Faculty of Architecture - Universität Innsbruck

PhD Symposium

Reader

29/11/2024

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Scientific committee and organisation
Karolin Schmidbaur, Barbara Imhof, Marjan Colletti,
Dagmar Reinhardt, Peter Massin, Andreas Körner,
Gonzalo Vaillo, Layla van Ellen, Rupert Maleczek, Tim Altenhof

Invited guests
Carolina Dayer
Aarhus School of Architecture
Susanne Witzgall
Academy of Fine Arts, Munich

PhD supervisors
Kathrin Aste
Marjan Colletti
Günther H. Filz
Andreas Flora
Ann Forsyth (Harvard GSD)
Olaf Gipser
Stefan Holst
Barbara Imhof
Xinghua Lu (Tongji University)
Claudia Pasquero
Marco Poletto
Miro Roman
Stefan Rutzinger
Kristina Schinegger
Karolin Schmidbaur
Peter Trummer

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The Faculty of Architecture at the University of Innsbruck initiated an annual PhD Symposium, open to all enrolled UIBK architecture PhD students. The symposium provides a platform for students to showcase and discuss the current status of their research. Participants presented their work on a poster display and gave a 5-10 minute oral presentation, followed by a discussion of their research approaches led by the scientific committee and guests. The event is open to all faculty, staff, and students.

PhD Symposium

The Faculty of Architecture at the University of Innsbruck is pleased to announce its annual PhD Symposium, open to all enrolled UIBK architecture PhD students. The symposium provides a platform for students to showcase and discuss the current status of their research. Participants will present their work in a poster display and a 5-10 minute oral presentation, followed by a discussion of their research approaches led by the scientific committee and invited guests. This event is open to the public, and we warmly invite faculty, staff, and students to attend.

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Kristina Schinegger
Karolin Schmidbaur
Peter Trummer

Foyer @ Faculty of Architecture

09:00 - Introduction *by Karolin Schmidbaur*

09:15 - Session 1 *Moderator: Layla van Ellen*
Georg Grasser: From Failure To Functional
Supervisor: Marjan Colletti
Fereshteh Khojastehmehr: Self-Organized Spatial Structures
Supervisor: Günther H. Filz
Mohammad Hassan Saleh Tabari: Heuristic Lightweight Crafting
Supervisor: Günther H. Filz

10:30 - Session 2 *Moderator: Andreas Körner*
Haoyi Chen: Materia
Supervisor: Claudia Pasquero, Marco Poletto
Anna Arlyapova: The Concept Of The New In Architecture
Supervisor: Peter Trummer
Yiqun Wang: Mediating Hyperobjects
Supervisor: Peter Trummer, Ann Forsyth (Harvard GSD), Xinghua Lu (Tongji University)

11:45 - Session 3 *Moderator: Peter Massin*
Vadim Smakhtin: Aesthetics As A Protocol
Supervisor: Claudia Pasquero
Peyman Esmaeelpour: City As An Accumulation Of Miniature Structures
Supervisor: Peter Trummer
Oliver von Malm: Design Innovation For Informal Settlements
Supervisor: Karolin Schmidbaur, Stefan Holst

13:45 - Poster Session *Moderator: Rupert Maleczek*
Santosh Kumar Ketham: Adaptive Architecture And Urbanism
Supervisor: Marjan Colletti
Ugochukwu Franklin Eze: Citiness Of Lagos
Supervisor: Andreas Flora, Miro Roman
Daria Smakhtina: Interspecies Architecture
Supervisor: Marjan Colletti
Natalia Pióreckа: Advancing Biofabricated Architecture
Supervisor: Barbara Imhof
Kilian Bauer: Additive Inherencies
Supervisor: Marjan Colletti

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University of Innsbruck

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Programme

Introduction by Karolin Schmidbaur

Session 1 Moderator: Layla van Ellen

Georg Grasser: FROM FAILURE TO FUNCTIONAL
3D printing between academic experiment and industrial application
Supervisor: Marjan Colletti

Fereshteh Khojastehmehr: SELF-ORGANIZED SPATIAL STRUCTURES
Exploration of Naturally Curved Patterns in Bending and Torsion Active Lightweight Structure
Supervisor: Günther H. Filz

Mohammad Hassan Saleh Tabari: HEURISTIC LIGHTWEIGHT CRAFTING
An augmented computational framework for creatively designing while intuitively making
Supervisor: Günther H. Filz

Session 2 Moderator: Andreas Körner

Haoyi Chen: MATERIA
Innovating Material Ontologies through Design Systems
Supervisor: Claudia Pasquero, Marco Poletto

Anna Arlyapova: THE CONCEPT OF THE NEW IN ARCHITECTURE
On the case study of works by Rem Koolhaas
Supervisor: Peter Trummer

Yiqun Wang: MEDIATING HYPEROBJECTS
Transforming Toxic Liquid into "Hyper Landscape Cyborg"
Supervisor: Peter Trummer, Ann Forsyth (Harvard GSD), Xinghua Lu (Tongji University)

Session 3 Moderator: Peter Massin

Vadim Smakhtin: Aesthetics As A Protocol
Using patterns and aesthetics to perceive and understand ecology
Supervisor: Claudia Pasquero

Peyman Esmaeelpour: City As An Accumulation Of Miniature Structures
Shenzhen Metapolis; "city of exacerbated difference"
Supervisor: Peter Trummer

Oliver von Malm: Design Innovation For Informal Settlements
Rethinking how we collaborate through full scale, built research
Supervisor: Karolin Schmidbaur, Stefan Holst

Poster Session Moderator: Rupert Maleczek

Santosh Kumar Ketham: Adaptive Architecture And Urbanism
Rethink Mumbai Flooding for Sustainable and Egalitarian Habitat
Supervisor: Marjan Colletti

Ugochukwu Franklin Eze: Citiness Of Lagos
Reimagining Cities through Digital Narratives and Local Perspectives
Supervisor: Andreas Flora, Miro Roman

Daria Smakhtina: Interspecies Architecture
Creating Interfaces Between Humans and Nature
Supervisor: Marjan Colletti

Natalia Piórecka: Advancing Biofabricated Architecture
Developing Mycelium-Based Materials with Enhanced Durability, Adaptable Design, and Natural Coloration for Automotive and Architectural Applications
Supervisor: Barbara Imhof

Kilian Bauer: Additive Inherencies
Strategies towards an additive design thinking
Supervisor: Marjan Colletti

SESSION 1

FROM FAILURE TO FUNCTIONAL

3D printing between academic experiment and ~~industrial~~ application

Georg Grasser
Supervisor: Prof. Marjan Colletti
department of experimental architecture | building design and construction

Large scale 3 D printing is becoming increasingly relevant in architecture and industry, with early efforts largely centered on 3D printed concrete due to its strength and durability However, concrete's high carbon footprint has raised environmental concerns, prompting a search for more sustainable alternatives The University of Innsbruck's spin off, incremental 3 d, has been developing techniques to enhance process stability with concrete now, a growing emphasis on bioplastics, recycled composites, and biodegradable materials signals a shift in material innovation and brings new challenges In response to resource limitations and environmental pressures, this research investigates a broader range of materials and processing methods that promote sustainable resource use While recycled, natural, and upcycled materials are becoming more accessible, critical lifecycle factors including durability, maintenance, recyclability, and overall resistance demand further study to maximize their potential in construction applications In large scale 3 D printing, each material's properties are crucial in meeting specific design and performance requirements This research emphasizes the integration of advanced computational techniques to manage localized print parameters such as layer width, height, speed, and additive use enabling precise control over material behavior and design outcomes By carefully managing these variables, 3D printing can achieve customized structures that meet aesthetic and functional needs while reducing material waste This project aims to optimize material efficiency in large scale additive manufacturing by enhancing precision and minimizing failure rates, ultimately evaluating the broader impacts of these strategies on sustainable construction practices.

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FROM FAILURE TO FUNCTIONAL:

3D printing between ~~academic~~ experiment and ~~industrial~~ application

University of Innsbruck
department of experimental architecture | building design and construction

Dipl.-Ing. Georg Grasser, MAS

Supervisor: Univ.-Prof. Dipl.-Ing. Marjan Colletti, PhD

ABSTRACT

Large-scale 3D printing is becoming increasingly relevant in architecture and industry, with early efforts largely centered on 3D-printed concrete due to its strength and durability. However, concrete's high carbon footprint has raised environmental concerns, prompting a search for more sustainable alternatives. The University of Innsbruck's spin-off, incremental3d, has been developing techniques to enhance process stability with concrete; now, a growing emphasis on bioplastics, recycled composites, and biodegradable materials signals a shift in material innovation and brings new challenges. In response to resource limitations and environmental pressures, this research investigates a broader range of materials and processing methods that promote sustainable resource use. While recycled, natural, and upcycled materials are becoming more accessible, critical lifecycle factors—including durability, maintenance, recyclability, and overall resistance—demand further study to maximize their potential in construction applications. In large-scale 3D printing, each material's properties are crucial in meeting specific design and performance requirements. This research emphasizes the integration of advanced computational techniques to manage localized print parameters—such as layer width, height, speed, and additive use—enabling precise control over material behavior and design outcomes. By carefully managing these variables, 3D printing can achieve customized structures that meet aesthetic and functional needs while reducing material waste. This project aims to optimize material efficiency in large-scale additive manufacturing by enhancing precision and minimizing failure rates, ultimately evaluating the broader impacts of these strategies on sustainable construction practices.

BACKGROUND & RESEARCH QUESTION

Additive manufacturing, or 3D printing, represents a transformative shift from traditional subtractive methods by building objects layer by layer. This approach enables intricate geometries and custom designs that are otherwise difficult or costly to produce conventionally. In architecture and design, integrating robotic fabrication with digital design tools pushes the boundaries of what is possible. Industrial robots execute complex printing tasks with precision, adhering to high design and quality standards. The adaptability of robotic fabrication allows rapid reprogramming, enabling fast prototyping and iteration essential for experimental design, where continuous innovation is key. Scaling up 3D printing for construction, particularly with concrete, has been made possible through partnerships across structural engineering, material science, and international institutions. These bring expertise in logistics, assembly, and material behavior. The establishment of incremental3d exemplifies a commitment to experimentation and innovation, embracing advanced technologies to meet evolving industry demands. Despite all advancements in 3D printing, questions around material selection often remain divided between economic (industry standards) and ecological (societal relevance) aspects.

METHODOLOGY

The methodology involves analyzing previous projects and case studies that highlight the interaction between materials and robotic processes, illustrating the shift from traditional craftsmanship to advanced, human-machine collaborative production in architecture. This research will proceed with systematic testing and data collection across three primary areas: Geometry Translation and Printability: Examining the conversion of input geometries into 3D-printable forms to understand the material behavior and accuracy of printed structures. Geometry and Scale Limitations: Investigating constraints in geometry and scale to define feasible design boundaries for large-scale 3D printing applications. Material Property Measurement: Establishing a standardized setup to quantify material properties of 3D-printed structures, including load-bearing capacity, resistance to temperature, UV exposure, moisture, and chemicals. Finally, the methodology integrates environmental impact analysis, linking energy consumption, circular economy principles, and material lifespan, thus evaluating the broader sustainability of 3D-printed construction materials. This approach provides a comprehensive framework for advancing sustainable and durable 3D printing practices in architecture.

BEYOND THE STATE OF THE ART

Robotic fabrication and advanced technology applications in architecture have become critical areas of exploration. Leading universities conduct pioneering research in additive manufacturing, focusing on 3D printing for construction, material science, and sustainable building techniques. Among the top research labs are Digital Building Technologies (DBT) and Gramazio Kohler Research (ETH Zurich), MIT's Mediated Matter Group and Digital Structures Group, TU Delft's Robotic Building Lab, UCL's Autonomous Manufacturing Lab at the Bartlett School of Architecture, the Institute for Computational Design and Construction (ICD) and ITKE at the University of Stuttgart as well as Harvard's Graduate School of Design and Wyss Institute. These groups advance themes such as additive manufacturing with concrete, optimized geometries, and 3D-printed structural elements, often integrating bio-inspired approaches, sustainable materials, and hybrid processes. They emphasize large-scale 3D printing using recycled and eco-friendly materials, innovating in robotic construction and adaptable structural systems. Collaborations with industry, particularly in areas like bioprinting, disaster-resilient architecture, and sustainable urban infrastructure, allow them to translate academic research into practical applications. This transdisciplinary approach, merging design, technology, and sustainability, bridges academia and industry, meeting the evolving demands of the field.

FINDINGS

Robotic additive manufacturing enables the creation of customized architectural elements, setting new standards in fabrication. Key findings include: Experimental processes in robotic 3D printing reveals potential pathways for advancing in design, architectural and fabrication aspects. The identification of an essential framework brings clarification to the requirements for applying 3D-printed elements effectively within the building industry, ensuring structural and regulatory suitability. The development of a matrix of 3D printing materials facilitates informed decisions on material selection and composition, supporting the use of optimized materials and the development of new 3D-printed composites for construction applications. These insights pave the way for innovation in sustainable and efficient construction practices.


1st 3D printed concrete @REX|LAB, 2015


DOT-printing experiments REX|LAB, HBM, 2016


REX|LAB, EM2, 2015


assembly of 47 parts for the 3D printed pavilion


probiotic structures prototype, R.P. Beckett, S.P.Nair & incremental3d


3D concrete printed pavilion for the University of Innsbruck's 350th anniversary 2019

SELF-ORGANIZED SPATIAL STRUCTURES

Exploration of Naturally Curved Patterns in Bending and Torsion Active Lightweight Structure

Fereshteh Khojastehmehr
Supervisor: Prof. Günther H. Filz
Institute of Design, LSU Lightweight Structures Unit

Flexible grid structures are considered efficient structures due to their form, structural performance, and low material consumption. For many years, the search for optimal structural forms of elastic grids has been mainly based on repetitive patterns with changing boundary conditions and cross-section of the grid by multi-layer lattices. In our research, we have shown the potential of applying twist in elastic structures to increase the design freedom to achieve self-organizing forms. Unlike the common grid structures that usually have a constant surface thickness, the depth of our structure varies by rotating the profile of the strip along its longitudinal axis. Twist allows for a smooth transition from one pattern type such as geodesic to another such as asymptotic with a 90° rotation of the flexible strip profile. In this paper, we compare a simple grid with three different patterns - asymptotic, geodesic, and their combination by twisting the strip profile - from architectural aspects such as density, view, shadow, pattern, and structural aspects, including the deflection of the structural form. Considering the material behavior and introducing bending and twist as the actuators of the self-forming process, the resulting grid structures are naturally formed, provide highly variant options for design and in some cases show structurally well performing results. This approach promotes the use of elastic grid structures making them viable options in multi-objective architectural design.

