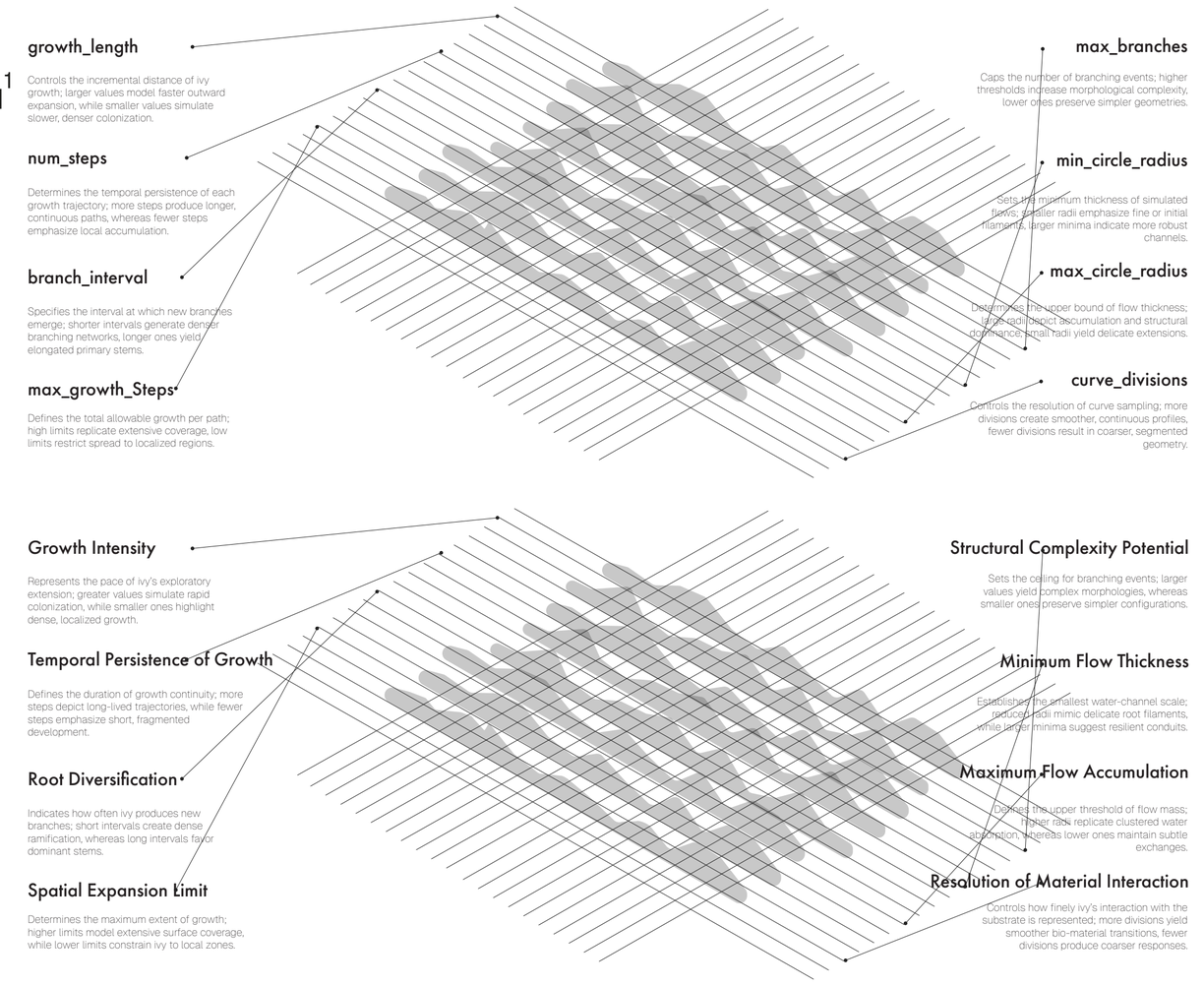
Cultivating Matter.
circular strategies
symposium 6

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University of Applied Arts Vienna, Auditorium,
Vordere Zollamtsstraße 7, 1030 Vienna

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Decoding Ivy-Induced Feedback Loops: Modeling Cumulative Biological Impacts and Morphological Adaptation



Research

Ivy plants exhibit a distinctive growth pattern that merges biological adaptation with structural interaction. Beginning their life cycle in soil, they climb vertically when encountering suitable surfaces such as walls or trees, forming an evolving and dynamic relationship with architectural elements. This study introduces a computational model that investigates ivy's growth behavior and water absorption dynamics, aiming to understand their implications on material performance.

