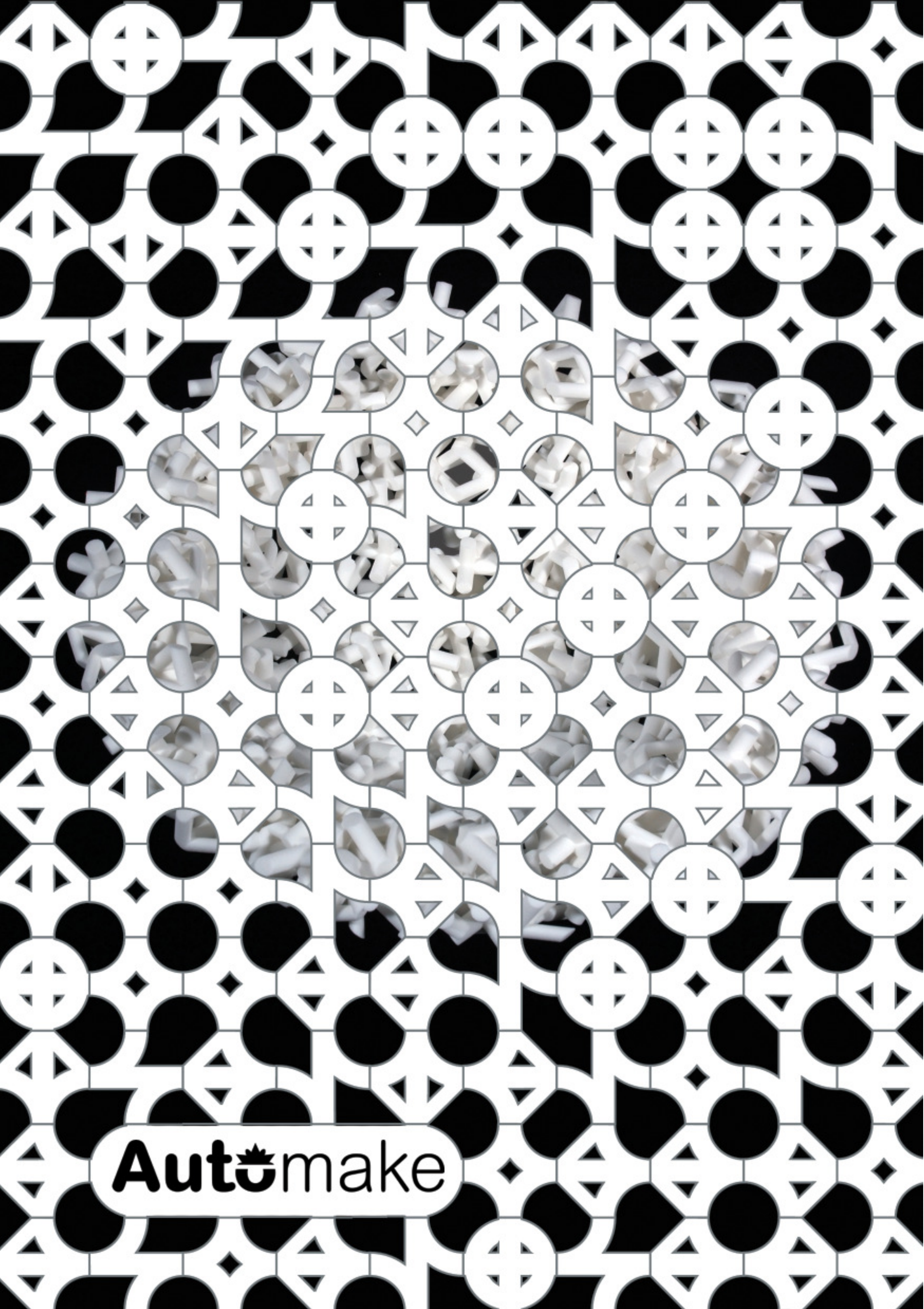
Automake

The work in this side of the catalogue was produced within the context of a collaborative project between the University of Huddersfield and University College Falmouth.

Dr. Justin Marshall Principal investigator
Justin is currently a research fellow in the 3D Digital Research Cluster based at University College Falmouth (www.autonomatic.org.uk). He is a practising artist/ maker and researcher with a diverse training in range of visual art and design disciplines.

Dr. Ertu Unver Programing expert and consultant
Dr Ertu Unver is a CAD/CAM specialist for 3D Design at the University of Huddersfield. He is a production and mechanical engineer with experience in computer programming. He is currently investigating the use of virtual reality and 3D gaming environments for use in teaching and learning.