SELF-ORGANIZED SPATIAL STRUCTURES

Exploration of Naturally Curved Patterns in Bending and Torsion Active Lightweight Structures

Austria
Universität Innsbruck
Institute of Design, LSU Lightweight Structures Unit

BA MA Fereshteh Khojastehmehr
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ABSTRACT

Flexible grid structures are considered efficient structures due to their form, structural performance, and low material consumption. For many years, the search for optimal structural forms of elastic grids has been mainly based on repetitive patterns with changing boundary conditions and cross-section of the grid by multi-layer arrays. In our research, we have shown the potential of applying twist in elastic structures to increase the design freedom to achieve self-organizing forms. Unlike the common grid structures that usually have a constant surface thickness, the depth of our structure varies by rotating the profile of the strip along its longitudinal axis. Twist allows for a smooth transition from one pattern type such as geodesic to another such as asymptotic with a 90° rotation of the flexible strip profile. In this paper, we compare a simple grid with three different patterns - asymptotic, geodesic, and their combination by twisting the strip profile - from architectural aspects such as density, view, shadow, pattern, and structural aspects, including the deflection of the structural form. Considering the material behavior and introducing bending and twist as the actuators of the self-forming process, the resulting grid structures are naturally formed, provide highly variant options for design and in some cases show structurally well performing results. This approach promotes the use of elastic grid structures making them viable options in multi-objective architectural design.

BACKGROUND & RESEARCH QUESTION

Elastic gridshells leverage the flexibility of materials to create sustainable design solutions for curved forms, eliminating the need for additional costs and energy associated with fabrication methods like CNC milling. In elastic gridshells, two pattern types are most commonly used: geodesic, where profiles are tangential to the surface, and asymptotic, where profiles are perpendicular to the surface. Each pattern has its own advantages from geometrical, architectural, and structural perspectives. Their shared advantage lies in the fact that both geodesic and asymptotic curves can be developed into straight, flat strips, allowing curved forms to be constructed from initially flat material sheets. Schling et al. proposed and implemented a hybrid pattern that uses one layer of geodesic and another of asymptotic profiles. But what if we could integrate these two patterns as a single, unified structure rather than treating them as separate layers? This approach enables us to leverage the benefits of both pattern types in different parts of a unified structure.

METHODOLOGY

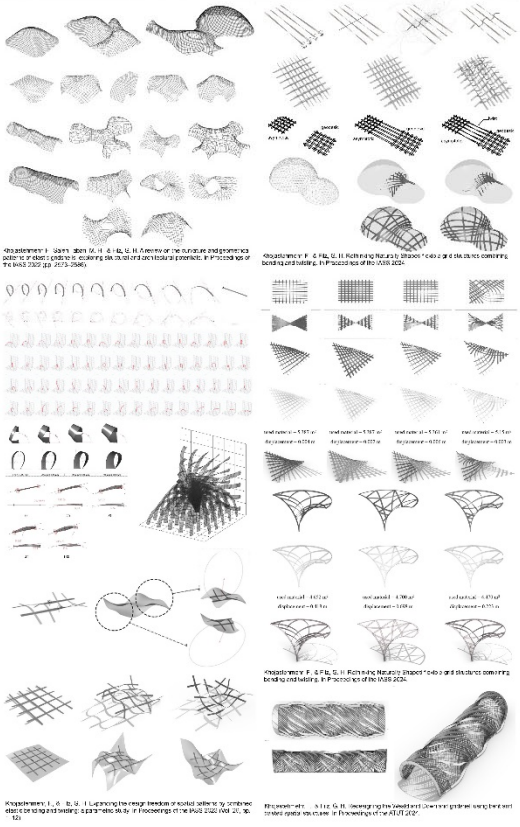
We propose applying an elastic twist along the longitudinal axis of the profile to create a smooth transition from the asymptotic to the geodesic pattern. For this approach, it is essential to consider the material properties, specifically the minimum bending radius and the twist length required to achieve a 90 degree twist, ensuring feasibility in fabrication. We use both digital and physical methods to conduct these experiments. In the first step, we perform physical tests on the material to determine its bending and twisting limits. In the second step, we incorporate this material behavior data into digital simulations, designing the geometric form based on both geometrical and physical constraints. Physical prototypes are used to validate the digital environment and evaluate the designed forms.

BEYOND THE STATE OF THE ART

Applying twist in the profile has shown effective results in changing the surface curvature, surface depth, and smooth transitioning between the pattern types of geodesic and asymptotic. Besides formal opportunities, shifting between the profile directions also responds to the structural performance. Utilizing the flexibility of the material and employing elastic twisting in the weak axis of the profile, we can transition between different cross-sections without cutting to shape, which usually generates additional waste. We propose combined geodesic-asymptotic patterns within the same grid structure, and compare and evaluate the resulting grid structure with the two common pattern types: geodesic and asymptotic. While in geodesic and asymptotic patterns the profile has a constant angle to the surface, in a combined geodesic-asymptotic pattern the profile twists in the longitudinal axis transitioning from one to the other pattern type. This results in change in characteristics including change in the surface depth, surface curvature, as well as structural performance.

FINDINGS

The results of our combined geodesic-asymptotic patterns improve our understanding of how pattern types—particularly the impact of profile twist—affect the architectural and structural qualities of resulting forms. This approach introduces these patterns as viable options for multi-objective design. We demonstrated that bent and twisted spatial structures can meet multiple design goals, such as enhancing user comfort in interior spaces, as shown by our first demonstrator, A-T-G Louvers. Additionally, these structures function effectively as self-supporting systems while offering unique formal and aesthetic qualities, as demonstrated by our recent large-scale prototype, Twisted Clouds. Our redesign of the Weald and Downland Gridshell, one of the most renowned elastic gridshells, demonstrated that our combined geodesic-asymptotic grid structures offer innovative solutions for revitalizing elastic gridshell design.

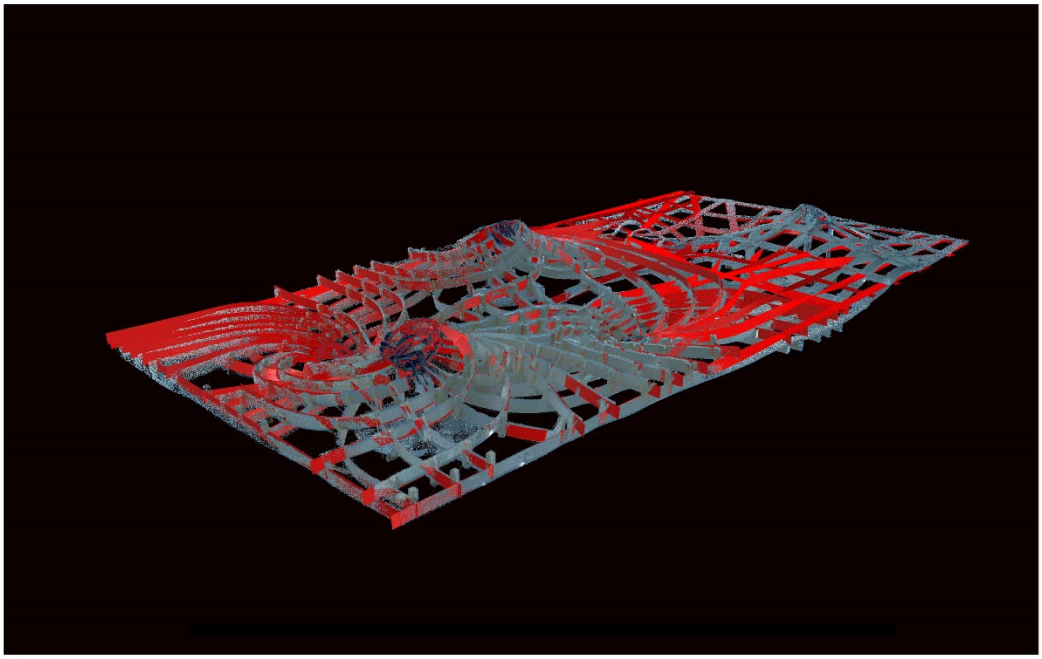


HEURISTIC LIGHTWEIGHT CRAFTING

An augmented computational framework for creatively designing while intuitively making

Mohammad Hassan Saleh Tabari
Supervisor: Prof. Günther H. Filz
Institute of Design, LSU Lightweight Structures Unit

Architects have always been concerned with adaptation, which involves selecting behaviors in response to change. Adaptive systems are open-ended systems working overtime with an evolutionary procedure to fit with dynamic changes. In design-space exploration, designers seek adaptability in both the design output and the design process. Adaptation in design outputs involves ensuring compatibility with the context, while adaptation in the design process entails adjusting the design based on findings. Adaptability can serve various target goals, depending on the design perspective, such as sustainability and economics. Designing a feasible spatial structure demands a combination of analytical evaluation and exploration of geometric design. Yet, considering geometry in such structures' design necessitates intricate mathematical computations. More specifically, the design of these structures is intimately tied to form-finding, a method that determines the complex geometric shape of a structure. Bird nest structures are examples of lightweight structures in nature. Based on what we may call intuition they integrate material properties and geometry in craft. While the birds` nest may seem chaotic and randomly assembled, investigations illustrate the fact that there is topological rules applied on the spatial structures they built. The adjustment of the structural pattern topology assets birds to adopt their nest to environmental conditions such as resistance against wind and rain. This project developed an intuitive design exploration and implementation inspired by weaverbirds nest-building to reach adoptive design. By studying the decision making of Weaverbirds during their nesting, we developed a learning algorithm to assist designers in design exploration through its intuition.



Heuristic Lightweight Crafting

An augmented computational framework for creatively designing while intuitively making

Austria
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BA MA Mohammad Hassan Saleh Tabari
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BACKGROUND & RESEARCH QUESTION

Architectural research groups have extensively explored natural and artificial systems, with a particular emphasis on adaptability, as evidenced by a wealth of literature. These studies have contributed to and offered insights into both the adaptive design process and the resulting design outputs.In the first categories of studies, the integration of digital fabrication techniques leads to a reduced need for direct designer intervention, shifting the creative process towards automated systems. The second categories investigations highlight the use of adaptation in fabrication, where the use of robotic technology primarily aids in achieving a more or less predefined final output, with less emphasis on mid process adaptability. In contrast, the third category of investigations centers on generative design within a digital environment, treating the generative engine as a "black box" that operates based on a predefined set of parameters, thus limiting the designer's ability to make real-time updates during the design-making process. Across these approaches, the trend indicates a move towards technology-driven design processes, with less emphasize on the designer interaction but more on adaptability. What strategies enable the synchronization of sustainable, low-tech fabrication techniques with advanced, AI-driven generative design systems to expand adaptive capabilities in architectural design?

METHODOLOGY

In our ongoing research, we have investigated the possibility of pattern prediction based on surface curvature change with a deep-learning model. The experiment results led us to develop a smart computational design environment, which we term 'pre-informed geometry modeling'. To implement our developed method, we introduce a cognitive multiple-actors spatial structure design, inspired by the strategy of weaverbirds. This design approach has the potential for local adjustments during the form-finding process, thereby achieving adaptability.

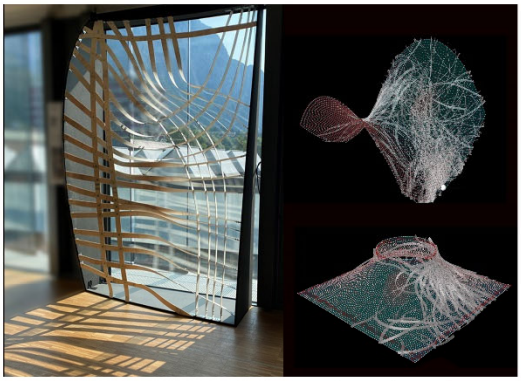
Currently we have developed an innovative numerical model that integrates differential geometry with reinforcement learning. This model generates complex geometrical patterns, evaluates structural stability, and learns from feedback. The output is a smart model that perceives the state of the design, predicts consequences heuristically, and suggests actions when prompted.

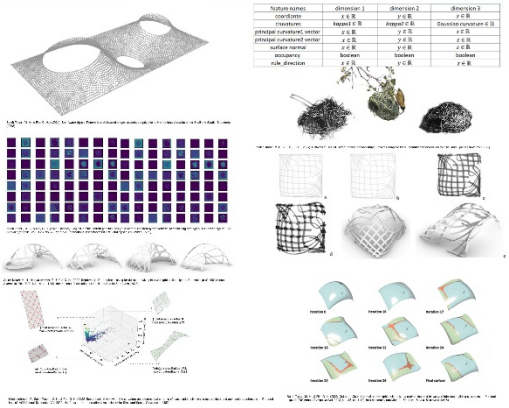
BEYOND THE STATE OF THE ART

Looking into nature, we can observe that design processes are inherently open-ended because their procedures are based on evolution. Naturally crafted structures provide valuable resources for investigating open questions. For instance, weaverbirds employ adaptive methodologies and gradually learn from their experiences in nest-building over time. This characteristic is similar to what we seek in adaptive design process. In seeking to implement their success in design, a crucial aspect of their process is that decision-making occurs directly during the construction of the nest. This implies that the overall output in shape and structure does not result from a hierarchical process, but rather emerges from direct exploration in craft. This type of exploration is referred as heuristic exploration. Following the principles of adaptive structure design, the applicant's research conducted extensive investigations over three years, resulting in a heuristic model of reinforcement learning, rooted in behavioral psychology, to seamlessly integrate diverse evaluation criteria into the form-finding process, fostering the creation of adaptive multi-purpose spatial structures.

FINDINGS

To exemplify our approach, the developed method has been applied to design a louver for one of the floors to ceiling windows as an alternative to conventional blinds for office and computer workspaces, aiming to enhance visual comfort, specifically with regards to glare effects in the indoor space. The results and monitoring confirmed that it is possible to design a low-tech fabricated louver with complex geometry that passively controls daylight, enhances social sustainability, a long-side with resource efficiency. We tested the developed numerical model in design and realization of roof structure in architectural scale. The investigations, findings, and development over our ongoing research results in an innovative approach to the design of spatial structures with capability of the self-learning.





SESSION 2

MATERIA

Innovating Material Ontologies through Design Systems

Haoyi Chen
Synthetic Landscape Lab
Supervisor: Prof. Claudia Pasquero, Dr. Marco Poletto

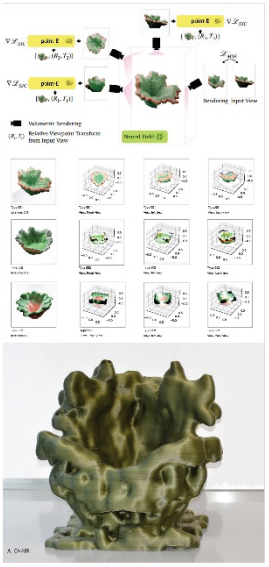
This research explores the transformative potential of Ulva algae within urban ecosystems through an innovative design system that integrates biological intelligence (BI), artificial intelligence (AI), and digital fabrication. Grounded in second-order cybernetics, the study unpacks materia into three interdependent layers—Material, Materiality, and Material Systems—revealing algae's potential to reshape ecological and social practices. Utilizing design as a recursive process, this framework positions algae as a regenerative agent rather than mere waste, contributing to a circular urban ecology. By converting algae into carbon-capturing bioplastics, urban products, and adaptive materials, this system aims to realign human intervention with natural cycles. Key case studies and design prototypes demonstrate a participatory approach that expands ecological awareness among nondesigners, enabling communities to engage directly with sustainable design practices. Through the proposed system, Ulva algae becomes a conduit for rethinking material cycles, encouraging collective responsibility and fostering new urban ecologies that are adaptive, resilient, and sustainable.