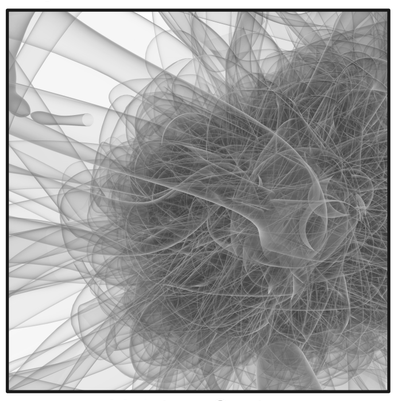
Methodology

Utilizing Python scripting in Rhino, the research develops digital simulations that replicate ivy's exploratory movement and interaction with porous building components. Curves and volumetric forms visualize the organic expansion of the plant, while the model shifts its focus from representation toward performance-oriented analysis of material transformation over time.
As the ivy establishes contact with porous substrates like mortar, moisture is gradually extracted, disrupting the internal equilibrium of the material. This leads to a drying process, the emergence of micro-fractures, and a reduction in structural cohesion. Simultaneously, the redistribution of water within the structure generates spatial hydrological gradients. These gradients influence the direction and density of biological colonization, with the architectural surface becoming an active participant in regulating flows of matter and energy.

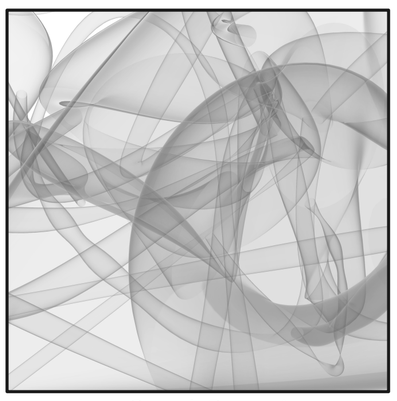
Findings

Rather than functioning solely as an inert host, the architectural surface evolves into a responsive mediator shaped by living processes. Over time, the accumulation of micro-damage triggers adaptive responses inspired by regenerative biology. The model speculates how material systems might develop self-regulating or healing capacities in response to stress.
Through feedback-driven behaviors, architectural components begin to mirror the regenerative logic observed in living tissues—enabling local restoration and performance recovery. These intertwined mechanisms of biological interaction, hydrological redistribution, and material adaptation offer new insights into resilient design strategies. Rather than resisting change, materials are envisioned as dynamically evolving systems, continuously shaped by their environment.
The research process is still ongoing, and future phases will integrate high-resolution datasets and physical testing to validate the computational predictions and explore practical applications of bio-integrated material systems.

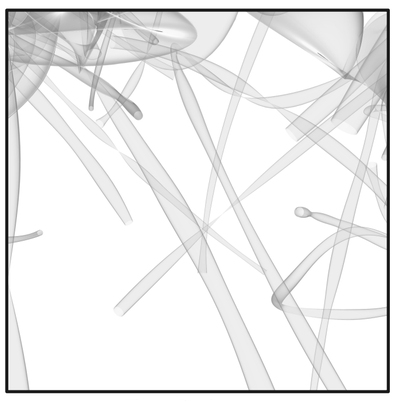
Layers



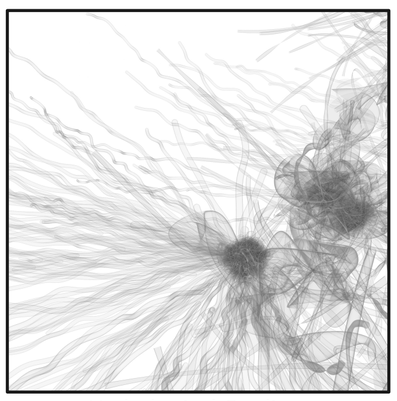
Moisture Capture
Water is absorbed into the mortar's micro-cavities, creating local reservoirs that initiate material transformation.



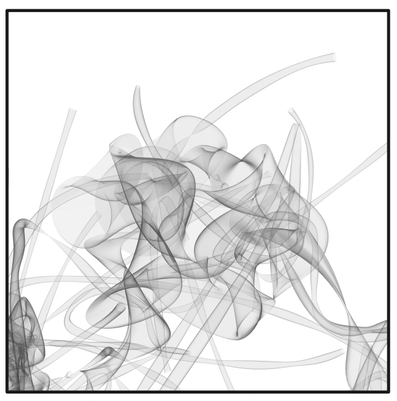
Ivy's Growth Dynamics
Ivy explores its environment through adaptive climbing behavior, weaving organic trajectories across architectural surfaces.



