and future research directions in design. The ideas and processes presented in this volume further our understanding of computational models of design, particularly those that are capable of assisting in the production of non-routine designs, and affirm that we are indeed moving toward a science of design.

*Computational Design for Landscape Architects* Springer

Over the last fifty years, the ability to carry out analysis as a precursor to decision making in engineering design has increased dramatically. In particular, the advent of modern computing systems and the development of advanced numerical methods have made computational modelling a vital tool for producing optimized designs. This text explores how computer-aided analysis has revolutionized aerospace engineering, providing a comprehensive coverage of the latest technologies underpinning advanced computational design. Worked case studies and over 500 references to the primary research literature allow the reader to gain a full understanding of the technology, giving a valuable insight into the world's most complex engineering systems. Key Features: Includes background information on the history of aerospace design and established optimization, geometrical and mathematical modelling techniques, setting recent engineering developments in a relevant context. Examines the latest methods such as evolutionary and response surface based optimization, adjoint and numerically differentiated sensitivity codes, uncertainty analysis, and concurrent systems integration schemes using grid-based computing. Methods are illustrated with real-world applications of structural statics, dynamics and fluid mechanics to satellite, aircraft and aero-engine design problems. Senior undergraduate and postgraduate engineering students taking courses in aerospace, vehicle and engine design will find this a valuable resource. It will also be useful for practising engineers and researchers working on computational approaches to design.

**Computational Design Methods and Technologies: Applications in CAD, CAM and CAE Education** Routledge

This open access book is a compilation of selected papers from 2020 DigitalFUTURES—The 2nd International Conference on Computational Design and Robotic Fabrication (CDRF 2020). The book focuses on novel techniques for computational design and robotic fabrication. The contents make valuable contributions to academic researchers, designers, and engineers in the industry. As well, readers will encounter new ideas about understanding intelligence in architecture.

**Designing the Computational Image, Imagining Computational Design** ORO Applied Research + Design

New computational design tools have evolved rapidly and been increasingly applied in the field of design in recent years, complimenting and even replacing the traditional design media and approaches. Design as both the process and product are changing due to the emergence and adoption of these new technologies. Understanding and assessing the impact of these new computational design environments on design and designers is important for advancing design in the contemporary context. Do these new computational environments support or hinder design creativity? How do those tools facilitate designers' thinking? Such knowledge is also important for the future development of design technologies. Research shows that design is never a mysterious non-understandable process, for example, one general view is that design process shares a common analysis-synthesis-evaluation model, during which designers interact between design problem and solution spaces. Understanding designers' thinking in different environments is the key to design research, education and practice. This book focuses on emerging computational design environments, whose impact on design and designers have not been comprehensively and systematically studied. It comprises three parts. The history and recent developments of computational design technologies are introduced in Part I. The main categories of technologies cover from computer-aided drafting and modelling tools, to visual programming and scripting tools for algorithmic design, to advanced interfaces and platforms for interactions between designers, between designers and computers, and between the virtual environment and the physical reality. To critically explore design thinking, especially in these new computational design environments, formal approaches to studying design thinking and design cognition are introduced and compared in Part II, drawing on literature and studies from the 70s to the current era. Part III concludes the book by exploring the impact of different computational design technologies on design and designers, using a series of case studies conducted by the author team building on their close collaboration over the past five years. The book offers new insights into designers' thinking in the rapidly evolving computational design environments, which have not been critically and systematically studied and reported in the current literature. The book is meant for design

researchers, educators and students, professional practitioners and consultants, as well as people who are interested in computational design in general.

**Computational Interaction** John Wiley & Sons

This book offers an introduction to the fundamental principles and systematic methodologies employed in computational approaches to ship design. It takes a detailed approach to the description of the problem definition, related theories, mathematical formulation, algorithm selection, and other core design information. Over eight chapters and appendices the book covers the complete process of ship design, from a detailed description of design theories through to cutting-edge applications. Following an introduction to relevant terminology, the first chapters consider ship design equations and models, freeboard calculations, resistance prediction and power estimation. Subsequent chapters cover topics including propeller design, engine selection, hull form design, structural design and outfitting. The book concludes with two chapters considering operating design and economic factors including construction costs and fuel consumption. The book reflects first-hand experiences in ship design and R&D activities, and incorporates improvements based on feedback received from many industry experts. Examples provided are based on genuine case studies in the field. The comprehensive description of each design stage presented in this book offers guidelines for academics, researchers, students, and industrial manufacturers from diverse fields, including ocean engineering and mechanical engineering. From a commercial point of view the book will be of great value to those involved in designing a new vessel or improving an existing ship.