MATERIA

Innovating Material Ontologies through Design Systems

Austria
University of Innsbruck
Faculty of Architecture / Synthetic Landscape Lab

MArch / Haoyi Chen (PhD Candidate)



ABSTRACT

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BACKGROUND & RESEARCH QUESTION

Contemporary urban systems often treat organic waste as a problem to be managed rather than a resource to be integrated. In Qingdao, for example, algae blooms are typically viewed as pollutants and removed without consideration for their ecological role. This research addresses the question: Can design practices transform Ulva algae from a pollutant into a regenerative agent within urban environments? Drawing on theories of ecological resilience and second-order cybernetics, the study investigates how algae, an often-overlooked material, might be integrated into urban ecosystems to create adaptive, sustainable, and participatory models of urban resilience. The study engages with the concept of engineered photosynthesis, positing that algae's potential for carbon sequestration, energy generation, and biomaterial production can redefine its ecological and material status. This research aims to challenge anthropocentric approaches to urban ecology, proposing instead a design system that empowers both human and non-human actors to co-evolve within dynamic, cyclical processes.

METHODOLOGY

This research adopts an interdisciplinary approach, combining ecological design, digital fabrication, and computational intelligence to develop and test a circular design system for Ulva algae. The methodology comprises three phases: material transformation experiments, computational simulations, and participatory design frameworks. In the first phase, algae biomass is processed into various forms, including 3D-printed biomaterials, leveraging lab-based synthesis and industrial collaborations. The second phase uses biointelligence algorithms, such as reaction-diffusion models, to simulate algae's adaptive behaviors, with outputs ranging from fashion prototypes to urban-scale designs. The final phase introduces the design system to public settings, evaluating its capacity to foster ecological awareness and collective action. This methodology provides a recursive framework, allowing insights from each phase to inform and refine subsequent stages, thereby creating a responsive and adaptable system that aligns with natural material cycles.

BEYOND THE STATE OF THE ART

Current practices in sustainable design often rely on top-down models that fail to account for the inherent intelligence within natural systems. This research advances the field by integrating Ulva algae into an adaptive, multi-scalar design system that redefines materiality and material cycles within urban ecologies. Existing studies have primarily focused on algae's biomaterial potential in isolation, overlooking its ecological role and the possibilities within computational design. By employing second-order cybernetics and engineered photosynthesis, this study contributes a novel framework that emphasizes material as an active participant within feedback loops. This approach moves beyond green design to offer an open, collaborative protocol that enables public engagement and non-designer involvement in the creation of sustainable urban environments. This shift from individual, isolated applications to a co-evolving system represents a critical advancement in understanding materials as entities capable of sustaining circular, adaptive ecologies.

FINDINGS

The findings reveal that Ulva algae, when integrated into a recursive, second-order design system, can serve as a powerful regenerative agent within urban environments. The transformation of algae into a circular urban ecology challenges conventional waste management models and demonstrates a sustainable alternative that aligns human intervention with natural cycles. Public engagement, facilitated through accessible design protocols, has shown potential for broad social impact, from individual designers incorporating algae-based materials to local government interest in algae-derived products. Prototypes such as AI-generated chairs and algae-based urban furniture highlight the adaptability of algae across scales and applications. By transforming algae into products that inspire interaction and aesthetic appreciation, this research illustrates how design can reshape societal perceptions of waste, fostering a shared commitment to ecological stewardship. This system provides a model for scalable, circular design, advocating for a future where urban ecologies and human practices coalesce within sustainable frameworks.

THE CONCEPT OF *THE NEW* IN ARCHITECTURE

On the case study of works by Rem Koolhaas

Anna Arlyapova
Faculty of Architecture / IOUD
Supervisor: Prof. Peter Trummer

Research explores the origins of architectural form and how the effect of novelty in the context of architecture is created. Building on philosopher Boris Groys's idea about *The New*, who introduces the concepts of "cultural archives" and "present" (or "profane") and argues that on the intersection of these two worlds innovation can emerge. By translating this idea into the discipline of architecture, research is testing a hypothesis, that novelty in architecture emerges on the border of the "architectural archive" and the world of objects existing outside of it. Manipulating objects from outside of the discipline into interacting with the "architectural archive" and putting them into the context of architecture could potentially lead to the generation of the new. In this research, this theory is exemplified on the case study of Rem Koolhaas's work. Incorporating Donna Harraway's concept of situated knowledge, this research explores the multiplicity of "architectural archives" in space and time as a decentralized network, enriched by varied perspectives that challenge traditional hierarchies. Rosi Braidotti's concept of becoming introduces a view on these archives as dynamic and evolving, in a state of constant transformation. Braidotti's posthumanism and non-linear perception of time further deepens the exploration, highlighting how architectural innovation thrives on a cyclical, layered temporality, rather than a linear progression. Besides that, the study aims to illuminate the strategic role of the architect as a mediator, actively selecting and valorizing elements from the profane to fuel architectural innovation.

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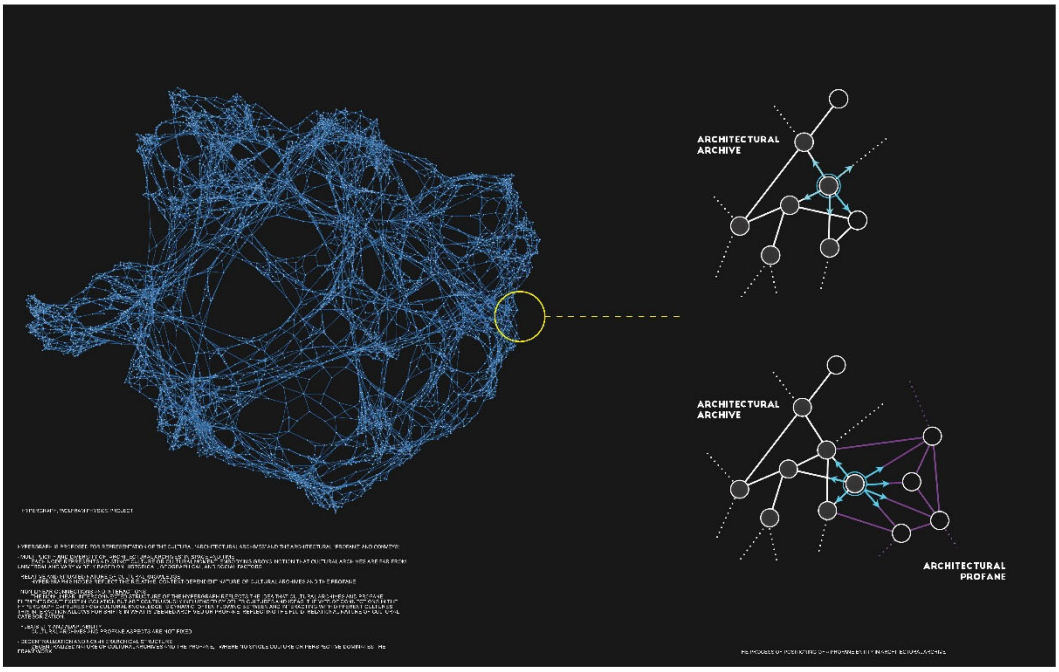


THE CONCEPT OF *THE NEW* IN ARCHITECTURE

on the case study of works by Rem Koolhaas

Austria
University of Innsbruck
Faculty of Architecture / IOUD

M.A. Anna Arlyapova

ABSTRACT

Research explores the origins of architectural form and how the effect of novelty in the context of architecture is created. Building on philosopher Boris Groys's idea about "The New" who introduces the concepts of "cultural archives" and "present" (or "profane") and argues that on the intersection of these two worlds innovation can emerge. By translating this idea into the discipline of architecture, research is testing a hypothesis, that novelty in architecture emerges on the border of the "architectural archive" and the world of objects existing outside of it. Manipulating objects from outside of the discipline into interacting with the "architectural archive" and putting them into the context of architecture could potentially lead to the generation of the new. In this research, this theory is exemplified on the case study of Rem Koolhaas's work.

Incorporating Donna Haraway's concept of *situated knowledge*, this research explores the multiplicity of "architectural archives" in space and time as a decentralized network, enriched by varied perspectives that challenge traditional hierarchies. Rosi Braidotti's concept of *becoming* introduces a view on these archives as dynamic and evolving, in a state of constant transformation. Braidotti's posthumanism and non-linear perception of time further deepens the exploration, highlighting how architectural innovation thrives on a cyclical, layered temporality rather than a linear progression. Besides that, the study aims to illuminate the strategic role of the architect as a mediator, actively selecting and valorizing elements from the profane to fuel architectural innovation.

BACKGROUND & RESEARCH QUESTION

Every historical period, every Zeitgeist brings a different paradigm of the new: overcoming the old in modernism, radical and ecstatic deletion of the past in avant-garde, doubt of the possibility of historical novelty in postmodernism. Philosopher Boris Groys points out that now we seem to be happy about the loss of history, the utopian future. It echoes an idea of Peter Eisenman, who in his text *Post-Fi-nctionalism* calls entering the era of "post-modernism" as a "relief" similar to that which accompanies the advice that one is no longer an adolescent. In this context, how the new and the effect of novelty in architecture has been evolved and how is it changing in the era of posthumanism? Specifically, how does innovation emerge within architecture when the archive itself becomes a vast field - one that blurs distinctions between cultural and profane, valuable and mundane? In addition to that, this research explores the shifting role of authorship. How the concept of the author is transforming, taking into account the technological development and shifts in cultural paradigms?

METHODOLOGY

This research takes Rem Koolhas as a case study, and through close reading of his works examines how the architect uses "architectural archive" and "architectural profane" for creation of new forms of architecture. Despite the fact that some elements could be traced back to the repertoire of well-known masters, when Koolhaas brings them together in his particular ensembles, they become something new. In addition to cultural precedents in the architect's work the research speculates on the "extra", something that cannot be identified and that could be considered as Koolhaas' unique reservoir. The hypothesis of this research is that this "extra" is coming from the "architectural profane", outside of the discipline. Drawing on Haraway's concept of *situated knowledge*, which challenges the notion of universal, objective truth, this research introduces a multiplicity of intersecting of architectural archives. Braidotti's theories on non-linear time and the concept of *becoming* enriches the framework by positioning "architectural archive" as a space of continuous transformation, where the new emerges from the archive's non-static, evolving nature.

BEYOND THE STATE OF THE ART

This research moves beyond traditional architectural theory by positioning cultural innovation within a broader, interdisciplinary framework. While architectural discourse has often celebrated novelty, it has not fully explored how innovation might arise from interactions with what Groys calls the profane. Existing studies on Koolhaas focus on his stylistic diversity or his influence on contemporary architecture, yet few have examined his work through the lens of Groys's cultural archive theory. By integrating Haraway's *situated knowledge*, this study departs from conventional architectural analyses, viewing the architectural archive as a networked, pluralistic space. Haraway's approach reveals the architectural archive as a decentralized, open-ended collection where diverse sources of knowledge coexist, challenging the singular, authoritative narratives often associated with architectural history. Braidotti's ideas on cyclical, non-linear temporality invite a posthumanist perspective on the archive, where historical and contemporary elements intermingle, creating dynamic, layered forms of cultural expression.

FINDINGS

The findings suggest that the architectural "archive" is not a fixed hierarchy but a fluid space where innovation occurs through strategic appropriation of profane elements. As Groys argues, "valorization of profane things does not happen automatically, but strategically." In Koolhaas's work, the transformation of non-architectural elements into culturally significant forms requires an active, strategic authorial presence. This study demonstrates that the architectural archive operates as a networked space enriched by intersecting cultural perspectives, challenging singular narratives. The archive emerges as an evolving network of cultural nodes, influenced by social and technological contexts that constantly reshape its boundaries. Informed by Braidotti's concept of becoming, the research concludes that architectural innovation is not a linear progression but a layered process, where the archive remains in flux, allowing historical and contemporary elements to coexist and generate new meanings.

"...try to find the concept through which the worthless turns into something, where even the sublime is not unthinkable".
Koolhaas, Rem. "Interview." El Croquis, no. 53, 1991, p. 18.

STRATEGIES OF THE NEW IN WORKS BY KOOLHAAS

TYPOLOGICAL SUBVERSION.
Taking an established architectural typology and integrating profane elements.

Dom-ino house
+
ramping system of a parking structures

Library typology
+
circulation of a shopping mall

COLLAGE OF FUNCTIONS
Merging multiple, diverse functions into a single architectural space, creating hybrid environments that blur the lines between public, private, cultural, and profane realms.

Layered, collage-like approach brings profane, everyday spaces—like cafes, retail areas, or transit hubs—into buildings traditionally focused on a singular purpose.

URBAN CONTEXT

Rem Koolhaas's research on Lagos can be viewed as an example of objet trouvé, where the city itself is explored as a complex, dynamic "found object."

PROFANE AESTHETICS
The usage of forms, materials, and aesthetics that are atypical, disruptive, and traditionally seen as utilitarian or unattractive.

The polygonal, concrete exterior deviates from the symmetry often associated with concert halls. Raw, geometric form draws on industrial aesthetics, challenging the elitism typically associated with cultural venues.

ADAPTIVE REUSE
Recontextualisation of existing structures.

Through adaptive reuse, he takes what might be considered outdated or obsolete (elements from the architectural profane) and recontextualizes them within a new architectural narrative.

MEDIATING HYPEROBJECTS

Transforming Toxic Liquid into “Hyper Landscape Cyborg”

Yiqun Wang
Supervisors: Prof. Peter Trummer (IOUD), Prof. Ann Forsyth (Harvard GSD), Prof. Xinghua Lu (Tongji University)
Institute of Urban Design (IOUD)

This study explores the transformation of toxic liquid into "Hyper Landscape Cyborgs," positioning landscape design as an active agency to mediate the hyperobject—a concept described by Timothy Morton. Integrating Morton's "Hyperobjects" with Elizabeth Meyer's "Landscape Cyborgs," the research reconceptualizes degraded landscapes as complex intersections of aesthetics, ecology, and technology in the Anthropocene. By focusing on different sites facing toxic liquid across three countries—Lingang New City in Shanghai, China; the South Boston Community in the United States; and the Fort McKay First Nation Oil Sands in Canada—the study introduces design methodologies that merge ecological restoration with technological innovation, addressing large-scale environmental degradation through landscape architecture's capacity to reveal, negotiate, and mediate hyperobjects. Key research questions investigate how these Hyper-cyborg landscapes can redefine aesthetic and ecological relationships, creating adaptable frameworks for similarly impacted sites globally. Through historical precedents, from Versailles to Freshkills Park, this study establishes a philosophical foundation that challenges conventional aesthetics, suggesting that beauty and ecological functionality can coexist in degraded contexts. By emphasizing "landscape design as an agent" of mediation, this study contributes to a new paradigm where landscapes actively engage with hyperobjects, rendering their impacts visible and guiding technological, ecological, economic, and social stewardship. This approach reimagines damaged landscapes as dynamic spaces for sustainable innovation and resilience, viewing contaminated sites as opportunities for ecological renewal and cultural transformation amid global ecological challenges.