Paul Atkinson Project instigator and coordinator
Paul Atkinson is an industrial designer, design historian and the subject leader of 3D Design at the University of Huddersfield. He has published widely in the field of design history (paulatkinsondesign.com). His practice-based research interests are in the impact of emerging technologies on design.

Automake/FutureFactories

FutureFactories photography by John Britton
Automake photography by Justin Marshall
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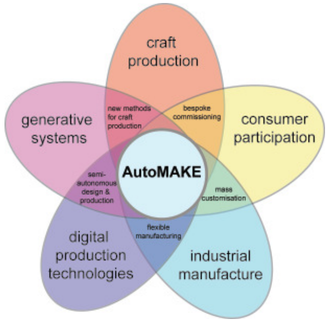
European Regional Development Fund

Contents

Automake

Automake is about combining computer based generative systems with craft knowledge and digital production technologies to create a new way of designing and making which challenges the boundaries between maker and consumer, craft and industrial production.



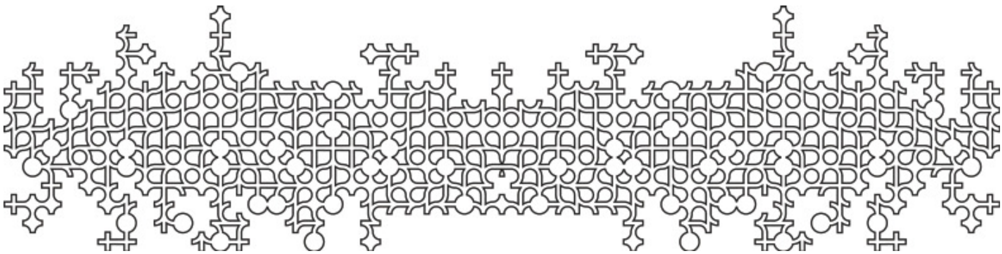
The term generative system applies to any system in which a few basic rules are repeatedly employed to produce varied, unpredictable and often complex results, with varying degrees of autonomy from the user of the system. Generative systems have been used in many fields in an attempt to model and understand existing natural phenomenon or as a tool to help find solutions to complex problems. The Automake design systems have a generative component that enables the creation of one-off unique designs and introduces a random element into the design process.

The collaborative research project from which the work in this catalogue has been developed was instigated by Paul Atkinson from the University of Huddersfield. Justin Marshall a craftsperson/maker and digital production researcher working in the Autonomatic research cluster at University College Falmouth, was invited to develop generative software concepts created by Lionel T Dean for his FutureFactories project. Working with Ertu Unver, a researcher, computer programmer and CAD expert based at the University of Huddersfield they have developed a number of systems which have the flexibility to create an infinite variety of unique one-off structures assembled from a range of modular units. These systems have been designed to balance the random generative element with a degree of user control, with the aim of enabling the creation of forms for which the user has some sense of ownership, but there is also the potential for the systems to produce the unexpected.

Until relatively recently using digitally based generative systems has been the preserve of computer scientists and those with the inclination to learn coding. An important part of this project was to create systems with user friendly interfaces, where no previous knowledge of 3D CAD, let alone computer programming, is required. This allows any individual to easily interact with the system and create their own unique designs; the designer becomes more of a facilitator, and the ‘consumer’ becomes a ‘co-designer’ gaining some control over the creation process.

Another essential element of the project was to develop an efficient system for physically producing the forms created within a digital environment. There are many interactive online generative tools and applets available for producing forms and patterns. However, there is rarely any mechanism for outputting data from these systems to enable the production of physical artefacts. We have developed a system by which very small data files are exported from our software and in post processing used to recreate the detailed models needed for the production of physical artefacts using rapid prototyping and other digital production technologies. This means users can access our software online and generate their own unique designs which can then be emailed to the Automake team for production.

