The basic principle adopted is the same conditional void-matter separation based on reaction-diffusion algorithms: the process described above is iterated at a more detailed scale in a self-similarity logic analogous to those governing fractals (Figure 9).

Since the Gray-Scott algorithm does not allow a wide range of scale variation over a given voxel matrix, the three-dimensional pattern obtained so far was scaled using an algorithm based on tricubic interpolation, which allowed the achievement of the desired void pattern scale with good approximation quality. The result is a multilayered domain, where every layer represents a particular field. In this model material system distribution, information and processes are all scalable: the process is iterated with systemic yet heterogeneous results at different scales (Figures 10, 11, and 12).

6 CONCLUSIONS

The project provides a material substrate for cultural development and aims at the possible repopulation of local seabed biodiversity by enhancing a pattern of differentiated spaces through the application of morphogenetic strategies that proactively shape the new environment through interacting with its own physical characteristics (Figure 13).

Although some tests were carried out of underwater behavior of D-Shape material artifacts with positive results, no current testing can yet provide a reliable assessment of its reaction dynamics over time (for instance, resistance to erosion); large-scale 3D printing technology is still a breakthrough sector in an early development and rapid evolution stage, and such tests require a longer timespan to deliver trustworthy assessments. However, this should not be an excuse for limiting design speculations. (Of course, real constraints that may be found during further testing should be taken into account and embedded in the project strategy.) As continuous assessment and rapid adaptation are an intrinsic part of the design approach, further implementation is also foreseen (such as, for instance, material behavior and its influences in terms of weight, mechanical and viscous behaviors over time, erosion, etc.).

Another reason that has limited the physical testing phase has been the lack of investors, although recent contacts with local institutions interested in touristic development and environmental care may provide the necessary economic fuel to start building a positive network among tourism, culture, material practice, and sound environmental transformation.

REFERENCES

Biorock. http://www.globalcoral.org/Biorock%20%20Mineral%20Accretion%20Technology%20for%20Reef%20Restoration.html.

Camazine, S. (2003). Self-Organization in Biological Systems. Princeton, NJ: Princeton University Press.

D-Shape Technology Presentation. http://www.d-shape.com/d_shape_presentation.pdf.

Johnson, S. (2002). Emergence: The Connected Lives of Ants, Brains, Cities, and Software. New York City: Scribner.

Hensel, M., Menges A., and Weinstock, M. (2010). Emergent Technologies and Design: Towards a Biological Paradigm for Architecture. Abingdon, Oxford, and New York City: Routledge.

Lynn, G. (1999). Animate Form. New York City: Princeton Architectural Press.

Milnor, J. (2006). Attractor. Scholarpedia 1 (11): 1815. http://www.scholarpedia.org/article/Attractor.

Pattern Formation Group in Osaka University Faculty of Frontia Bioscience. http://www.fbs.osaka-u.ac.jp/labs/skondo/paper_laboE.html.

Reef Balls. http://www.reefballaustralia.com.au/.

Reiser, J. (2006). Atlas of Novel Tectonics. New York City: Princeton Architectural Press.

Reynolds, C. (1987). Flocks, Herds and Schools: A Distributed Behavioral Model. In Computer Graphics, SIGGRAPH '87 Conference Proceedings, 21 (4): 25–34.

Turing, A. M. (1952). The Chemical Basis of Morphogenesis. Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences 237 (641) : 37–72.

WORK IN PROGRESS

LOW FIDELITY

Erin Besler
Southern California Institute of Architecture

ABSTRACT

A contemporary exhaustion with technological fidelity (Gow 2011) has identified an environment where control and precision are reduced to illusive promises in the game of materialization. The recent ascent of the homogenous copy, arguably brought on by the onslaught of digital tools, has collapsed the gap between the object and its representation, obliterating the productive tension and creative friction from architectural design methodologies.

This work proposes to reopen the gap and locate new sites for architectural design by engaging in the translational discrepancies that occur through mediums of architectural representation, not as instances of dilemma but as opportunities to subdue tautology and augment the seductive latency of representation (Perez-Gomez and Pelletier 1997). In an attempt to negotiate the digital and physical, this work situates itself within the feedback loop between the translations of architectural ideas, representational strategies, material propensities, and back again. The discrepant becomes a dynamic catalyst through the engagement of participatory tools (Carpo IKKM 2011), interactions with matter, and processes of materialization.