AESTHETICS OF JUXTAPOSITION FROM A HYPEROBJECT PERSPECTIVE

From Toxic Liquid to 'Hyper Landscape Cyborg'

Austria
University of Innsbruck
Architecture / IOUD

Mr. / Yiqun Wang
Prof. Peter Trummer (IOUD)
Prof. Ann Forsyth (Harvard GSD)
Prof. Xinghua Lu (Tongji University)

ABSTRACT *(250 WORDS)*

This research explores how landscapes degraded by toxic substances can be reimagined as "Hyper Landscape Cyborgs." By integrating Timothy Morton's notion of "Hyperobjects" with Elizabeth Meyer's "Landscape Cyborgs," the study examines these landscapes as complex intersections of aesthetics, ecology, and technology within the Anthropocene. Focusing on large-scale toxic sites like Owens Lake, it addresses ecological degradation through innovative design methodologies that blend restoration with technological intervention. Key research questions investigate how these cyborg landscapes can redefine aesthetic and ecological relationships, providing models for global application to similarly contaminated sites. By analyzing precedents from the Palace of Versailles to Freshkills Park, the study establishes a philosophical foundation that challenges conventional aesthetics, suggesting that beauty and ecological functionality can coexist even in degraded environments. Ultimately, this research contributes to landscape architecture by proposing the "Hyper Landscape Cyborg" as a framework for sustainable design, offering new insights into rehabilitative approaches and adaptive ecological stewardship. This concept fosters an integrated, culturally resonant approach to reimagining degraded landscapes, suggesting new pathways for environmental management and landscape architecture as the world faces extensive ecological challenges. The Hyper Landscape Cyborg thus invites a rethinking of damaged landscapes as dynamic spaces for sustainable innovation and ecological renewal.

BACKGROUND & RESEARCH QUESTION *(200 WORDS)*

This research explores how the "Hyper Landscape Cyborg" concept can help landscape architecture address the vast complexities of toxic liquid landscapes. Through integrating ecological restoration with technological innovation, the study aims to understand how damaged sites can transform into resilient, hybrid spaces that functionally and aesthetically benefit their environments. Central to this inquiry are the questions: How can the Hyper Landscape Cyborg framework provide global strategies for other degraded landscapes? Can it redefine the notion of "repair" by embracing the coexistence of damage and recovery? Using Owens Lake as a primary case study, this research examines ecological and technological interventions—such as dust control, habitat creation, and public engagement—as means to transform landscapes where damage and restoration intersect. By framing toxic sites within a global and adaptable model, this study seeks to demonstrate how these spaces can evolve beyond degradation, guiding future interventions that merge beauty with ecological responsibility. Ultimately, the Hyper Landscape Cyborg framework offers a pathway for reshaping damaged landscapes into dynamic, sustainable systems that embody both environmental resilience and aesthetic engagement.

METHODOLOGY *(150 WORDS)*

The essay adopts a case study approach, examining both historical precedents and design methodology. In the historical section, it explores sites like the Palace of Versailles, British romantic gardens, Chinese gardens, Central Park, OMA's Lavioletta Park, and Fresh Kills Park, analyzing each within its zeitgeist to understand evolving views of nature, aesthetics, and design methods. For design methodology, Owens Lake serves as a focal site of large-scale environmental degradation. Analysis includes: 1) the transformation of Owens Lake via historical data, satellite imagery, and ecological interventions; 2) aesthetic strategies addressing the "toxic sublime"; and 3) technological and ecological design methods like dust control, habitat creation, and public engagement.

BEYOND THE STATE OF THE ART *(150 WORDS)*

This research redefines landscape architecture by tackling the complexities of large-scale toxic sites like Owens Lake. It grounds its approach in a philosophical evolution of aesthetics—from Versailles' geometry to the British picturesque, Olmsted's Central Park, and modern landscape urbanism. Through the concept of the "Hyper Landscape Cyborg," it combines Timothy Morton's "Hyperobjects" with Elizabeth Meyer's "Landscape Cyborg," forming a layered aesthetic that bridges technology and ecology. This framework acknowledges both the "Toxic Sublime" and restorative needs of Anthropocene landscapes, advocating resilient, hybrid approaches that unite human interventions with natural systems. By framing toxic sites within a context that balances beauty, function, and resilience, the study proposes an aesthetic that transcends convention, urging landscape architects to address degradation while fostering ecological responsibility. Embracing these unique aesthetics positions toxic landscapes as critical sites for sustainable innovation.

FINDINGS *(150 WORDS)*

The study demonstrates the "Hyper Landscape Cyborg" concept as a powerful approach for rehabilitating degraded sites, utilizing case analyses and strategies that integrate ecological and aesthetic objectives. Examining Owens Lake alongside speculative designs in China, the U.S., and Canada, it establishes a globally applicable model for tackling similar environmental challenges. This design methodology balances ecological restoration with aesthetic enhancement, showing how contaminated landscapes can become functional spaces embodying the "toxic sublime." The framework offers landscape architects and planners actionable strategies for large-scale remediation, creating resilient, meaningful landscapes. By merging beauty with ecological function, it paves a path forward for addressing industrial impacts, highlighting the synergy of aesthetics and environment in sustainable design.

SESSION 3

AESTHETICS AS A PROTOCOL

Using patterns and aesthetics to perceive and understand ecology

Mag. Vadim Smakhtin
Supervisor: Prof. Claudia Pasquero
Synthetic Landscape Lab

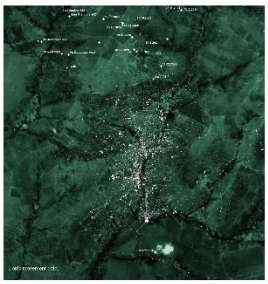
The process of digitising reality often leaves us with isolated digital representations of static landscapes. Stored on our digital servers while extracted from the surrounding ecology, these digital objects slowly lose their actual state. Disconnected from both digital and physical ecosystems, these three-dimensional representations become historical artefacts of the interaction between sensing technology and the ecology of the landscape. While ecology cannot be indexed in a number, 3D scanned landscapes can be used as an alternative way of understanding and measuring the value of ecology. In contrast to carbon credits used in carbon off set markets, the aesthetic approach of 3D scanning gives us a new symbolic view of interactions or processes within the selected slice of a landscape. This visual system can be seen as a new form of symbolic computation. Compared to traditional satellite-based measurement reporting and verifi cation (MRV) systems, such a computational system uses aesthetics as the main information transfer, inference, and communication protocol. By viewing ecological information as a set of visual symbols or patterns, we can deepen our understanding of landscape ecology from both micro and macro perspectives — redefi ning computation from a tool of compression to a cybernetic tool of contextual awareness. Enhancing digital data through our ability to understand and extract information as visual structures.

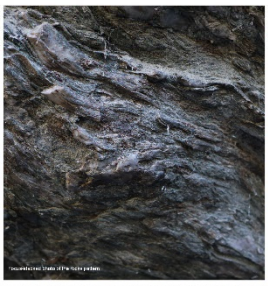
AESTHETICS AS A PROTOCOL

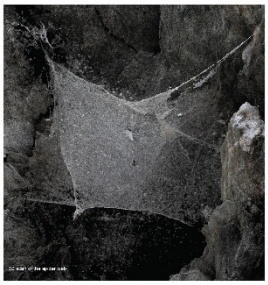
Using patterns and aesthetics to perceive and understand ecology

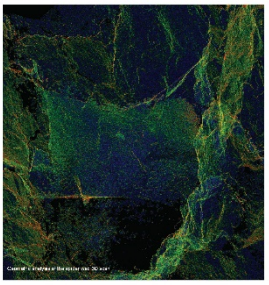
Austria
UIBK
IOUD / Synthetic Landscape Lab

Mag. Vadim Smakhtin (PhD Candidate)
Supervisor: Prof. Claudia Pasquero









ABSTRACT

The process of digitising reality often leaves us with isolated digital representations of static landscapes. Stored on our digital servers while extracted from the surrounding ecology, these digital objects slowly lose their actual state. Disconnected from both digital and physical ecosystems, these three-dimensional representations become historical artefacts of the interaction between sensing technology and the ecology of the landscape. While ecology cannot be indexed in a number, 3D scanned landscapes can be used as an alternative way of understanding and measuring the value of ecology. In contrast to carbon credits used in carbon offset markets, the aesthetic approach of 3D scanning gives us a new symbolic view of interactions or processes within the selected slice of a landscape. This visual system can be seen as a new form of symbolic computation. Compared to traditional satellite-based measurement reporting and verification (MRV) systems, such a computational system uses aesthetics as the main information transfer, inference, and communication protocol. By viewing ecological information as a set of visual symbols or patterns, we can deepen our understanding of landscape ecology from both micro and macro perspectives — redefining computation from a tool of compression to a cybernetic tool of contextual awareness. Enhancing digital data through our ability to understand and extract information as visual structures.

BACKGROUND & RESEARCH QUESTION

The greatest challenge to modern understanding of ecology is our ability to move from the specifics of ecological processes to an understanding of ecology as a whole. While the traditional definition of landscape has an underlying connection to the larger ecology, landscape is often viewed as a topological but not an ecological system. The link between landscape morphology and larger ecological processes is often unclear or uncertain. We tend to think about landscape morphology in isolation from the surrounding ecological context or ecological processes that influence or are influenced by landscape topology. Digital tools or methods such as satellite analysis or 3D scanning are seen as major breakthroughs in modern ecological research, but our understanding of these tools is still limited by the reductionist ideas of the past. While such tools allow us to measure the specifics of selected objects and processes in incredible detail, the digital approach usually lacks a deeper or broader understanding of the surrounding ecological context. Aesthetics as a Protocol aims to address these issues by applying a more visual and intuitive way of understanding and measuring ecology through the process of 3D scanning.

METHODOLOGY

Aesthetics as a Protocol explores different ways in which digital scans of landscapes can be used to understand different ecological processes and interactions within the landscape. Using high-resolution 3D scanning as a driver for storytelling, it explores how digital tools can become an integral part of how we communicate and measure the state of ecology. It builds a universal design language to communicate ecological information through a visual language of patterns, symbols and ornaments rather than numbers and indicators. Using publicly available and bespoke software systems for data processing and visualisation, this research aims to innovate the field of digital tools for measuring, reporting and verifying the state of ecological systems.

BEYOND THE STATE OF THE ART

Used as machines of compression and action, computers tend to encode processes into actionable outcomes and indicators, removing so-called 'unneeded' or optional information from decision-making systems. In contrast, Aesthetics as Protocol follows the idea of maximum decompression, using aesthetics as a tool to communicate loose or unprocessed ecological data as a set of visual symbols. Compared to the widespread MRV practices used in the carbon offset and biodiversity credit markets, Aesthetics as a Protocol proposes alternative methods of understanding ecological complexity through visual patterns and ornaments rather than indexing it in statistical aggregates. Such a visual language works at both human and satellite scales, opening the door to a universal ecological language that is entirely visual. The need for such a language can be found in various human-centred decision-making systems where the observability and predictability of the measurement system is important.

FINDINGS

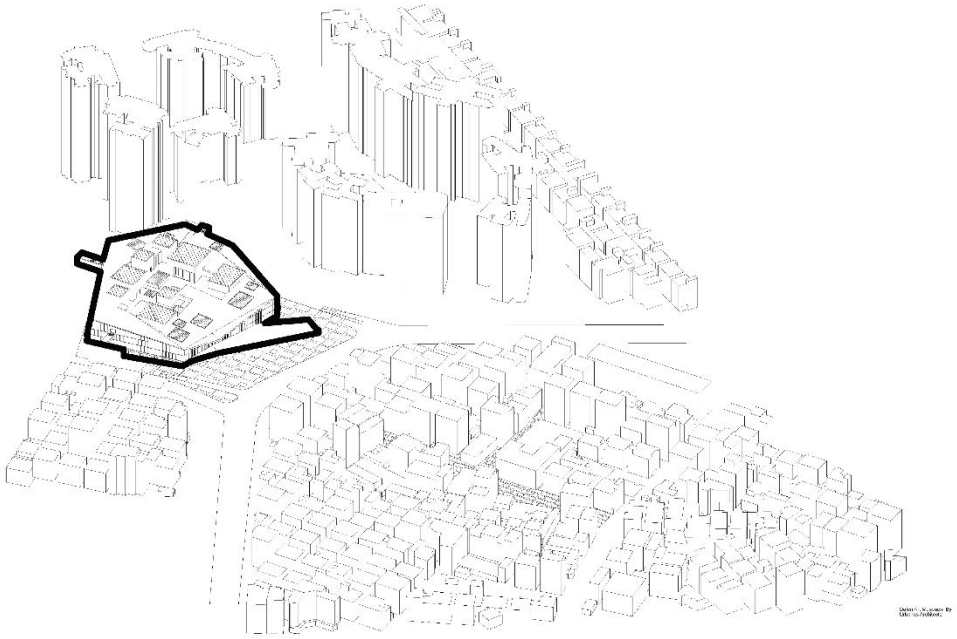
3D scanning can be used as a powerful tool not only to archive the topological properties of the landscape, but also as a storytelling and research tool for its underlying ecology. By combining 3D scanning with machine learning and data processing algorithms, we can create a system that allows us to measure the ecological state of the landscape in terms of ecological complexity and aesthetics. Using the cybernetic approach to human-machine interaction, we can create a new way of observing the landscape where digital tools are deeply integrated with our ability to be present in the landscape. Such tools significantly lower the barrier to ecological research and open up new possibilities for citizen science and community-driven approaches.