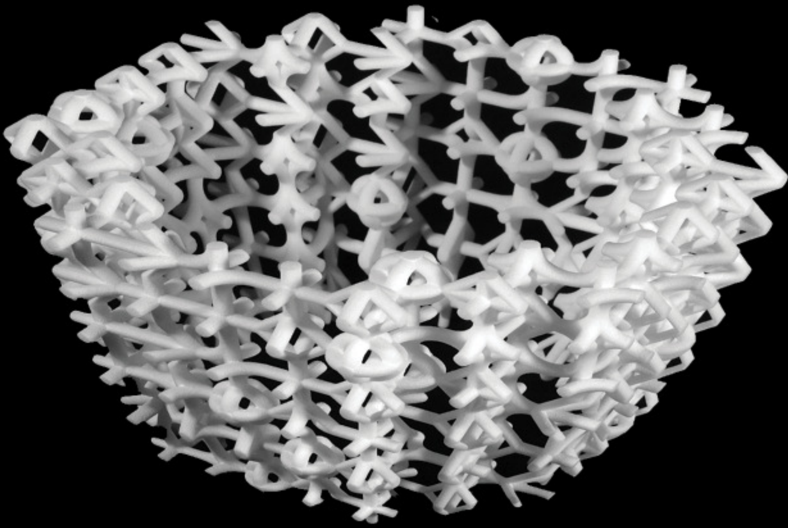
The exploratory work illustrated here has been created using a variety of digital manufacturing technologies, from 2D cutting and printing equipment to 3D rapid prototyping and manufacturing technologies. Rapid prototyping technologies allow physical three dimensional objects to be produced from CAD files. These machines use a range of materials to create objects, however many of them have poor physical or visual qualities. Rapid manufacturing is developing fast and allows objects to be produced out of more robust and appealing materials such as metals, ceramics and durable plastics.

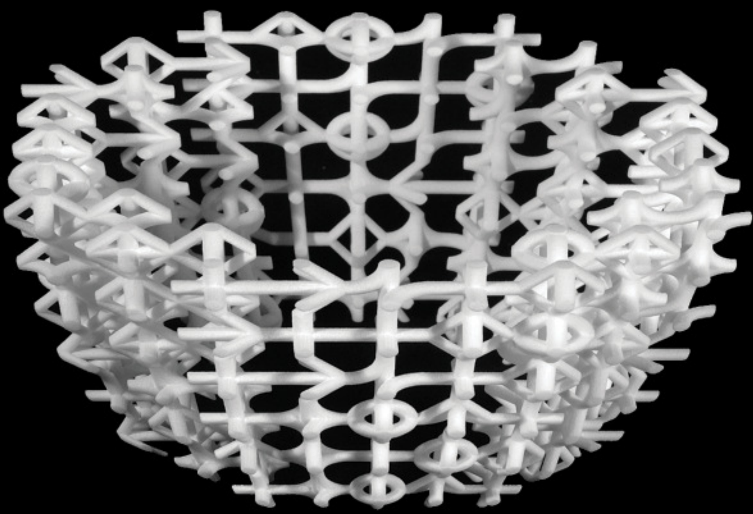


We believe that rapid and desktop manufacture will become commonplace methods for making things and, as in the desktop publishing revolution, there will be a need for systems which allow a wide range of people to make use of the possibilities that these production technologies afford. The Automake project provides embryonic examples of such systems, in which anyone can engage in a process that sits somewhere between a computer game and a CAD tool to generate one-off forms.

Documentation of this project and access to the build systems which will allow you to create your own designs can be found at www.automake.co.uk. The team would like to thank 3D Systems for their sponsorship of designs produced by visitors to the Hub exhibition.

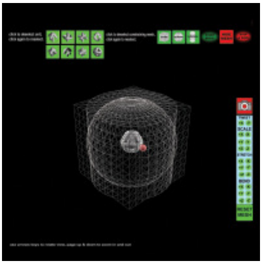
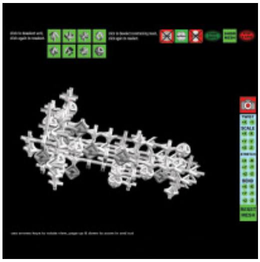
matrix build bowl 1, 2008