**Computational Protein Design** John Wiley & Sons

The current transition from Computer Aided Design (CAD) to Computational Design in architecture represents a profound shift in design thinking and methods. Representation is being replaced by simulation, and the crafting of objects is moving towards the generation of integrated systems through designer-authored computational processes. While there is a particular history of such an approach in architecture, its relative newness requires the continued progression of novel modes of design thinking for the architect of the 21st century. This AD Reader establishes a foundation for such thinking. It includes multifaceted reflections and speculations on the profound influence of computational paradigms on architecture. It presents relevant principles from the domains of mathematics and computer science, developmental and evolutionary biology, system science and philosophy, establishing a discourse for computational design thinking in architecture. Rather than a merely technical approach, the book will discuss essential intellectual concepts that are fundamental not only for a discourse on computational design but also for its practice. This anthology provides a unique collection of seminal texts by authors, who have either provided a significant starting point through which a computational approach to design has been pursued or have played a considerable role in shaping the field. An important aspect of this book is the manner in which adjacent fields and historical texts are connected. Both the source of original inspiration and scientific thought are presented alongside contemporary writings on the continually evolving computational design discourse. Emerging from the field of science, principally the subjects of morphogenesis, evolution and mathematics, selected texts provide a historical basis for a reconfigured mindset of processes that generate, arrange and describe form. Juxtaposed against more contemporary statements regarding the influence of computation on design thinking, the book offers advancements of fundamental texts to the particular purpose of establishing novel thought processes for architecture, theoretically and practically. The first reader to provide an effective framework for computational thinking in design. Includes classic texts by Johan W. von Goethe, D'Arcy Thompson, Ernst Mayr, Ludwig von Bertalanffy, Gordon Pask, Christopher Alexander, John H. Holland, Nicholas Negroponte, William Mitchell, Peter J. Bentley & David W. Corne, Sanford Kwinter, John Frazer, Kostis Terzidis, Michael Weinstock and Achim Menges Features new writing by: Mark Burry, Jane Burry, Manuel Delanda and Peter Trummer.

**Computational Morphologies** Springer

Computational design is an emergent discipline that operates at the intersection of computer science, engineering, and design knowledge to develop new strategies, tools, methods and workflows in and for the conceptualisation and construction of the built environment. While computational design thinking and methods are widely argued to be troubling and transforming long-standing ways of working in the architecture, engineering and construction industries, the shift from promise to practice remains a challenge. This book documents the unique nexus of research and practice collaborations that form the basis of the Computational Design Education and Research programme at the University of New South Wales, Sydney. The diversity of projects and positions outlined in this publication contributes to advancing computational design as an interdisciplinary pursuit that is capable of innovatively addressing real-world built environment problems and opportunities through collaborative human-machine thought and action.

**Computational Approaches for Aerospace Design** Routledge

Parametric Design for Landscape Architects provides a sequence of tutorial-based workflows for the creation and utilization of algorithmic tools calibrated toward the field of landscape architecture. Contemporary practice and projective theory in landscape architecture require the processing and design of data associated with complex systems to adequately represent composite, emergent scenarios. Aligning to both traditional and nascent processes of analysis and digital modeling, this book unpacks and decodes the characterization of algorithmic-based automation, leveraging software that is widely accessible in both academia and professional practice. Curated throughout are workflows that apply to a multiplex of computation programs that widely support the design, analysis, and production of landscapes, primarily concentrated on digital modeling tools Grasshopper and Rhinoceros. It is a much-needed, visually accessible resource to aid in more efficient understanding and creation of tools that automate and re-examine traditional calculations, analyses, drawing standards, form-finding strategies, fabrication preparations, and speculative assessments/simulation. This primer provides professionals and students with multifaceted skill-sets that, when applied in practice, expand and expedite conventional and speculative design workflows applicable to spatial design, and more specifically landscape architecture. The book includes over 200 full-colour drawings, images, and tables to illustrate and support examples throughout.

**Material Synthesis** Routledge

- Computational Design offers an informed overview of the impact of computational techniques on architectural design today, providing a snapshot of

the latest developments in the field, drawing upon the leading experts in architectural practice and education from across the world - Publication accompanies that of a companion volume - Digital Fabrication ISBN 9787560873343 How are computational techniques changing the ways in which architects are designing buildings today? Computational Design offers a range of informed opinions on the subject written by some of the leading authorities in the world. It addresses parametric and algorithmic design, along with other related subjects, such as swarm intelligence, artificial intelligence, machine learning, interactive design, video gaming, building information modelling, geographic informational systems, remote sensing and data visualisation. The volume is divided into different sections comprising Manifestos, Methodologies and Projects, and also includes a helpful Introduction that offers a brief history of computational design.