CITY AS AN ACCUMULATION OF MINIATURE STRUCTURES

Shenzhen Metapolis; “city of exacerbated difference”

Peyman Esmaeelpour
Supervisor: Prof. Peter Trummer
Institute of Urban Design (IOUD)

The “City as an Accumulation of Miniature Structures,” introduces an alternative paradigm for the city based on Architectural ensembles as Miniature structures encapsulating the city as whole within themselves, transforming an urban entity into a city. Through a miniaturizing process embodying the idea of bringing large-scale urban features, infrastructures, or functions into compact, integrated units, creating a microcosm of the larger environment. It reflects both technical precision and conceptual refinement, enabling the intricate replication of vast systems within a constrained space. In my research, I read the city as a formal system based on Incompleteness theorem of Gödel, and its relationship with its miniatures by the idea of “Strange loops” introduced by Douglas Hofstadter. I read the miniaturization process of the city of miniature structures, referring to the idea of “Scalar Inversion”—I got inspired by the article of John Durham Peters’ 33+1 Vignettes on the History of Scalar Inversion—these miniatures condense vast city elements into compact, self-referential forms, turning the city into a recursive system. And Shenzhen serves as the primary case study, a city of kind which Rem Koolhaas introduced as “City of exacerbated difference”, My research is complementary to the idea of “City of exacerbated difference” where rapid urban growth transformed Shenzhen into an architectural laboratory, when the city started to generate strange loops and recursive structures to miniaturize itself. This research proposes a paradigm that the city as a formal system generates the self-reverential forms and start to miniaturize itself, through an accumulative process, And promising an alternative version of ‘‘cities within the cities’’.



City as an accumulation of *Miniature structures*

Shenzhen Metapolis; "city of exacerbated difference"

Austria
University of Innsbruck
Architecture/ IOUD

M.A Peyman Esmaeelpour
Prof.Dr Peter Trummer (IOUD)

ABSTRACT *(250 WORDS)*

The "City as an Accumulation of Miniature Structures," introduces an alternative paradigm for the city based on Architectural ensembles as Miniature structures encapsulating the city as whole within themselves, transforming an urban entity into a city. Through a miniaturizing process embodying the idea of bringing large-scale urban features, infrastructures, or functions into compact, integrated units, creating a microcosm of the larger environment. It reflects both technical precision and conceptual refinement, enabling the intricate replication of vast systems within a constrained space.

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BACKGROUND & RESEARCH QUESTION *(200 WORDS)*

In Log magazine, issue 27 (2013), Peter Trummer's article, "The City as an Object: Thoughts on the Form of the City," introduces a concept of the city as a single, aggregated object. He begins with a quote from Leon Battista Alberti, likening a city to a large house and its rooms to miniature buildings, thus highlighting formal parallels between city and architecture. Trummer interprets Alberti's idea as a twofold problem: first, each room as a miniature building and, second, the city as a singular, aggregated object. Trummer further explores "Aggregation" through Graham Harman's Object-Oriented Philosophy, categorizing cities as circles, grids, archipelagos, solids, and his own concept of the "Aggregated Object." However, the quote from Alberti's which is also a prelude to Trummer's reading of the city, has also another quality when it ends with a metaphorical question by bringing the term "miniature" and it is the point where our research deviates from what Peter interestingly visions. By which the city or any form of Parts from a whole can be read as Miniatures. But if we read these parts as Miniatures, is whole being generated through the "process of Miniaturization"? Moreover, the research is investigating to read the "Contemporary city", starting with a very general question: *What a contemporary city is?*.

METHODOLOGY *(150 WORDS)*

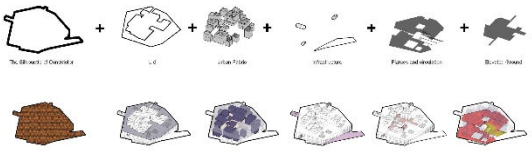
The methodology of this PhD research begins with interpreting the city as an archipelago, or "cities within cities," establishing a foundation to view the city as an accumulation of miniature structures. This approach is rooted in my observations from Shenzhen, my primary field of study, where distinct urban areas function as microcosms within the larger city. Building on these observations, I develop a philosophical framework, positioning the city as a formal system—a discourse expanded through concepts like strange loops and scalar inversion. Using these theoretical insights, I conduct a formal analysis of Shenzhen's miniatures, examining how individual architectural elements encapsulate broader urban functions and dynamics. This layered aporoach enables me to construct an alternative vision, framing Shenzhen's architectural miniatures as embodiments of the city's complexity in compact, recursive forms, thereby contributing to a new paradigm of understanding urban systems through the lens of miniaturization.

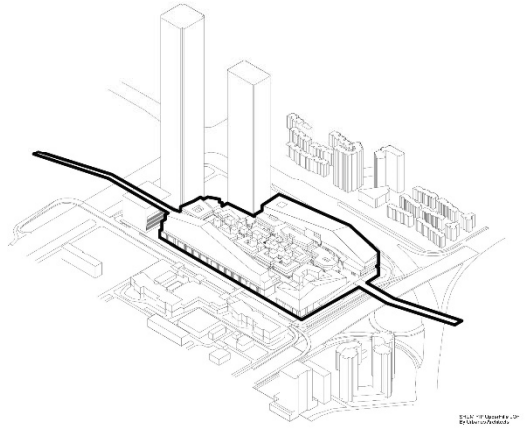
BEYOND THE STATE OF THE ART *(150 WORDS)*

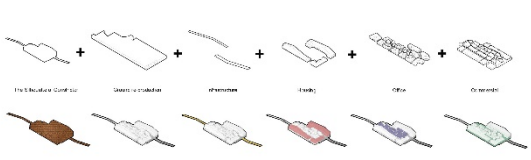
This research advances the understanding of urban development by proposing that urban areas can transform into cities through the accumulative process of miniature structures. Observing Shenzhen's growth in two distinct phases—initial urbanization followed by its establishment as a city—reveals how architectural miniatures drive this transformation. During the first phase, urban functions and infrastructure take root, creating foundational urban areas. In the second phase, these areas integrate and accumulate, embodying the complexities of a full-scale city within compact architectural forms. This study suggests that miniature structures, each containing essential urban functions, can progressively create cohesive urban systems, allowing for the emergence of city-like dynamics even within constrained spaces. By analyzing these phases through the lenses of scalar inversion and strange loops, the research demonstrates how cities can generate their qualities as cities through recursive and self-referential structures, And although the research focuses on Shenzhen but it is celebrating an alternative for the city.

FINDINGS *(150 WORDS)*

The findings of this research demonstrate that the city, as a formal system, builds a recursive structure that drives it to miniaturize itself through architectural miniatures. Observed in Shenzhen's development, this process reveals how the city creates smaller, self-referential entities that embody its complexity in condensed forms. This recursive self-replication suggests a new paradigm for "cities within cities" and complements Rem Koolhaas's concept of the "city of exacerbated difference," developed with his Harvard GSD students in the early 2000s, by finding that the city of exacerbated difference tends to generate strange loops within itself and, on another scale, initiates its re-development as an "accumulation of miniature structures." The research promises a process of making the city can start within an urbanized area or along with an urbanization process, and introduces a different kind of "Cities within the cities".







DESIGN INNOVATION FOR INFORMAL SETTLEMENTS

Rethinking how we collaborate through full scale, built research

Oliver von Malm
Supervisors: Prof. Karolin Schmidbaur, GP Dipl. -Phys. Stefan Holst

The TwistBlock® initiative, led by Start Somewhere, addresses the urgent housing and economic challenges faced by Kibera, Nairobi, one of Africa's largest informal settlements. Through an innovative modular concrete block system, TwistBlock® enables affordable housing construction with decentralized, community-run production, creating jobs and supporting local economies. Unlike traditional methods, TwistBlock® requires no mortar, allowing for rapid construction, reduced costs, and the use of unskilled local labor. The system's adaptability supports complex wall configurations to meet the spatial constraints of informal settlements. A custom planning software has been developed to streamline design processes, ensuring accurate block placement and construction efficiency. In addition, a compatible roof system has been designed to optimize structural integrity, complementing TwistBlock®'s unique configuration. The Kibera pilot factory, launched in 2019, has since inspired additional facilities and local economic growth. Start Somewhere's community-centered approach facilitates job creation, technical training, and a new local industry for building materials, while promoting sustainable practices with minimal environmental impact. Iterative feedback loops through lessons learned continuously refine both production methods and construction processes, addressing field challenges. This PhD research evaluates TwistBlock®'s effectiveness in meeting housing needs and fostering community empowerment, considering its social, economic, and environmental impacts in Kibera as a potential model for informal settlements across the global South.

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DESIGN INNOVATION FOR INFORMAL SETTLEMENTS

Rethinking how we collaborate through full scale, built research

Austria
University of Innsbruck
Faculty of Architecture

Dipl. -Ing. Oliver von Malm, PhD Candidate
Univ. Prof. Dipl. -Ing. Karolin Schmidbaur
GP Dipl. -Phys. Stefan Holst

ABSTRACT

The TwistBlock® initiative, led by Start Somewhere, addresses the urgent housing and economic challenges faced by Kibera, Nairobi, one of Africa's largest informal settlements. Through an innovative modular concrete block system, TwistBlock® enables affordable housing construction with decentralized, community-run production, creating jobs and supporting local economies. Unlike traditional methods, TwistBlock® requires no mortar, allowing for rapid construction, reduced costs, and the use of unskilled local labor. The system's adaptability supports complex wall configurations to meet the spatial constraints of informal settlements. A custom planning software has been developed to streamline design processes, ensuring accurate block placement and construction efficiency. In addition, a compatible roof system has been designed to optimize structural integrity, complementing TwistBlock®'s unique configuration. The Kibera pilot factory, launched in 2019, has since inspired additional facilities and local economic growth. Start Somewhere's community-centered approach facilitates job creation, technical training, and a new local industry for building materials, while promoting sustainable practices with minimal environmental impact. Iterative feedback loops through lessons learned continuously refine both production methods and construction processes, addressing field challenges. This PhD research evaluates TwistBlock®'s effectiveness in meeting housing needs and fostering community empowerment, considering its social, economic, and environmental impacts in Kibera as a potential model for informal settlements across the global South.

BACKGROUND & RESEARCH QUESTION

Urbanization and a high cost of living have exacerbated the housing crisis in Nairobi, where over half of the population lives in informal settlements like Kibera. Rapid population growth and scarce affordable housing have led to overcrowded conditions, with many living in inadequate structures made of mud or metal sheets. The situation is compounded by safety hazards such as fire risks, lack of sanitation, and threats of eviction. Start Somewhere developed the TwistBlock® system as a response to these challenges, aiming to create safer, affordable, and sustainable housing. TwistBlock® provides a modular, mortar-free construction solution, leveraging community-based production that generates income and fosters economic growth. This PhD research explores how TwistBlock® can meet the housing needs in informal settlements, considering the community's social and economic conditions. Key questions include: How effective is TwistBlock® as a scalable, sustainable housing solution? What impact does community-driven production have on economic and social resilience? How can an efficient planning software further increase the system's construction efficiency? Additionally, could the TwistBlock® system be expanded into a holistic building system capable of constructing entire homes?

METHODOLOGY

This study combines field research, participatory workshops, and iterative design to evaluate the effectiveness of the TwistBlock® system in Kibera. A digital planning software developed in Rhino 3D and Grasshopper optimizes construction accuracy and efficiency, enabling TwistBlock® to be used effectively by unskilled local labor. To test production and implementation, a pilot factory was established, with community members trained to independently manage block production. Real-world pilot buildings constructed by these trained workers are assessed for construction efficiency, ease of assembly, and user-friendliness. Using design thinking, the study also explores the development of a compatible roof system, expanding TwistBlock® into a comprehensive building solution. Lessons learned from the pilot projects inform continuous refinements to planning processes, design, and construction techniques. Community feedback and documented results provide insights into TwistBlock®'s economic, social, and environmental impacts, supporting its potential scalability in other informal settlements.

BEYOND THE STATE OF THE ART

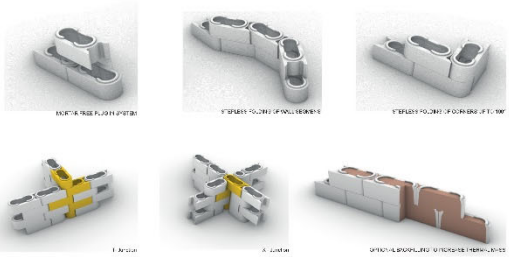
Traditional masonry and concrete constructions are often too costly or technically complex for informal settlements. TwistBlock® transcend these limitations by offering a modular, scalable approach that can be adapted to Kibera's challenging environment. The mortar-free interlocking design allows for efficient construction by untrained laborers, making the technology highly accessible. Unlike existing block systems, TwistBlock® accommodate irregular layouts and non-standard angles, crucial for maximizing space in densely populated areas. Additionally, its sustainable production process — using low-cement concrete and a decentralized, community-run factory model — contrasts with industrial-scale methods that are less feasible in informal settlements. TwistBlock® are designed to be both earthquake-resistant and fire-resistant, addressing critical safety issues. Furthermore, the blocks can be dismantled and relocated, providing a flexible solution in case of eviction, offering stability and security for vulnerable populations. This system presents a potential model for other cities facing similar urban housing challenges, combining architectural innovation with social and economic empowerment.

FINDINGS

The implementation of TwistBlocks® in Kibera has shown promising results. The production of blocks within the community not only offers employment but also instills a sense of ownership and pride among local workers. Initial findings indicate a 20% cost reduction compared to traditional building techniques, alongside increased construction speed due to the mortar-free assembly. Community acceptance is high, with locals praising the improved safety, comfort, and durability of TwistBlock® structures over traditional mud or sheet-metal homes. The pilot project's success has led to the establishment of additional TwistBlock® factories, furthering economic growth. Challenges remain, particularly regarding infrastructure and resource access, but the model has proven viable. TwistBlock®'s community-driven model highlights its potential for scalability in other informal settlements, paving the way for a sustainable, decentralized approach to housing in the global South.

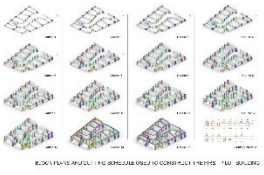
REAL WORLD PILOT BUILDINGS

STARTING POINT: TWISTBLOCK® SYSTEM



PLANNING ALGORITHM

PILOT FACTORY IN KIBERA



REAL WORLD PILOT BUILDINGS

ROOF DEVELOPMENT

POSTER SESSION

ADAPTIVE ARCHITECTURE AND URBANISM

Rethink Mumbai Flooding for Sustainable and Egalitarian Habitat

Santosh Kumar Ketham
Supervisor: Prof. Marjan Colletti

Climate change is no longer a distant threat; it is actively reshaping communities worldwide. Flooding, a frequent consequence of this crisis, severely impacts millions, particularly in densely populated coastal, riverside, and low-lying areas. This environmental crisis disrupts economies, social structures, and political relationships, disproportionately affecting urban poor and marginalized communities. For cities vulnerable to flooding, addressing climate change is essential. To effect meaningful change, cities must engage all residents in a collective dialogue where everyone plays a role in crafting solutions. A promising method for fostering this engagement is through "Collective Approach" design practices. Drawing from my experience with Ketham's Atelier Architects and the NGO Thinking Hand, which I co-founded in Hyderabad, India, my research promotes a speculative design methodology aimed at redefining our collective relationship with environmental challenges. This approach posits that collaborative research can inspire new perspectives and actionable solutions to climate-related issues, such as urban flooding. My objective is to create participatory formats that facilitate the collaborative envisioning, discussion, and reimagining of resilient, flood-prepared cities. My thesis focuses on refining this practice by incorporating input from diverse community members, experts, and policymakers to enhance its impact. Current projects involve spatial learning through collaborative drawing, modeling, and scenario planning in workshops, competitions, and public exhibitions. Using Mumbai as a case study, I will explore mediating formats—workshops, competitions, and public discussions—that deepen collective reflection on climate resilience. This research collaborates with Thinking Hand, Ketham's Atelier, and various organizations, aiming to forge a shared path toward a sustainable future.