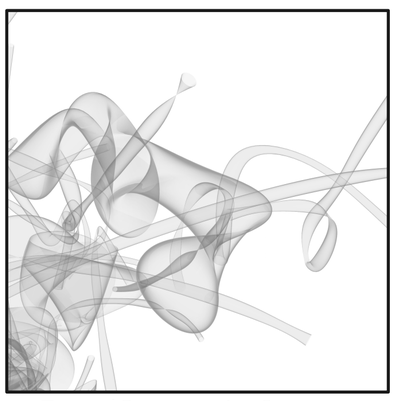
Flow Pathways
Extracted water redistributes along hydrological gradients, guiding the direction and density of further colonization.



Hydrological Gradient
Large-scale redistribution of moisture generates environmental flows that regulate biological activity across surfaces.

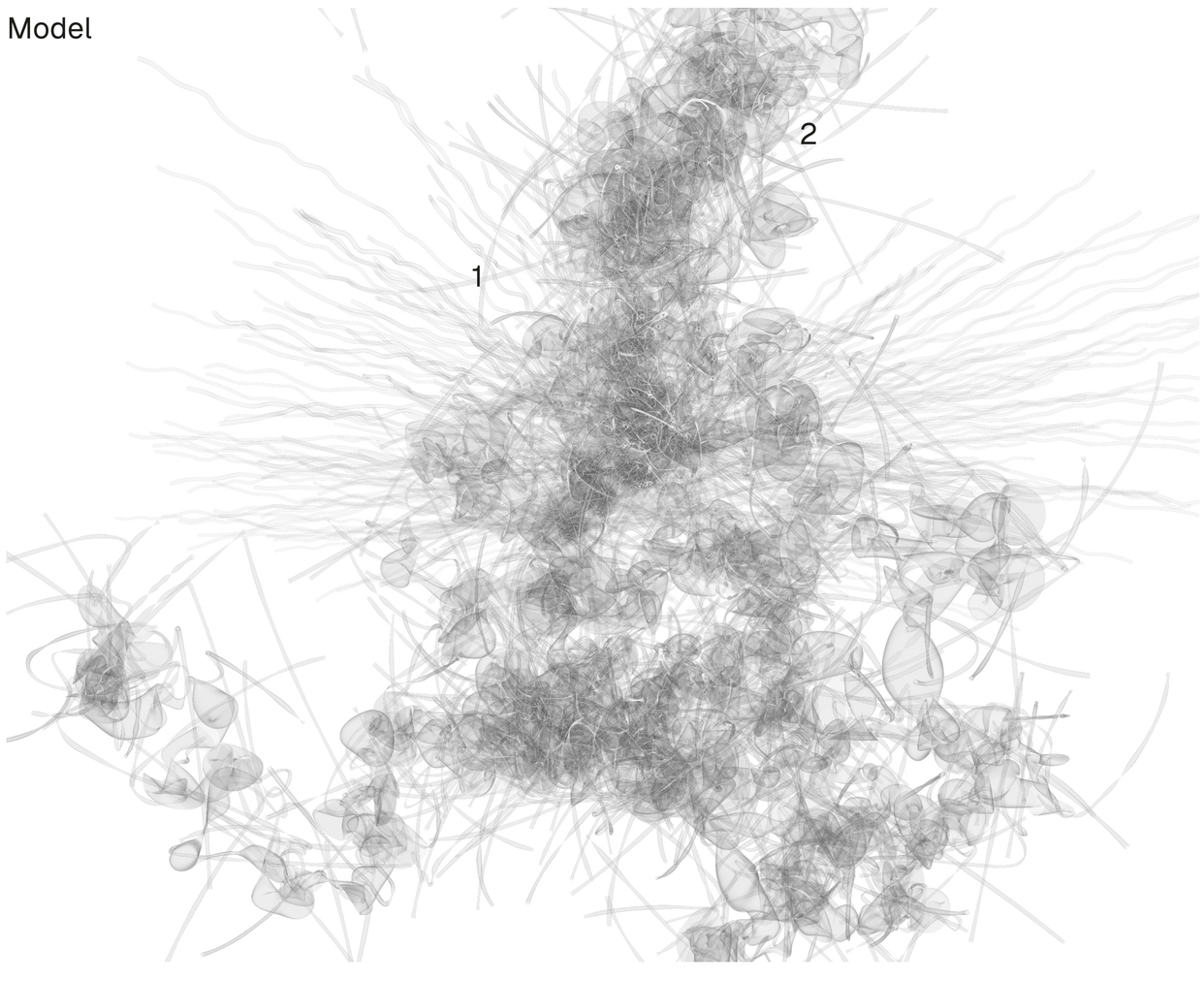


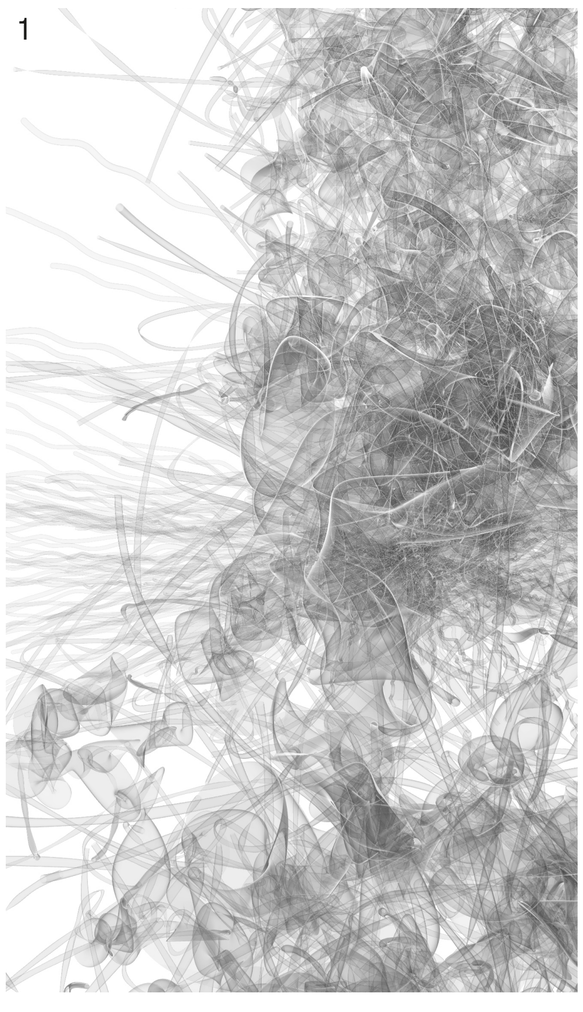
Responsive Mediator