1 INTRODUCTION

Imbued with discrepancy and permeated with increasing disparity between perception of space, conception of space, and representation of space, architectural design methodologies result in a disconnect between medium-driven processes and material-driven production. Low Fidelity engages in the translational discrepancies that occur through mediums of architectural representation, not as instances of dilemma but as opportunities to subdue tautology and augment the seductive latency of representation (Perez-Gomez and Pelletier 1997). In an attempt to negotiate the digital and physical, this work situates itself within the feedback loop between the translations of architectural ideas, formal logics, material propensities, representational strategies, and back again.

2 MATTERS OF FIDELITY

A contemporary exhaustion with technological fidelity (Gow 2011) has identified an environment where control and precision are reduced to illusive promises in the game of materialization. Contrasting a faithfulness to the "identical copy of the architect's design" (Carpo 2011) and by employing and extending the translational discrepancies that occur through mediums of architectural representation, the discrepant becomes a dynamic catalyst through the engagement of new participatory tools (Carpo IKKM 2011), interactions with matter, and processes of materialization.

Through its history architecture has purported a high-fidelity translation from drawing to building; the most recent ascent of the homogenous copy, arguably brought on by the onslaught of digital tools, has completely collapsed the gap between the object and its representation, nullifying the productive tension that was at one time identified as being the site for engagement, creativity, and agency in the field of architecture (Evans 1997). Low Fidelity asserts that the emphasis on faithful Albertian reproduction, the precise translation from represented to representation, from digital to physical, has not only sterilized architecture's mediums but also has failed to deliver in the promise of its own fidelity. The semblance of the homogenous copy has been exhausted.

Within a discipline of representation, architectural ideas move from the prima maniera, through drawings, models, material processes, formal logics, and built work; representation translates architecture across mediums, introducing varying degrees of abstraction at each stage in the process. The discrepancies, or transmission losses, as Brian Eno relates, "inevitably occur when a traditional composer or pop arranger takes a sounding idea and fixes it in written form, musicians read the written form, and then play it" (Tamm 1995); similarly, with the communication component that allows for near synchronous robotic motion in the lab "the potential for distortion of the original information is present at each stage of the process" (Tamm 1995).

Both unintended and planned, discrepancies have the capacity to be generative by engaging in the feedback loop of real-time material processes and design methodologies. The loss in fidelity engages challenges and explores the gap between the represented, its representation, and the process of translation. The fidelity of mechanical reproduction and the translational discrepancies that occur not only between the original and the object of representation, but also between and among the copies of the objects themselves, are impressions of the fact that there is no true copy. If we remember, before mechanical printing, and before the computer, everything was reproduced by hand; the human was the representational tool, with an enthralling set of variables and idiosyncrasies. The digital, on the other hand, has no fidelity, or perhaps it has ultimate fidelity, so long as it stays digital—in code. But as designers we rarely code exclusively, we work through a visualization and produce a visual representation.

3 MATERIAL INTERACTIONS

Where some might contend the motion decay or discrepant is unlawful, the methodology that this work argues for engages the digital, and explores and extends the translational discrepancies that challenge and interrupt our interface with matters of materialization and excite material propensities. These