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ADAPTIVE ARCHITECTURE AND URBANISM

Rethink Mumbai Flooding for Sustainable and Egalitarian Habitat.

Austria
Innsbruck University
Institute of Experimental Architecture, Hochbau.

Santosh Kumar Ketham
MSc (Urban Strategist), B.Arch (Landscape), Dipl.Ing (Architecture), PhD Researcher

ABSTRACT

Climate change is no longer a distant threat; it is actively reshaping communities worldwide. Flooding, a frequent consequence of this crisis, severely impacts millions, particularly in densely populated coastal, riverside, and low-lying areas. This environmental crisis disrupts economies, social structures, and political relationships, disproportionately affecting urban poor and marginalized communities. For cities vulnerable to flooding, addressing climate change is essential. To effect meaningful change, cities must engage all residents in a collective dialogue where everyone plays a role in crafting solutions. A promising method for fostering this engagement is through "Collective Approach" design practices. Drawing from my experience with Ketham's Atelier Architects and the NGO Thinking Hand, which I co-founded in Hyderabad, India, my research promotes a speculative design methodology aimed at redefining our collective relationship with environmental challenges. This approach posits that collaborative research can inspire new perspectives and actionable solutions to climate-related issues, such as urban flooding. My objective is to create participatory formats that facilitate the collaborative envisioning, discussion, and reimagining of resilient, flood-prepared cities. My thesis focuses on refining this practice by incorporating input from diverse community members, experts, and policymakers to enhance its impact. Current projects involve spatial learning through collaborative drawing, modeling, urban planning in workshops, competitions, and public exhibitions. Using Mumbai as a case study, I will explore mediating formats—workshops, competitions, and public discussions—that deepen collective reflection on climate resilience. This research collaborates with Thinking Hand, Ketham's Atelier, and various organizations, aiming to forge a shared path toward a sustainable future.

BACKGROUND AND RESEARCH QUESTION

Throughout the 21st century, environmental crises have dominated headlines, underscoring a planet in dire need of intervention. Rising sea levels and climate change are now critical issues impacting economies, environments, health, and social structures globally. According to the United Nations' 2017 Ocean Conference, over 600 million people—10% of the world's population—live in coastal regions less than 10 meters above sea level, including major cities like New York, Miami, Shanghai, and Mumbai. Mumbai, India's most populous city and a major economic hub, faces significant challenges due to its susceptibility to flooding. Built on land reclaimed from seven islands, Mumbai is home to extensive slum populations, with over 55% of residents living in inadequate housing and many others homeless. The city's aging drainage systems, high poverty rates, and dense population make it particularly vulnerable to climate shocks. Despite these risks, property developers continue constructing without long-term climate assessments, prioritizing immediate profits over sustainability. The critical question remains: How can cities like Mumbai balance economic growth with proactive climate resilience? Addressing this issue requires integrating sustainable urban planning, flood prevention measures, and policies that protect vulnerable communities from the escalating impacts of climate change.

METHODOLOG

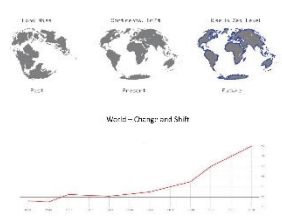
This research advocates a collaborative approach to addressing climate-related urban issues, particularly flooding. By engaging communities and institutions in reflective, participatory exercises, this approach fosters resilience against climatic change. Our "Collective Approach" is grounded in speculative design, employing bottom-up strategies through courses, workshops, competitions, and exhibitions to encourage social cohesion and long-term thinking. The initiative emphasizes hands-on experiences, enabling communities to envision adaptive architecture and urban practices tailored to their specific cultural and climatic contexts. Drawing on concepts by Mathur and da Cunha, the Thinking Hand NGO combines architectural education and practice to create speculative design formats where diverse participants—students, professionals, and local citizens—collaboratively speculate, build, and evaluate urban ideas. This collective, participatory approach not only promotes environmental awareness but also empowers communities to actively shape sustainable futures through design.

BEYOND STATE OF THE ART

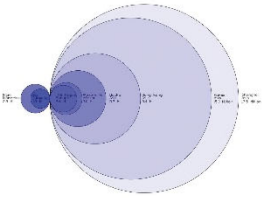
Speculative design, as conceptualized by British designers Fiona Raby and Anthony Dunne, encourages a visionary approach that transcends conventional problem-solving. Instead, it integrates design thinking, storytelling, and speculative fiction to develop prototypes and experiences that inspire discussions about alternative futures. This research leverages this forward-thinking methodology to facilitate debates on how architecture can address urgent issues like climate change and urban flooding. The "Rethink Mumbai Flooding" competition exemplifies this by inviting architects, designers, and community members to propose innovative, context-sensitive solutions. Public exhibitions and talks serve as platforms to empower local communities and raise awareness of pressing environmental issues. By involving a diverse array of stakeholders, this initiative fosters dialogue and advocates for climate-responsive urban policies, bridging gaps between policymakers, residents, and experts to promote equitable and sustainable growth in urban development.

FINDINGS

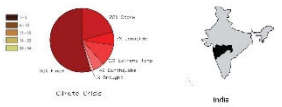
This research underscores the significance of collective reflection on flooding as a strategy for combating climate change. It highlights the work of the Thinking Hand NGO and Ketham's Atelier, which collaborates with vulnerable communities, local organizations, international professionals, and students through speculative design workshops and exhibitions. This bottom-up approach aims to study, design, and experiment with new concepts, fostering social cohesion and long-term thinking. Speculative design workshops and competitions generate innovative, unconventional ideas, assessing architecture's societal impact while engaging those most affected by climate change. These workshops and exhibitions provide a platform for diverse global perspectives to evaluate and explore various solutions. By blending theory and practice, they promote transparency, encourage dialogue, and stimulate political accountability. Through our collective efforts, we advocate for governments to rethink climate policies and integrate local stakeholders. While complex and time-consuming, this participatory model fosters shared responsibility and has the potential to bridge societal gaps, empowering communities to drive change collaboratively and rethink environmental policies and systems for a sustainable future.



Global Temperature Change, Drawing by Author, Source: UN



Flooding cities around the world: Affecting more than 600 Million People



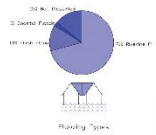
Climate Crisis

India

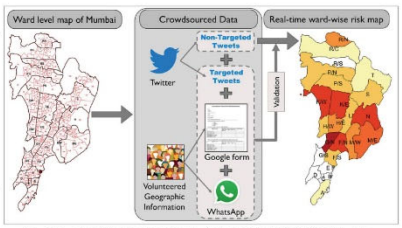
Maharashtra

Mumbai Suburban

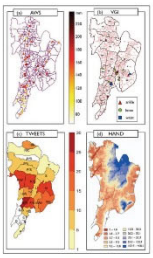
Mumbai City



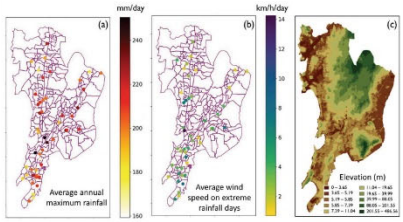
Flood events in India
Source: Seeds & Cred India



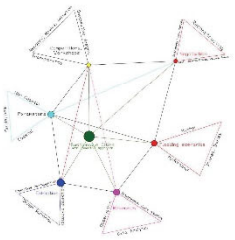
24 municipal wards and 227 co-operators wards of Mumbai: Data collection and methodology followed to generate real-time ward-wise risk map. Source: Urban Climate 53 (2024) 101815



(a) Observed station based daily accumulated rainfall information, (b) VGI information, and (c) Ward-wise Tweets received, on July 5, 2023
(d) HAND value for Mumbai. Source: Urban Climate 53 (2024) 101815

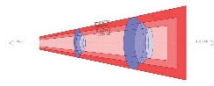


(a) Average annual maximum rainfall, (b) Average wind on extreme rainfall days, (c) elevation map for Mumbai (in meters). Source: Urban Climate 53 (2024) 101815

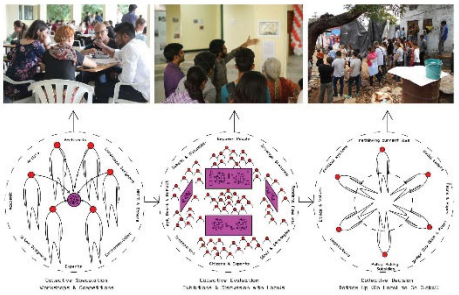


Re-search- Form and Shape. Drawing by Author.

Mumbai Flooding 2020 (Video, screenshots) – Flooding in Homes, Hospitals, Railways, Roads and Airports and more. Source: Unknown



Speculative Design – Future zones. Redrawn by Author. Source: Elliot P. Montgomery



Collective Approach. Drawing by Author. Source: Thinking Hand NGO and Ketham's Atelier

Mumbai Slum and Skyline- Photo by Author

"This mapping is a part of YUVA's Climate Justice Project. The maps were developed on QGIS software and all information shared is subject to change.

Mumbai life in pictures - Photos by Author

Collective - Documentation, Discussion, Designing, Developing, Initiated and hosted by Author. Source: Thinking Hand NGO and Ketham's Atelier

CITINESS OF LAGOS

Reimagining Cities through Digital Narratives and Local Perspectives

Ugochukwu Franklin Eze
Supervisors: Assoc Prof. Andreas Flora, Assoc Prof. Miro Roman
Architecture / Gestaltung 1
Poster

In our increasingly digital and interconnected world, cities have become complex organisms that require a new approach to understand and navigate. This paper proposes a digital computational approach to cities that goes beyond their functional aspects and explores their urban complexity through the lens of digital literacy. By examining, navigating and articulating various sources of data shared on the internet and social media, from the perspectives of a citizen, a researcher, a tourist, and a journalist, we can gain a comprehensive understanding of their intricacies and uncover new insights into their development and dynamics. This approach acknowledges that the digital realm is not merely a reflection of physical reality, rather an abstract space where we can analyze and interpret urban phenomena in a way that transcends traditional limitations. We can utilize text and images streams, pollution levels, electricity and water grid data, satellite images, shopping records, crime and safety-related open data, and more, this approach allows us to go beyond the traditional notions of city typologies and delve into the intricate fabric of urban complexity. By leveraging digital technologies and data analytics, we can gain new insights into the dynamics of cities and uncover hidden patterns and connections. The research proposes an experiment that explores the intersections of architecture, culture, and humanity through digital modelling, mapping and navigating visualizations and projections. The experiment uses Artificial Intelligence in the form of Neural Network to perform the task of word embedding –Word2Vec– and an unsupervised machine learning algorithm for edge detections, clustering –Self Organizing Maps and renderings of the geolocated tweets, for the tweets we crawled from twitter (X). Finally, it employs Human Intelligence for the selection of information and decision making.

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CITINESS OF LAGOS

Reimagining Cities through Digital Narratives and Local Perspectives

Austria.
University of Innsbruck,
Architecture / Gestaltung 1

Titles / Ugochukwu Franklin Eze

Prof. / Andreas Flora

Assoc Prof. / Miro Roman

ABSTRACT *(200 WORDS)*

In our increasingly digital and interconnected world, cities have become complex organisms that require a new approach to understand and navigate. This paper proposes a digital computational approach to cities that goes beyond their functional aspects and explores their urban complexity through the lens of digital literacy. By examining, navigating and articulating various sources of data shared on the internet and social media, from the perspectives of a citizen, a researcher, a tourist, and a journalist, we can gain a comprehensive understanding of their intricacies and uncover new insights into their development and dynamics. This approach acknowledges that the digital realm is not merely a reflection of physical reality, rather an abstract space where we can analyze and interpret urban phenomena in a way that transcends traditional limitations. We can utilize text and images streams, pollution levels, electricity and water grid data, satellite images, shopping records, crime and safety-related open data, and more, this approach allows us to go beyond the traditional notions of city typologies and delve into the intricate fabric of urban complexity. By leveraging digital technologies and data analytics, we can gain new insights into the dynamics of cities and uncover hidden patterns and connections. The research proposes an experiment that explores the intersections of architecture, culture, and humanity through digital modelling, mapping and navigating visualizations and projections. The experiment uses Artificial Intelligence in the form of Neural Network to perform the task of word embedding – Word2Vec– and an unsupervised machine learning algorithm for edge detections, clustering –Self Organizing Maps and renderings of the geolocated tweets, for the tweets we crawled from twitter (X). Finally, it employs Human Intelligence for the selection of information and decision making.

BACKGROUND & RESEARCH QUESTION *(200 WORDS)*

Lagos, Nigeria's bustling megacity, is often studied through traditional frameworks that emphasize its physical infrastructure and economic metrics. However, these methods fall short of capturing the dynamic and interconnected experiences of its residents. This paper introduces a novel approach, employing digital, indexical, and probabilistic perspectives to reimagine Lagos not just as a static physical space, but as a living, evolving urban entity shaped by human interactions and perceptions. Using crawled social media data, to map and model the social dynamics and cultural activities of Lagos's residents. To also highlights case studies on family gatherings, community meetings, ritual ceremonies, and festivals, showing how these events shape the urban landscape. By analyzing everyday interactions, such as those with roadside vendors and market stalls, the research reveals the underlying social fabric of the city.

METHODOLOGY *(150 WORDS)*

The present research proposes a new method to look at a dynamic city of this scale with a nuanced view on the complex internal organization of this city, which is not unique to Lagos: one finds similar systems in large African and Indian cities. The process starts by collecting tweets shared on Twitter (X) (Web scraping and APIs) — then encode its representation to numerical vectors (Word2Vec). And the images, with an algorithm to cluster Self Organizing Maps (SOM). the texts based on their similar pattern in their numerical vectors. Ending, when a numerical vector encapsulating a specific interest (encoded query) finds its similar information, location, mean and frequency from the already clustered literature. This research integrates Artificial Intelligence, Machine Intelligence with the abilities of architect, who collects the data, ask the questions in a masterful and architectonic way. With the introduction of digital design tools, architects could manipulate testing of data, create and visualize complex geometries and perspectives in a more dynamic and interactive manner. These digital tools allow architects to push the boundaries of traditional design practices and explore new possibilities in Data driven, architectural form, geometry, and spatial relationships.