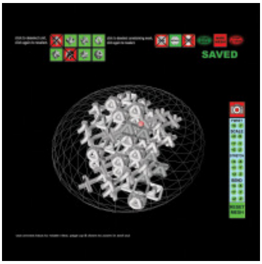


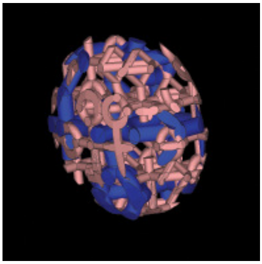


matrix build 1

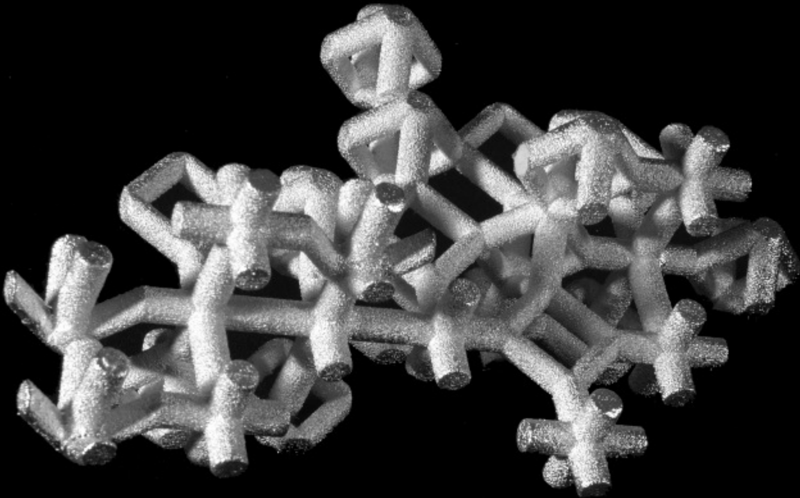
Matrix build 1 was the first system developed and is based on generating matrix structures from a set of pre-defined units within a simple cubic (rectilinear) grid structure. Any combination of units can be selected and once the software is set in motion units are randomly placed next to each other to create unique structures which will grow indefinitely until stopped by a user. The top three images below illustrate an unrestricted build and the resulting rapid prototyped object.

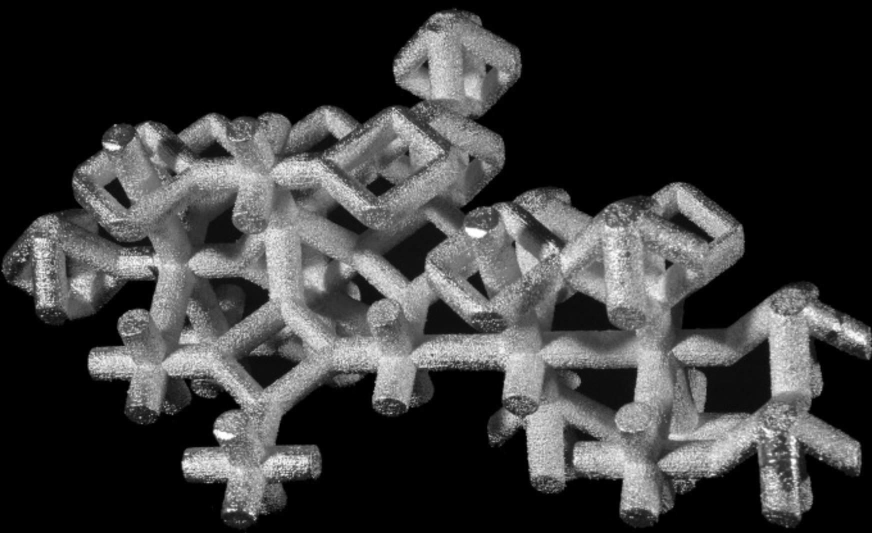





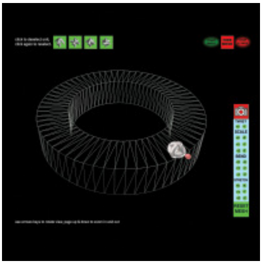

To create both a restriction on the size of the structures generated and provide greater interactivity for users, constraining meshes were introduced to restrict the growth of the matrixes to a particular shape. These meshes can be distorted using a variety of modification tools, so increasing the range of outcomes achievable. In addition, the constraining meshes can be used to ‘trim’ the structures generated. The bottom three images show a structure generated within an elliptical mesh, the same structure ‘trimmed’ and the final rapid prototyped object

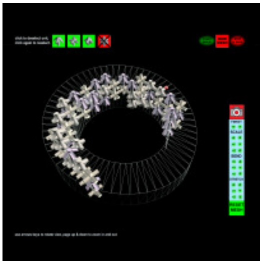


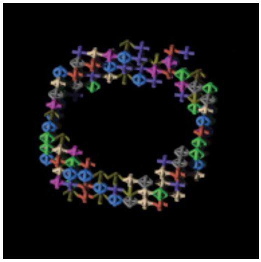


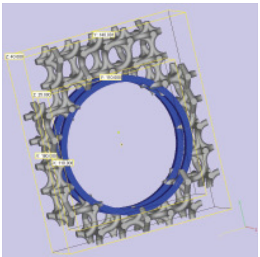
matrix build 2

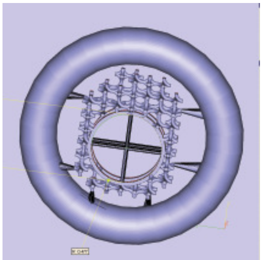
Matrix build 2 uses the same build system as matrix build 1, but employs a torus constraining mesh which allows the creation of ring shaped structures. The constraining mesh can be distorted to produce a wide range of bangle, bracelet and ring forms. Once the generated forms have been reconstructed in a Computer Aided Design package and any errors in the computer model mended, the forms can be directly produced using a range of rapid prototyping technologies.

