INSIDE SMARTGEOMETRY
Expanding the Architectural Possibilities of Computational Design

BRADY PETERS & TERRI PETERS
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Brady Peters & Terri Peters
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‘Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.’

‘What information consumes is rather obvious: it consumes the attention of its recipients. Hence a world of information creates a poverty of attention.’

Herbert Simon, Sciences of the Artificial

The Nobel Prize-winning polymath Herbert Simon wrote the above observations more than half a century ago at the time the world’s first CAD systems arrived. His freakishly prescient declaration of the extreme consequences of modern, cognitive models captures both the potential as well as the challenge of a) design worlds conceived (enthusiastically) in terms of information-based problem solving; and b) the unexpected consequences (somewhat more tentatively) to time, and not only space, in an era dominated by the production of information.

Long after Simon’s foresight we all know now that the construction of attention is amongst the most difficult of all architectural undertakings, in a world of relentless media, information and access. Surely one of many remarkable accomplishments of Smartgeometry is its least obvious feature: its genuinely sustained, focused attention to a bounded set of architectural, geometric and linked questions, from which immense knowledge has been advanced. Like other computational cultures and not only digital design technologies, Smartgeometry is now a truly global enterprise; a regularly convened, creative space of like-minded architects and others interested in an open experimentation, exploration and invention of new design systems alongside the projects for which these associative systems have been developed.

Conceived a little more than a decade ago by Hugh Whitehead, Lars Hesselgren and J Parrish as a cross-disciplinary series of design workshops, presentations and discussions, and soon joined by Robert Aish and other key collaborators giving from its earliest days both breadth and depth (in an architectural world too frequently describable by means of a surface), Smartgeometry has by now come of age. This fact is the first of many demonstrated in the wonderful volume that follows; a book that is both a document and proposition, not only for recent (rapidly evolving) concepts, tools and techniques, but also for future ones. This is an interest Smartgeometry’s founders share with a cast of thousands that by now have participated (myself included) as presenters, workshop leaders, design gurus, students, teachers and curious observers at the group’s annual gatherings.

1 Sean Ahlquist, Bum Suk Ko and Achim Menges, Material Equilibria: Variegated surface structures, ggfgallery, Copenhagen, 2012. Material Equilibria is a part of a larger body of research done by Sean Ahlquist, a professor at the University of Michigan and a tutor for the 2010 Smartgeometry workshop cluster ‘Deep Surfaces’. The project focuses on the development of computational design methodologies and techniques which enable the generation of self-structured spatial forms through the generation of informed material behaviours.
The following volume provides an in-depth record of these gatherings, and has been wonderfully edited by Brady Peters and Terri Peters as two dozen chapters containing insightful accounts of both the history of these events and highlights from their various undertakings. What follows is part post-post-modern super-nerd primer (filled with fascinating weird things like ‘augmented composites’, ‘shape grammars’, ‘swarm algorithms’, ‘parametric acoustic surfaces’, or ‘particle spring solvers’, amongst many other things), while also being a remarkably accessible, straightforward demonstration of how contemporary design tools are at work in unexpected ways. They are reconfiguring the concepts emerging alongside the various forms of machinic, digital and physical modelling, prototyping and testing that provide the more visible outcome of Smartgeometry’s remarkably robust, sustained attention. It’s an approach that, like the impetus of contemporary ‘object-oriented’ programming cultures, crucially prefigures as well as continues to inform the generative model-making activities surrounding Smartgeometry. What we see above all else in this book is how contemporary experimentation wrestles ultimately with the most complex architectural projects of all – the cognitive architecture of the architect’s own mind.

What follows is far more than a demonstration of just how far and fast contemporary experimentation has pushed architecture’s millennial reliance on geometry and advanced mathematics. Writing half a century ago Herbert Simon understood the figure of the modern architect as a perfect demonstration of what it means to design today. ‘The modern architect’, Simon wrote, ‘is the maker of instructions’. The architect’s job isn’t the ‘making’ of things in a conventional sense – it is the recording of design intentions, ideas and ambitions in the form of documents (drawings, sketches, models etc.) whose real purpose is to tell others what to do. Architects, in Simon’s view, ‘make instructions’. In this sense, the artefacts produced in the architect’s studio are hardly anything other than memory structures. In this sense, we can grasp the real values of Smartgeometry’s remarkable, collective, collaborative and sustained focus: not only on the role of information-based approaches to architectural design, but also on the making of the most difficult of all architectures, the architect’s own cognitive structure. It’s a memory structure of a very different sort than most kinds of architecture, and in the hands of the protagonists whose examples follow it is proven no less elastic, and intelligent, than other forms of building.