**Computational Design Methods** John Wiley & Sons

This book introduces algorithmic approaches to computational design through both Grasshopper and Python. This book (including its accompanying code and datasets) is a much-needed guide, both theoretical and practical, on computational design for students, educators, and practitioners of landscape architecture.

**Informed Architecture** CRC Press

The contemporary material culture--everyday objects surrounding us--is dominated by mass manufactured products, but Digital Fabrication together with Computational Design (also called generative or parametric design) promises a shift towards substantially personalizable products, in a relatively cost-effective way. Considering this shift an opportunity for designers, the book argues that in order to consolidate the practice of developing personalizable products, designers need to change their focus from convergent to divergent user needs and desires, leaving room for the creative contributions of the users in the design of their objects, thus converting them from simple users to (computational) co-designers. Albeit such "on-demand" products are still rare in the everyday environment, there are numerous appreciable examples, which led to the recognition of six recurring personalization principles--or user motivations--of both mechanical and cognitive nature. Based on these, the book proposes a design approach the systematic replicating the observed principles on any product typology, with the support of a new design tool: a canvas that guides the designer's thinking towards product concepts to which personalization is essential. The proposed tool might help designers to spread personalisable design across many product categories, thus creating new business opportunities coherently with the recent development of the Industry 4.0 paradigm. On the long term, this might promote a more active role of the user in shaping the material culture, both through improving functionality and through new ways of creating meaning.

**PRACTICE: Computational Processes in Architecture and Design** Springer Science & Business Media

New technologies are made possible by new materials, and until recently new materials could only be discovered experimentally. Recent advances in solving the crystal structure prediction problem means that the computational design of materials is now a reality. Computational Materials Discovery provides a comprehensive review of this field covering different computational methodologies as well as specific applications of materials design. The book starts by illustrating how and why first-principle calculations have gained importance in the process of materials discovery. The book is then split into three sections, the first exploring different approaches and ideas including crystal structure prediction from evolutionary approaches, data mining methods and applications of machine learning. Section two then looks at examples of designing specific functional materials with special technological relevance for example photovoltaic materials, superconducting materials, topological insulators and thermoelectric materials. The final section considers recent developments in creating low-dimensional materials. With contributions from pioneers and leaders in the field, this unique and timely book provides a convenient entry point for graduate students, researchers and industrial scientists on both the methodologies and applications of the computational design of materials.

**Computational Design Thinking** John Wiley & Sons

The development of new and superior materials is beneficial within industrial settings, as well as a topic of academic interest. By using computational modeling techniques, the probable application and performance of these materials can be easily evaluated. Computational Approaches to Materials Design: Theoretical and Practical Aspects brings together empirical research, theoretical concepts, and the various approaches in the design and discovery of new materials. Highlighting optimization tools and soft computing methods, this publication is a comprehensive collection for researchers, both in academia and in industrial settings, and practitioners who are interested in the application of computational techniques in the field of materials engineering.

**Parametric Design for Landscape Architects** Springer

Despite all of the technical advancements in generative design computing, there are many questions concerning the method by which computer generated forms should be designed and the meaning behind their shapes. While the seemingly endless possibilities of digital tools have allowed for the fluid patterning and manipulation of surfaces to become an icon of parametricism, they often fail to provide any deeper meaning or correlation between the formal and functional aspects of a building. There is often a lack of depth or significance behind the flashy images of assumed intricacy these algorithms produce--falling far short of their rich potential to engage with the real problems, processes, and functions of today. By exemplifying how to acquire and use data to inform design decisions, this book aims to shift complexity from the product to the process. Only then can we see the trend of computational design root itself in purpose and meaning and begin to engage with real issues. Focusing primarily on the use of algorithms to generate form, this manual includes instructions to access an online library of six different ready-to-go Grasshopper definitions (as well as videos and a digital copy of the book) that are set-up as a series of fast and easy form-finding techniques that can impact your work from the earliest stages of design. The minute you find out you have a project at a given location, within a determined site, of a specific square footage, you can begin this process. It is simply a matter of plugging in fixed, tangible information to run analyses that help you make informed design decisions. As a result, this manual will guide you step-by-step through both the technical and conceptual frameworks of several generative design processes. Ultimately, this book seeks to establish a meaningful methodology, guided by larger frameworks of design, that can be referenced by designers looking for help generating ideas for building forms through the use of digital tools.