figure 1

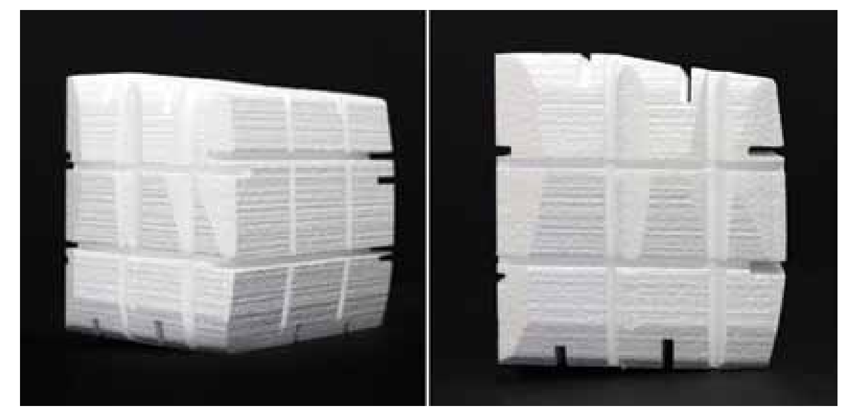

figure 2

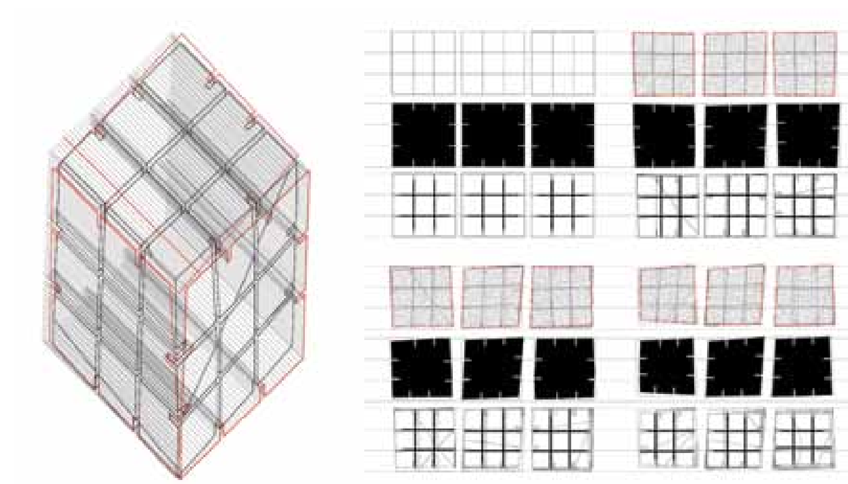

figure 3

figure 1

Cubes. When seen together the series relates not only the discrepancies within each object, but between the objects themselves. Each cube is a result of a generative process of translation and fabrication rather than a prescriptive one, relocating sites for architectural design to be within material processes.

figure 2

Translated cube. The misaligned indexical marks, the surface texture, the lozenge-like profile shape, and the compounded anomalies characterize the object through the engagement of translational discrepancies.

figure 3

Cube—materialization and translation. The diagram on the left shows the conceptualization of mechanical extrusion, a digital process translated into physical space through the tracing of profile curves. The series of diagrams on the right show the means of translation through three orthographic projections: the registration of the object as a point cloud in space, the attenuation of those points to a profile curve, and the establishing of the indexical marks which gets fed back into the system for each individual cube.

figure 4

Column—translation. The diagram on the left shows the shaft of the designed column. The diagram in the center shows the design for two sequential drums that make up the column shaft. The diagram on the right illustrates the translation from design to fabrication which is evidenced through the specific process of profile tracing; the discrepancies between the lengths of the curves begin to register in a very particular way on the surface of the column.

figure 5

Column—materialization. The image on the left shows the process of fabrication, the robotically controlled hot wire, and material interactions with low-density foam. The middle and right images show the materialization of sequential drums, the discrepancies between the represented as shown in Figure 4 and its representation, the process of fabrication, and material actualization. The designed column becomes the compounded translation of the discrepancies between mediums of representation.

studies investigate the potential for the discrepant in the platonic architectural object and the classical architectural form: the cube and the column. While these investigations are not intended to encapsulate architecture in the embodiment of a building, they do begin to address the implications of architectural scale in another way that deals more with the depths and extents of a working methodology that has the capacity to locate new sites for design.

As a site of habit in architecture, the cube has embedded within its geometry an inherent logic and orientation (Figure 1). These studies stand as a few in a series of representations, existing as both generator and generated, that subvert the homogeneity of digital tools and take advantage of the seductive latency of representation (Perez-Gomez and Pelletier 1997) through the liberation of a mechanically confined device, a hot wire, and material interactions with low-density foam (Figure 2).

The line of materialization becomes the attenuated translation, the representation, through the abstract and reductive process of extrusion (Figure 3). While the profile tracing is carefully calibrated, and the wire controlled through robotic motion, the variables and inconsistencies already present in the system are incongruously compounded as the wire makes contact with the foam. The materialized object is then surveyed in the form of a mediated point cloud, its profile curve extracted and fed back into the system of interactions. The discrepancies between the objects are evidenced through their resultant two-dimensional elevations and further through the superposition of indexical marks which begin to serve as registers of the system of differences established throughout the series.

Where the cube studies dealt with the tracing of a set of single profile curves in space materialized through the conceptualization of mechanical extrusion, the column studies look at the negotiation of the tracing of two profile curves simultaneously that exist in planar series along a column shaft. The discrepancies between the curves result from the geometrical logic of diminution in the column (Figure 4). They are compounded as the toolpath constantly tries to balance the discrepant lengths between the two curves while the speed and trajectory of the robotically navigated wire begins to decay as it moves through the low-density foam (Figure 5).