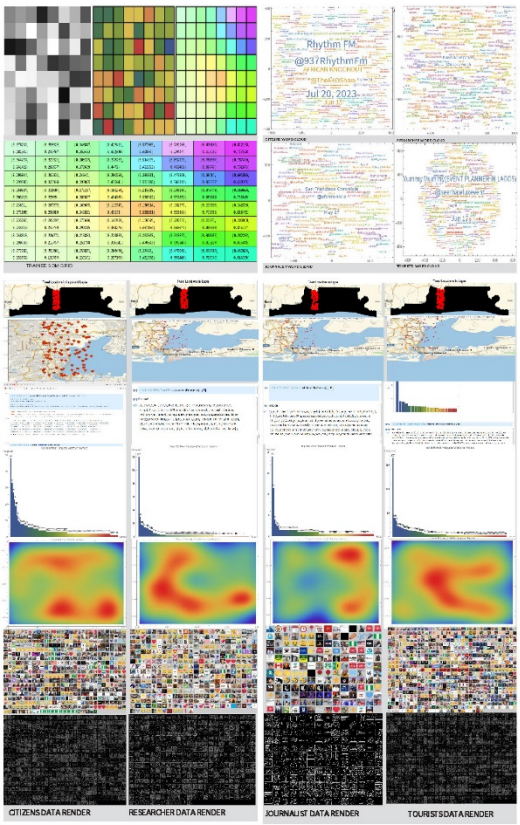
BEYOND THE STATE OF THE ART *(150 WORDS)*

Studies by Chourabi et al. (2012) and Bibri & Krogstie (2017) highlight the potential of smart technologies and data analytics in creating more responsive and connected cities. However, these studies often focus on technical aspects, Recent Studies, such as those by Kevin Lynch, Image of the City and Diana Marin Alvarez, Atlas of Indexical Cities provide valuable ways of looking for understanding the differences in city study approach. Lynch's concept of mental maps and Alvarez's exploration of digital citizenship provides theoretical foundations for this paper, which extends these ideas to the inclusion of data-driven participation. The use of digital tools in exploring architectural history opens avenues for interdisciplinary collaboration and knowledge exchange. By integrating urban cybernetics theory and data analytics into the study of Lagos's architectural evolution, we can uncover hidden patterns, spatial relationships, and historical contexts that transcend traditional approaches to architectural history. It enables us to embrace a multi-dimensional perspective that goes beyond physical structures, allowing us to appreciate the interplay of historical, cultural, and societal forces that have shaped the architectural identity of Lagos.

FINDINGS *(150 WORDS)*

By incorporating machine learning algorithms, Artificial Intelligence and data-driven insights from social media engagements, urban planning, living circumstances, and decision-making in Lagos can be greatly viewed and upgraded by integrating machine learning algorithms. Deeper understanding of the urban landscape can be gained by applying picture recognition algorithms, which can identify locations with potential for development or refurbishment in addition to well-known landmarks. For example, examining how frequently particular places or activities appear in texts and photographs shared on social media might provide important information about the demand for particular services, difficulties, interests, or amenities in the area.

Furthermore, by integrating sentiment analysis algorithms into social media posts, many categories, personal and groups' emotional reactions and viewpoints may be seen. This data can be very helpful in comprehending the community's attitude towards various aspects of personal experiences, culture, lifestyle, habits and urban life in Lagos, thus guiding policymakers and urban designers in creating initiatives that resonate with the sentiment and needs of the citizens.



INTERSPECIES ARCHITECTURE

Creating Interfaces Between Humans and Nature

Daria Smakhtina
Supervisor: Prof. Marjan Colletti
Institute of Experimental Architecture
Poster

During the past decades, our conceptualisation of Nature mutated from depicting it as a detached, pristine entity into the portrayal of a deeply intertwined, complex human-nature-technology system. In the context of merging nature and technology and increasing complexity of the interconnectedness of all living and non-living parts, can we re-evaluate the role of human and human activities? Can we reconceptualize architecture and enrich the purpose of the human-built environment as a part of a 'giant cybernetic system' of the earth? This research seeks to investigate how architectural design practices can become aligned with natural processes and enhance mutual co-living. It also examines the possibility of creating a visual spatial language that conveys information about animals in a way that humans can perceive and vice versa. The incoming eco data can be encoded in multiple ways and translated into informational models assembling elements of human and non-human habitats, or 'architectures'. This communication system can be transmitted through various mediums—as physical sculptural objects, organic, tactile, embedded with digital layers, or fully virtual. This experiment aims to reveal hidden natural processes and ecological data through tangible and enfolding forms to bring more understanding to imperceptible logics and fragility of ecosystems and reveal deep levels of human-non-human interconnectedness. By creating hybrid (digital and physical, organic and inorganic) sculptural architectural objects that can beemployed as an analytical and representational tool, the possible forms of context-aware architecture can be developed. These hybrid habitats can possibly operate as a communication device and updatable interface between humans and non-human species.

INTERSPECIES ARCHITECTURE

Creating Interfaces Between Humans and Nature

Austria
University of Innsbruck
Faculty of Architecture, Department of Experimental Architecture

Student: MArch. **Daria Smakhtina**

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ABSTRACT

During the past decades, our conceptualisation of Nature mutated from depicting it as a detached, pristine entity into the portrayal of a deeply intertwined, complex human-nature-technology system. In the context of merging nature and technology and increasing complexity of the interconnectedness of all living and non-living parts, can we re-evaluate the role of human and human activities? Can we reconceptualize architecture and enrich the purpose of the human-built environment as a part of a 'giant cybernetic system of the earth'? This research seeks to investigate how architectural design practices can become aligned with natural processes and enhance mutual co-living. It also examines the possibility of creating a visual spatial language that conveys information about animals in a way that humans can perceive and vice versa. The incoming ecological data can be encoded and translated into informational models assembling elements of human and non-human habitats, or 'architectures'. This communication system can be transmitted through various mediums—as physical sculptural objects, organic, tactile, embedded with digital layers, or fully virtual. This experiment aims to reveal hidden natural processes and ecological data through tangible and enfolding forms to bring more understanding to the imperceptible logics and fragility of ecosystems and reveal deep levels of human-non-human interconnectedness. By creating hybrid (digital/physical/organic/inorganic) sculptural architectural objects that can be employed as an analytical and representational tool, the possible forms of context-aware architecture can be developed. These hybrid habitats can possibly operate as a communication device and updatable interface between humans and non-human species.

BACKGROUND & RESEARCH QUESTION

The current state of ecological technologies allows scientists to collect various types of environmental and wildlife data to monitor the state of ecosystems at multiple scales. Remote sensing data from satellites; acoustic recordings of various species; GPS-collar tracking; videos from camera traps, etc. are constantly gathered to capture the distribution of species and plants in space and time and analyse biodiversity dynamics. Human activities create anthropogenic disturbances and influence the dynamics of biodiversity in various parts of the world. However, it is hard to analyse and display the deep level of interconnectedness and deep level of influence of human activities on the animal world. The sphere of ecological data analysis and visualization remains a highly professional area. Can new forms of wildlife data representation be created – a spatial language that translates ecological and animal data into forms that humans can perceive and understand? With emerging technologies, architecture is gaining the potential to become connected with its contextual data, aware of its real-time performance and environmental impact. However, can we imagine architectural design practices that involve eco data at the core of design strategies to support biodiversity and encounter various species in the design approach? Can Architecture serve as a dynamic interface for communication between humans and non-human species?

METHODOLOGY

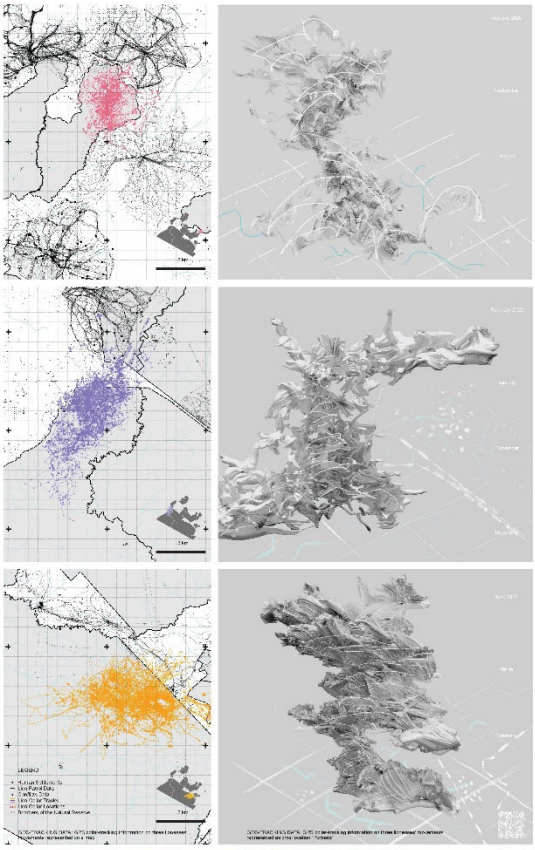
In order to develop sculptural architectural language for interspecies cohabitation and communication, the research can proceed through the following steps: picking up several test sites (varying in scale and type of environment); gathering relevant ecological data with remote and site located sensor tools; developing the workflow for encoding various types of ecological data (CSV spreadsheets with coordinates, acoustic files, images and videos, etc.) into spatial models; building datasets of the potential representations and spatial forms; developing a sculptural architectural language based on the datasets that represent various types of eco-data by utilising AI tools and custom training models; testing various modes of representation (combining digital and physical, organic and inorganic); and developing strategies for object analysis, updating, and feedback.

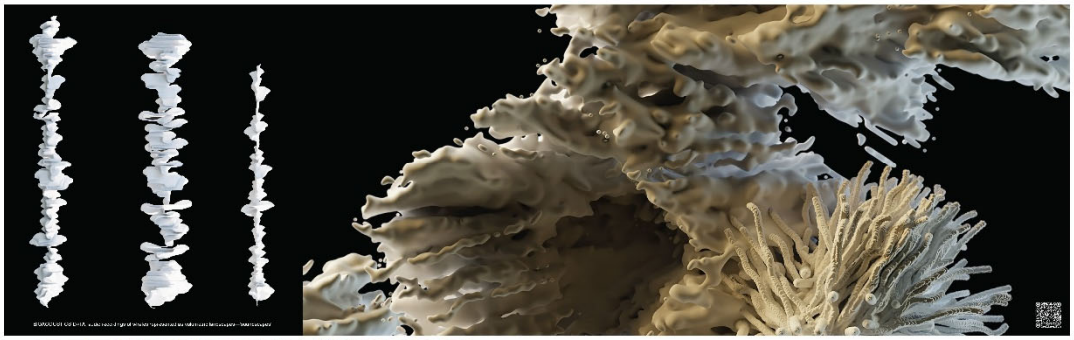
BEYOND THE STATE OF THE ART

This research attempts to utilize emerging technologies in order to develop a new mode of architectural design that involves natural processes and ecological data in the design strategy and allows the creation of hybrid structures that can be inhabitable by various species and play the role of a communication tool for interspecies interactions. By creating a series of hybrid site-specific objects, it aims to investigate the possibility of nature-consistent architectural design practices while examining the relevant types of ecological data and pushing data-driven design and experimental fabrication methods. This investigation also opens a number of intricate questions, for example: the subjectivity of any communication system; experiments with the resolution and possibility of coming up with a sculptural language that would store the maximum amount of information; and experiments on human-machine co-creation.

FINDINGS

The emerging immersive technologies, in combination with parametric modelling instruments and the latest eco-monitoring tools, give an extraordinary possibility to represent the ongoing dynamics of human-non-human cohabitation. While connected to fabrication technologies and the physical realm, this approach can give rise to evolving, self-aware, and self-analysing architectural designs. Objects created as the final output of this research will no longer be fully physical or digital but hybrid site-specific entities with layers of encoded information and updates. They can examine the concepts of adaptation and self-construction, and serve as an interface for interspecies communication. The time-based nature and mixed reality characteristics can serve as a testing ground for self-evolving and semi-autonomous sculptural architecture, interacting with multiple users in multiple realms.



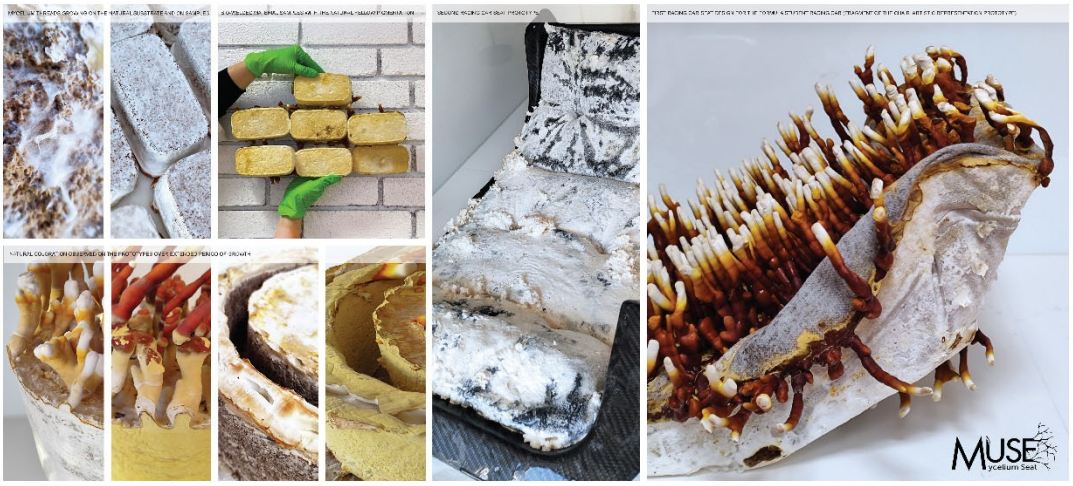


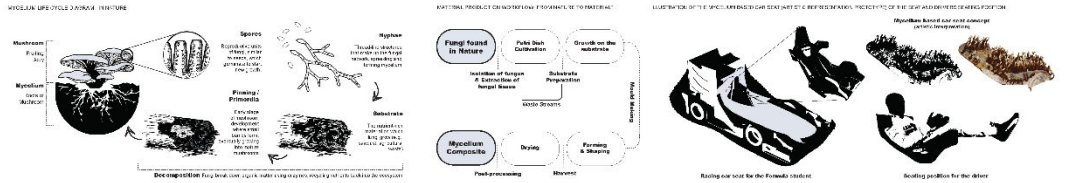
ADVANCING BIOFABRICATED ARCHITECTURE

Developing Mycelium-Based Materials with Enhanced Durability, Adaptable Design, and Natural Coloration for Automotive and Architectural Applications

Natalia Beata Piórecka
Supervisor: Prof. Barbara Imhof
Department of Experimental Architecture, Integrative Design / EXTREMES
Poster

The PhD research has started autumn 2024 and is set in the framework of the R&D funded project “MUSE - MyceliUm SEat”. The project investigates sustainable mycelium-based materials for applications in furniture and automotive design, with the aim of developing both high-performance prototypes and a catalogue of mycelium-based furniture. Early experiments have produced promising prototypes, including two car seats made with Ganoderma lucidum (Reishi) and Trametes versicolor. Testing has involved varied fabrication techniques such as fabric forming and mold-based processes, resulting in durable, formable structures. Additionally, a coloration effect on Reishi samples emerged from extended growth periods, opening new avenues for natural color application. Building upon these findings, further exploration of the fungal pigmentation by extracting pigments from various fungi is examined alongside their application in dyeing mycelium composites. These studies address the potential to engineer customizable, functional mycelium-based components. Upcoming phases will focus on integrating interchangeable parts to adapt car seats for various drivers, exploring substrates that offer both structural integrity, ergonomics and comfort, and expanding the research to a broader furniture catalogue. By investigating multi-organism collaborations and substrate variety, the project aims to create novel material systems and design products.