Instead of remaining passive, the architectural surface evolves into an active interface, shaping exchanges of matter and energy.

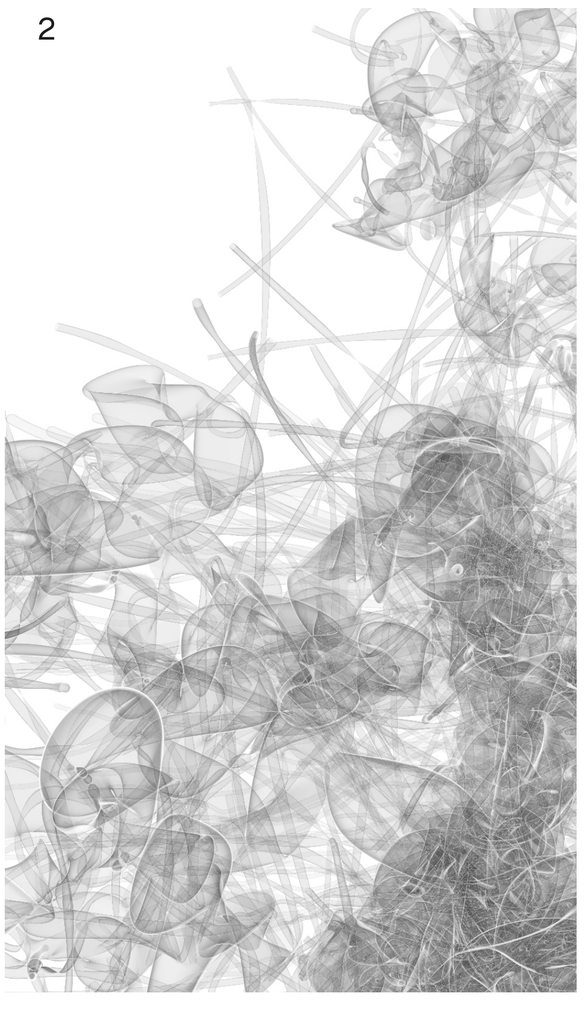


Toward Regenerative Systems
Accumulated stress and micro-damage trigger adaptive, tissue-like responses, envisioning materials as self-regulating, resilient systems.

Model







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Building Construction