2 Sean Ahlquist, Bum Suk Ko and Achim Menges, Material Equilibria: Variegated surface structures, ggggallery, Copenhagen, 2012. The parametric model shown here controls the knit of shifting patterns and densities, influencing the structure of the tensile spatial surface. Through computation, the micro-structure of the textile is varied to create particular organisational and structural behaviours. The accumulated material phenomena are calibrated to derive an equilibrium which works with the resistance of an actively bended glass-fibre structure at the boundary.
Smartgeometry (SG) was founded in 2001 as an informal network of designers interested in harnessing the powers of computation for architectural design. Friends and former colleagues Hugh Whitehead, Lars Hesselgren and J Parrish felt frustrated by the lack of resources and network surrounding computation and architecture and sought to redefine ways that architects could use digital tools. At first, the trio of architects drew on their network of friends and collaborators such as computer scientist Robert Aish, academics Robert Woodbury and Axel Kilian, and experimental practitioners architect Mark Burry and engineer Chris Williams to put together a few modest conferences and workshops. These began with a lecture and workshop in 2003 in Cambridge, UK, then in 2004 at the University of Waterloo, Ontario, Canada, where the focus was on software development, new tools for architects and engaging with ideas outside the boundaries of ‘architecture’. These early workshops provided inspiration and a testing ground for the creation of new parametric software GenerativeComponents (GC) that was introduced to the group by Robert Aish and Bentley Systems. Rather than being concerned solely with software or form-making, SG focuses on the creation and application of digital tools and technologies, and in cross-disciplinary fertilisation of emerging ideas in practice. In workshop groups, designers are able to work on projects ‘off the books’, away from their offices or university settings, creating pure explorations of technique beyond the confines of the design project. SG embodied new ideas and new ways of thinking. The event now spans six days, with a four-day curated workshop and two-day public conference, and attracts more than 300 international participants and attendees each year.

WHY GEOMETRY?
Architectural design software at the time SG was founded was created by software developers using object-oriented programming that almost literally translated software ‘objects’ as building ‘objects’. SG co-founder Lars Hesselgren has written that they wanted to build new design tools and founded SG as a rejection of these conservative influences that promoted computer-aided design (CAD) solely as the organisation of building components. In order to be free of these predefined tools and have a higher-level discussion of building form in terms of first principles, this led to a discussion of geometry and mathematics. As this is a more generic approach, thinking of architecture and form in this way allowed them to share computational tools between disciplines. It allowed architects to design conceptually and create their own custom ‘objects’ rather than use the specified objects provided by their CAD software.

As Robert Aish explains in his chapter, SG explores the ideas of design computation, with the notion that there is a distinction
2 ‘Responsive Acoustic Surfaces’ workshop cluster at SG 2011, Copenhagen, Denmark. Participants engage in a design discussion.

Digital models from the ‘Responsive Acoustic Surfaces’ workshop cluster at SG 2011, Copenhagen, Denmark. Participants work on digital models of hyperboloid geometry using a variety of software.

‘Use the Force’ workshop cluster at SG 2011, Copenhagen, Denmark. Participants discuss design and computation.
between the generative description of the building, and the resulting generated model of the building. Therefore SG is more about the exploration of design intent and how this is inscribed in the design tools and the design environment, rather than specific technology for the integrated delivery of building projects. It is about designing a system, rather than working on a more detailed 3D model.

SG is an agile network. It is purposely structured to be able to react to and reflect ideas in contemporary practice; there is no overriding goal or charter. The idea is to engage with current issues and debates in a collaborative and non-competitive environment. Digital design leads logically to digital fabrication. Over several years, but culminating in 2010 where it was a central feature, the event embraced digital fabrication, interaction and simulation with ‘workshops’ that more equally split experimentation in digital and physical realms. As Xavier De Kestelier and Shane Burger explain in their chapter, the evolving workshop structure is due to shifts in participants and leadership. The earlier events attracted lower numbers of workshop participants and leaders and these were almost exclusively from professional practice. Recent SG events have had multi-day programs with larger audiences and an increased focus on academic and research questions. This shift is discussed in the chapter by CASE, where they identify the move away from the pragmatics of designing for construction of buildings, towards workshops based not only on research and experimentation, which does not necessarily rule out the practical building issues, but also on creative explorations using these same methods. The five current SG Directors are all from architectural practice, but each year attendees and workshop leaders come increasingly from research and academia.

TALKING ABOUT COMPUTATION
‘The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from them.’2 This statement from computational pioneer Mark Weiser in 1991 is relevant to architectural practice today. Computation is everywhere; should it really be the medium and not the message? Architects desperately need to talk about computation, and over the past decade SG has provided the only experimental workshop-based discussion forum on this topic. It is not enough to say computation is ubiquitous in our field; it is not ‘just’ a tool – there can be no doubt that it is fundamentally changing architecture. Computation is not what architecture is, but if architecture can be understood as a practice, concerned with technique, then computation is a technique intricately connected to designing for meaning and experience in architecture. Even architecture as edifice, separated from any discussion of technique, reveals the tool of the maker. While meaning in architecture can come from symbols and symbolism in the building itself, it also comes from the experience of that building.3 Therefore the better we can simulate the experience of architecture, the better we can design for it. The technologies explored and discussed at SG are still quite visible. However, one hopes they will be customised,