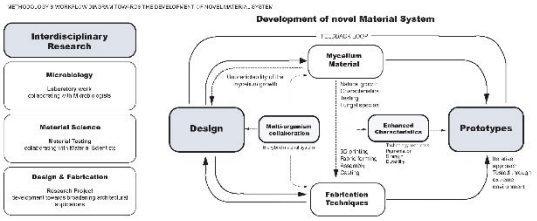


Advancing Biofabricated Architecture

Developing Mycelium-Based Materials with Enhanced Durability, Adaptable Design, and Natural Coloration for Automotive and Architectural Applications

Austria
University of Innsbruck
Faculty of Experimental Architecture, Integrative Design / EXTREMES

PhD Candidate / Natalia Beata Piórecka



Abstract
The PhD research has started autumn 2024 and is set in the framework of the R&D funded project 'MUSE - MycelIUm SEat'. The project investigates sustainable mycelium-based materials for applications in furniture and automotive design, with the aim of developing both high-performance prototypes and a catalogue of mycelium-based furniture. Early experiments have produced promising prototypes, including two car seats made with *Ganoderma lucidum* (Reishi) and *Trametes versicolor*. Testing has involved varied fabrication techniques such as fabric forming and mold-based processes, resulting in durable, formable structures. Additionally, a coloration effect on Hemlock samples emerged from extended growth periods, opening new avenues for natural color application. Building upon these findings, further exploration of the fungal pigmentation by extracting pigments from various fungi is examined alongside their application in dyeing mycelium composites. These studies address the potential to engineer customizable, functional mycelium-based components. Upcoming phases will focus on integrating interchangeable parts to adapt car seats for various drivers, exploring substrates that offer both structural integrity, ergonomics and comfort, and expanding the research to a broader furniture catalogue. By investigating multi-organism collaborations and substrate variety, the project aims to create novel material systems and design products.

Background & Research Question
The MUSE project addresses the growing demand for sustainable, bio-integrated material systems in product design and architecture. Mycelium offers a lightweight, biodegradable alternative to traditional materials, with interesting properties such as structural flexibility, fire resistance, and biodegradability. However, further research is needed to optimize mycelium composites for everyday applications, particularly in complex structures like car seats, which require strength, comfort, and adaptability. The research question focuses on identifying the optimal combinations of fungal species and substrates to create bio-composites that meet specific performance demands. The aim is also to investigate how the growth and appearance of these materials can be controlled through fungal pigmentation and fabrication techniques. The PhD project seeks to determine how mycelium-based composites can be engineered to meet high durability and adaptability requirements, with real-world applications in automotive and architectural systems.

Methodology
This PhD is developed through an interdisciplinary methodology combining microbiology, material science, and design. Initial phases involve testing various fungi species (e.g., *Ganoderma sp.*, *Pleurotus sp.* and *Trametes sp.*) on different substrates, examining growth rates, textures, and mechanical properties. Fabrication methods include fabric forming and molding (including 3D printing), producing prototypes that reveal each species' unique capacity in rigidity and flexibility. Current experiments include coloration studies, where Reishi samples showed natural color changes from prolonged growth. The planned investigation will also focus on extracting pigments from other fungal species to test their potential in dyeing mycelium-based materials. Furthermore, multi-organism systems will be explored, analyzing the impact of bacteria or algae in enhance material characteristics. In the upcoming stages, prototypes will undergo durability testing, and car seat designs will integrate interchangeable parts and mixed substrate layers for customized support and insulation.

Beyond the State of the Art
While mycelium-based materials are emerging as sustainable alternatives, few studies have advanced these composites to functional prototypes in high-demand applications such as furniture. With the shift from 'what if' to 'where can we buy it,' as seen in 2018 with the collaboration between Ecovative and bioMASON, the development of marketable mycelium-based furniture has stagnated. With the few commercially available examples, such as Zwampen or 'MyStool by Olle Sahlqvist. Pioneni by Kamilla Design Studio, and small architectural objects like lamps by Carole Collet's panels by MOGU, this project aims to develop a marketable, functional catalogue of mycelium-based furniture, further expanding the options available in the market. The project introduces a novel approach to fungal-based design by integrating multi-organism systems and exploring various fungal pigments, potentially enabling a broader spectrum of natural colors and finishes. Additionally, the goal is to engineer prototypes to meet the complex ergonomics and strength required for racing car seating accommodating multiple body types of the drivers. By combining innovative fabrication methods and customization options the research aims at replacing traditional, non-biodegradable materials with marketable, functional, adaptable, and composable alternatives in both automotive and architectural contexts.

Findings
Initial findings reveal that different fungal species and substrates influence both the structural and aesthetic properties of mycelium composites. For instance, prolonged growth of Reishi led to a natural coloration, suggesting potential for pigmentation control through growth timing. Fabrication techniques such as fabric forming and mold-based processes allowed to produce initial miniature furniture design sets, two primary car seat prototypes as well as a number of stools, and mini chairs that meet the fundamental demands of a seating. Preliminary discussions and testing suggest that car seats made with mycelium can incorporate interchangeable parts and multi-layer substrates to balance support and comfort for different drivers. Further testing will explore how pigment extraction and multi-organism systems can enhance both the material's appearance and its functional versatility, contributing to a new generation of bio-composite products. Findings will also reveal to which extend we can manipulate the material characteristics in a low risk laboratory setting.

The PhD research is funded by the Land Tirol.

ADDITIVE INHERENCIES

Strategies towards an additive design thinking

Kilian Bauer
Supervisor: Prof. Marjan Colletti
Department of Experimental Architecture w/ REX|LAB
Poster

Architecture, design and construction are increasingly utilizing additive fabrication processes. At the moment, two distinct approaches have evolved - the approach of industrializing the construction industry contrasts with the approach of a novel additive design language in architecture and design. Whereas the first approach of industrializing the construction industry considers additive techniques as an instrument for a rationalized reproduction of established components and objects, the second approach aims at the experimental use and evolution of the technique. This second approach emphasizes the inherent characteristics and postdigital flaws to elevate additive manufacturing from a fabrication method to a generative design tool that brings forth original works. Nevertheless, the anew opportunities to realize experimental geometries as rarely before by means of robotic 3D-printing only slowly influences and alters our creative way of thinking and designing. While this work is at its core an elaboration and contribution to the second approach by exploring experimental fabricationinherent strategies in large scale robotic 3D-printing, it also argues for a broader overlap of both concepts by incorporating experimental aspects into classical architectural tasks and showcases common use cases in order to contribute to the discipline as a whole.

Additive Inherencies

Strategies towards an additive design thinking

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ABSTRACT

Architecture, design and construction are increasingly adopting additive manufacturing processes. Two distinct approaches have emerged: one emphasizes industrializing the construction industry, while the other advocates for a novel additive design language in architecture and design. The first approach treats additive techniques as a tool for automating the reproduction of known components and objects. In contrast, the second approach explores the experimental potential of these techniques, focusing on their inherent characteristics and embraces postdigital flaws. This perspective seeks to transform additive manufacturing from a mere fabrication method into a generative design tool, capable of creating original, expressive works.
Despite the significant anew opportunities robotic 3D printing provides for realizing complex experimental geometries, it only slowly influences and transforms our creative design thinking. Therefore, this research aims to contribute to the second approach by exploring and advancing experimental, fabrication-inherent strategies for large-scale robotic 3D printing. It investigates how these methods can elevate the aesthetics and materiality of architectural production while fostering new creative practices.
Moreover, this work advocates for integrating experimental approaches into conventional architectural tasks, proposing a synthesis between the two paradigms. By showcasing practical use cases and exploring experimental fabrication strategies, it underscores the potential of additive manufacturing to enhance traditional workflows while expanding the boundaries of architectural expression. This dual focus not only enriches experimental methodologies but also aims to contribute to the broader discipline, bridging the gap between innovation and practical application in design and construction.

BACKGROUND & RESEARCH QUESTION

Over the past decade, robotics and additive manufacturing have carved a niche in architecture and design, prompting architects to explore their potential. The prevailing approach treats the technology as a large-scale 3D printer, directly translating digital designs into physical structures. This method, rooted in Industry 4.0 principles, focuses on the rationalized reproduction of established components, representing the current state of large-scale 3D printing in architecture.
However, additive manufacturing offers far more than conventional reproduction techniques. While it builds on traditional methods, its intrinsic principles and limitations remain underexplored. The inaccuracies, imperfections, and artifacts inherent to the process present a unique opportunity to develop a fabrication-inherent aesthetic – one that embraces the flaws and quirks of the manufacturing process. This postdigital aesthetic, echoing the sentiments of other artistic disciplines, finds "beauty in the flaws inherent in digital processes" (Andrews, 2013), offering untapped potential for innovation in architectural design.

[Andrews, I. (2013). Post-digital aesthetics and the function of process. Retrieved May 4, 2023, from https://ses.library.usyd.edu.au/bitstream/handle/2123/9975/post-digi-aesthetics.pdf?sequence=1&isAllowed=y]

RQ: What defines (postdigital) fabrication-inherent, additive aesthetics, what (unexpected and unprecedented) design potentials (still) lie in experimental additive manufacturing techniques and (where) can they find their place in architecture and design?

METHODOLOGY

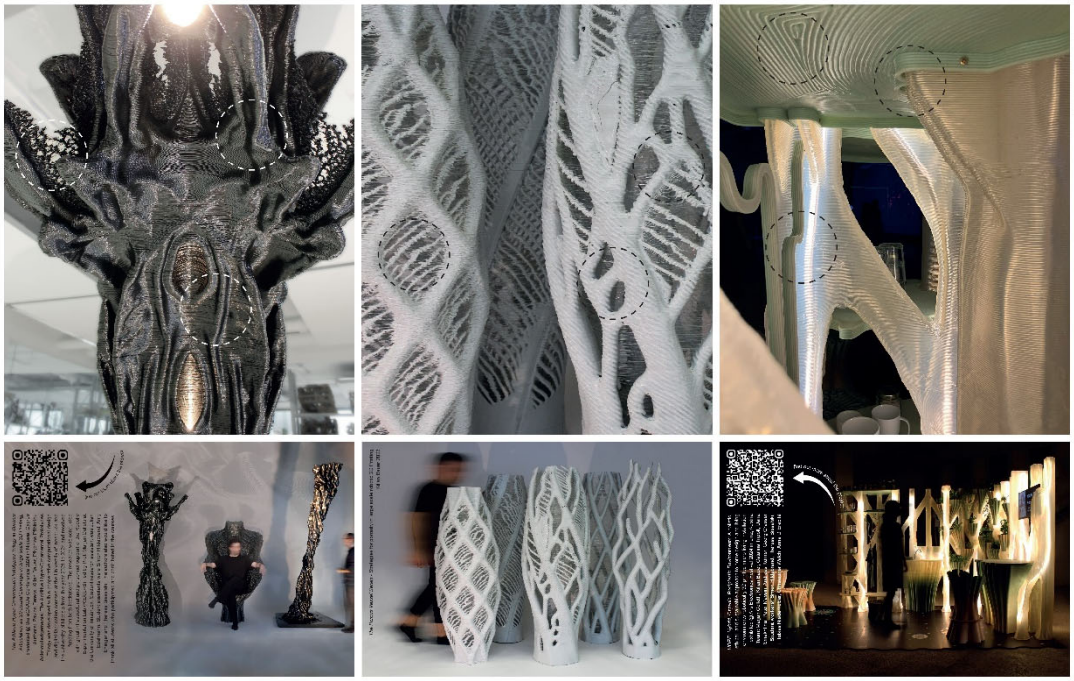
This research combines a PhD by Design and PhD by Theory approach, pairing theoretical reflection with practical exploration. Alongside a contextual and historical analysis, the core of the research is a series of case studies involving 1:1 prototyping projects. These projects aim to advance experimental additive fabrication processes by refining materials, fabrication strategies, and details, with a particular emphasis on the aesthetics inherent to these emerging techniques. The research examines the architectural potential of these methods, exploring how fabrication influences design, construction, ornamentation and ultimately our design thinking. Through a practice-oriented methodology, the construction of multiple full-scale prototypes serves as a proof of concept, demonstrating the feasibility and applicability of the processes while providing meaningful contributions to the field of architecture. This dual focus on theory and practice ensures a comprehensive understanding of additive fabrication's implications for contemporary design and its evolving disciplinary framework.

BEYOND THE STATE OF THE ART

While the dominant approach to large-scale robotic 3D printing emphasizes the direct translation of digital designs into physical form, this research seeks to push beyond conventional boundaries. It investigates the creative potential of fabricated imperfections, material and fabrication effects, and the inherent agency of the manufacturing process itself. By embracing these elements, the study aims to advance an additive design thinking paradigm that views additive manufacturing not merely as a fabrication method but as a transformative design tool and a catalyst for generative design innovation.

FINDINGS

So far this research could showcase and contribute some findings to shared publications, including aspects of porosity in large scale 3D printing in *Postdigital Natures – Digital-material hybrids for robotic 3D printing of architectural elements* by Peter Massin, Andreas Körner, Marjan Colletti, Georg Grasser, Theresa Utz and Kilian Bauer presented at the eCAADe Conference 2023 in Graz, Austria; structural strategies as in *Surface Articulation as Stratotrave Leverage in Large Scale 3D Printing* by Pavlos Fereos, Kilian Bauer and Eftychios-Nicolaos Efthimiou presented at the eCAADe Conference 2024 and generative ornamental aspects as in *Morphology and Ornamentation – Robotic fabrication of a biocomposite relief* by Peter Massin and Kilian Bauer, also presented at the eCAADe Conference 2024 in Nicosia, Cyprus.
Additionally, it was possible to demonstrate potentials of large-scale 3D printing in everyday settings with the micro-living exhibition construction *HOPE: Hybrid, Organic, Postplastic Environments*, exhibited at the Ars Electronica Festival 2024 in Linz, Austria, together with the team of Marjan Colletti, Kilian Bauer, Catalina Tripolt, Daria Smakhtina, Peter Massin, Andreas Körner, Georg Grasser, Simon Hildebrand, Theresa Biesalski, Tobias Niederholzer, Christopher Walch and Anna D'Eredita.



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