The variables at play—from the resolution of the toolpath and the speed of the robotically controlled wire to the temperature of the nickel chromium and its built-up resistance—in a seemingly highly controlled and resolute system begin to draw open the gap between the represented and its representation. The direct access to the feedback loop allows medium-specific tools and techniques to be created, accessed, and extended. The machine and digital code allow translation of a visual representation, a scanned object, fed back into physical space in real time through a low-fidelity translational medium. This brings into question the medium as being more than just the piece of paper that a drawing is printed on, or the specific material of reification. The medium is much more interactive, adaptable, and flexible. It refers to what could be called the abstract machine, the feedback loop, the system of interactions and contacts. This research subsists on the translational discrepancies that occur during interplay between an excessively controlled but exceedingly irresolute digital environment and its materialization into the reality of physical space.

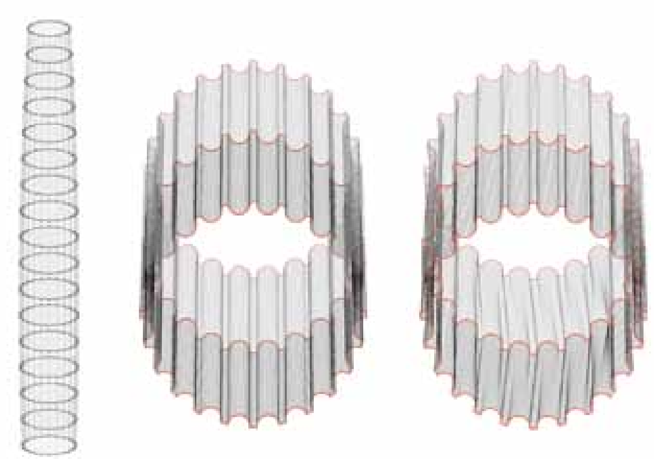

figure 4

4 CONCLUSION

From flux to stability, material engages with the digital and machinic in a generative approach rather than a prescriptive one. Real-time feedback in the design process and the opportunity to cull out translational discrepancies and feed them forward, into the system, is arguably essential in an architecture that is "deeply entwined with digital media" (Gannon and Hayles 2009). As part of a working methodology, it is an idea transferred from real-time robotic systems wherein an event in the past gets translated back into the original system and affects any series of events yet to occur. The presence of feedback in a system, the medium, the abstract machine, and the engagement with matter means that it is flexible and adaptable, that it can be accessed, that conjecture can be introduced, and that it can be manipulated to subvert the homogeneity of digital tools and augment the seductive latency of representation (Perez-Gomez and Pelletier 1997). As Brian Eno might say, "It makes possible whole new ranges of use and abuse" (Tamm 1995).

For a discipline that has been overcome by the ascent of high-fidelity reproduction, Low Fidelity proposes to break through the tendencies and illusive promises of verisimilitude to open up new sites for architectural design and reestablish the gap between mediums of representation. The gap, "the blind spot between the drawing and its object" (Evans 1997), allows for productive tension to be present; the gap is what defines architecture as a discipline of mediation and provides room for creative space in architectural design.

ACKNOWLEDGMENTS

The presented text and images are part of my Master of Architecture Graduate Thesis completed at the Southern California Institute of Architecture (SCI-Arc). I would like to thank my graduate thesis advisor, Andrew Atwood (SCI-Arc faculty), for his invaluable feedback, advice, and support. I would also like to thank Marcelyn Gow (SCI-Arc faculty, cultural studies advisor), Peter Testa (SCI-Arc faculty, thesis prep advisor), Brandon Kruysman (SCI-Arc faculty), and Jonathan Proto (SCI-Arc faculty).

REFERENCES

Carpo, M. (2011). The Alphabet and the Algorithm. Cambridge: MIT Press.

Carpo, M. (2011). Unauthorized Architecture IKKM Research Project. Accessed at https://vimeo.com/30628101

Carpo, M. (2004). Pattern Recognition. Catalogue of the 9th International Biennale d'Architettura. Focus. Vol. 3 of Metamorph, 44–58.

Gow, M. (2011). Email to E. Besler, November 11, 2011.

Evans, R. (1997). Translations from Drawing to Building. London: Architectural Association Publications and J. Evans.

Hayles, K. N., and T. Gannon. (2009). Virtual Architecture, Actual Media. In The SAGE Handbook of Architectural Theory, eds. C. G. Crysler, S. Cairns, and H. Heynen. Thousand Oaks, CA: Sage Publications.

Perez-Gomez, A., and L. Pelletier. (1997). Architectural Representation and the Perspective Hinge. Cambridge, MA: MIT Press.

Tamm, E. (1995). Brian Eno: His Music and the Vertical Color of Sound. Boston: Da Capo Press.

figure 5