# A new material practice

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*Publication date:*
2012

*Document Version:*
Peer reviewed version

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published for SmartGeometry 2012 on www.smartgeometry.org

The first generation of digital architecture was fascinated with the extension of the digital possibilities into the physical world. Today, we are seeing the emergence of a new material practice. This practice is focusing on a design and production process that is seeking an understanding of the aggregated behavior of matter in an environment. Advances in material science and in computational tools are creating new opportunities within architectural design. However, these approaches are challenging the current practices of design and representation. We find that our current digital design tools are limited in their ability to address the complexities of material performance. They are based on the orthogonal logics of projective drawing, and as such, support the traditional approach of abstracting problems to a geometrical level. Despite this method having success historically, it exhausts itself in the understanding of the world on the level of symbols. Within this world of representation, each symbol can be invested with any meaning at any time. This is yet not possible in the material world which is composed of scale, interrelationships and absolute values. Today's Digital models stripped to mere geometric descriptions are not able to represent at any one time, the multiple scales that interact within the systems they represent. Yet digital fabrication calls us, as designers, to a new relationship between design intent and material understanding. We therefore need urgently, tools that can address this linkage in a performative sense. This will enable us as designers to answer the challenge to the profession of integrating the complex and time based interrelations that occur in the systems we work and construct with.

This call for a computational engagement with material performance leads to a new consideration of the calculative capabilities of our digital design tools. More akin to the tools of structural engineering, computer graphics and material science, our tools need to incorporate algorithms that enable firstly material description, but more importantly the feedback from calculations of material at work. Appropriating tools from these parallel knowledge fields and integrating these with spatial design practice will allow for digital prototyping and testing.

**Simulation**

Learning from the fields of computer science and robotics, we need to engage with simulation as fundamentally different to visualisations. If visualisation operates within a representational paradigm, the aim for simulation is not visual similarity, but rather to model a system's actual behaviour. Here, data is seen as a parallel instantiation of a data-scape based upon the measurement and combination of real world events. Like the meteorological simulations of weather, these descriptions rely on the processing of real data streams detailing the humidity, temperature and pressure of an environment. Running weather within a computational system becomes conceptually 'as real as' the weather that we experience. As such the tradition of representation is replaced with a cultural paradigm, in which data is extractable and calculable in meaningful ways.

***The idea of a bespoke material***

This idea of design based on performative simulation is informing a series of parallel practices, allowing the emergence of the possibility that materials could be tailored to their situation.

In the sail industry the practice of fabricating sails in direct response to environmental and material simulation has given rise to a new league of sail making within high performance races such as America's Cup. Here, complex wind simulations give the designers the ability to map the forces anticipated to occur across the sail. North Sails have famously designed fabrication techniques by which the laying of fibres within the sail directly responds to the anticipated forces of the wind. Directly moving from simulation to design and from design to fabrication allows an unprecedented control over the material.

From the very large to the very small, the possibility for *performative materials* that are engineered in response to highly defined design criteria is challenging the traditional boundaries of design and representation.

This idea of the bespoke material takes on a new degree of relevance upon engagement with a second tier of tools that allow for material fabrication. As the focus of material manipulation changes in scale, increasing in complexity and detail, we enter a radical rethinking of our material practices. Advancements in material science, more complex models of material simulation, combined with improved digital interfaces between design and fabrication, are fundamentally changing the way we conceive of and design architecture. This new technological platform allows us to conceive materials as complex composites, differentiated and graded, whose particular detailing is a central part of a project's overall solution.

Performative materials might be structurally differentiated or materially graded. They might be designed in response to a variegated load or a change in programme. Hyper specified and designed, they can be developed as a response to particular criteria by which the strength, structure, elasticity or density of a material can be devised.

With the introduction of generative approaches on all levels of design and fabrication we can no longer understand these criteria merely as givens anymore. We must address them within our conception of the design itself. Within this new paradigm, simulation moves from being a pure analytical tool to be a device within the realm of design. Experimental projects such as Listener and *Composite Territories* hint at the possibilities for making materials that correspond to designed properties. *Listener* allows variation in the responsiveness of a surface. Integration of simulation and material making into the design process of *Composite Territories* allows architects to steer the bending of material – a behaviour avoided by the general profession though it has always been present in the material realm.

In these projects, the interplay of design, simulation and material making challenges the common idea of the dominance of abstract design thinking and introduces a material practice that is considerably more subtle and responsive through different levels of feedback than our common design approaches allow today.

**Picture Boxes:**

1) Sail made with 3DL Technology by North Sail that thermo-molds sails as a unitary membrane on a full-sized 3-dimensional mold.
http://www.nz.northsails.com/TECHNOLOGY/3DLTechnology/tabid/8356/language/en-US/Default.aspx
**2) Listener CNC Knitting**
Listener explores the idea of a textile membrane that has an inherent capacity to sense and react to its surrounding. Collapsing the idea of the controlled and the controlling, Listener is the making of a material that has its own, autonomous, relationship to its environment. The textile is treated as a composite material that through its inherent conductivity allows for the passing of computational signals, but also through its exceptional structural strength, and through its treatment, gains new properties.
Listener is a collaboration of Mette Ramsgard Thomsen, CITA and Ayelet Karmon, Shenkar College of Engineering and Design with support by Dr. Eyal Sheffer and Ami Cang, Knitting Lab, Textile Design Department, Tzach Harari, Robotics Lab, Yair Reshef, Interactive
http://cita.karch.dk/Menu/Projects/Behaving+Architectures/Cad+Cam+Knitting+%282010%29

3) **Composite territories**

The project explores how architects might simultaneously be designers of material as well as form. Fibre reinforced composites allow materials to be designed for a specific property and a specific context. But the idea that a property such as bending might be desired, rather than minimized, is new to architecture. So is the idea that material might be incorporated into the form-making process, rather than form being imposed upon it. The object of this exhibition is to rediscover the capacity of a material to bend, not as failure or a shift from the normal but rather as something that can be tailored to specific design concerns.

Composite territories was developed within a research workshop by the Centre for Information Technology and Architecture (CITA) with Paul Nicholas, Martin Tamke and Matt Gilbert in collaboration with the Department 8 (Ali Tabatabai) and Department 2 (Phil Ayres) of the School of Architecture in Copenhagen. The project is part of the postdoctoral Project designing material - material design by Paul Nicholas at CITA funded through FKK Denmark.

The installation is on display in ggggallery™, Sølvgade 5 Copenhagen until 5th March 2012.

www.ggggallery.com