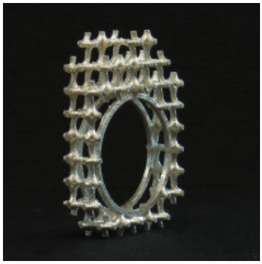












The physical characteristics of rapid prototyping materials can be inappropriate for producing some items, or just plain unappealing! Therefore rapid prototyped models can be used as an intermediary step in the creation of objects, rather than an end in themselves. The bottom three illustrations show a ring form that has been generated in matrix build 2 and extra strengthening bands added in a CAD package. Further casting sprues were added and the wax rapid prototyped model used for the lost wax casting of the final silver ring.

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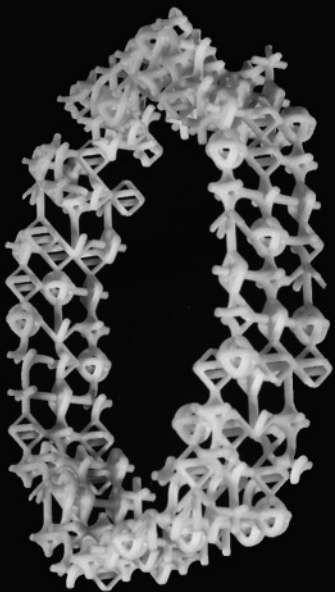

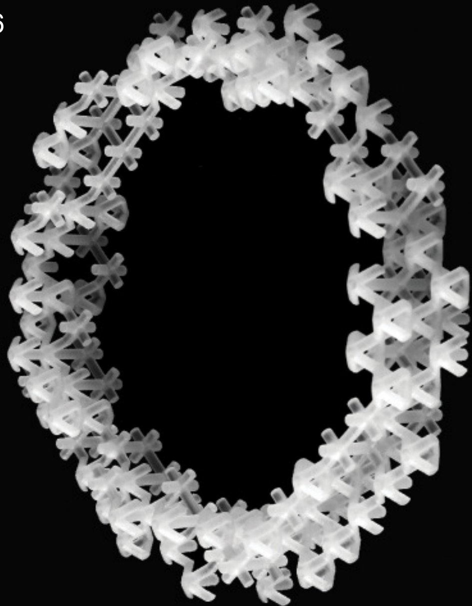

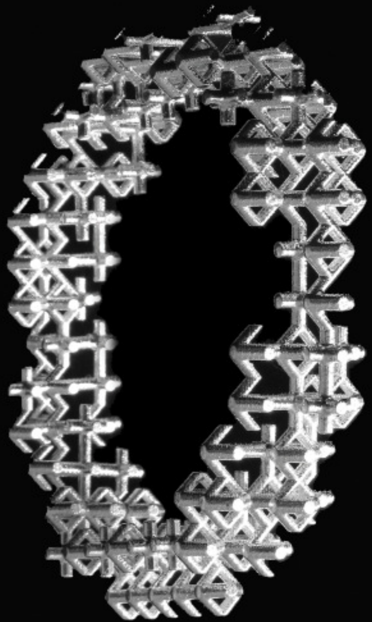

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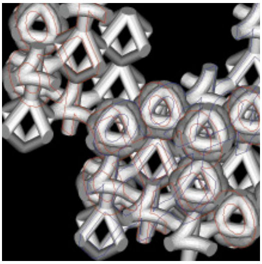
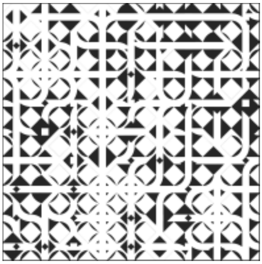
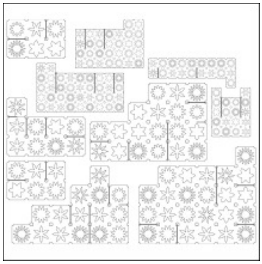
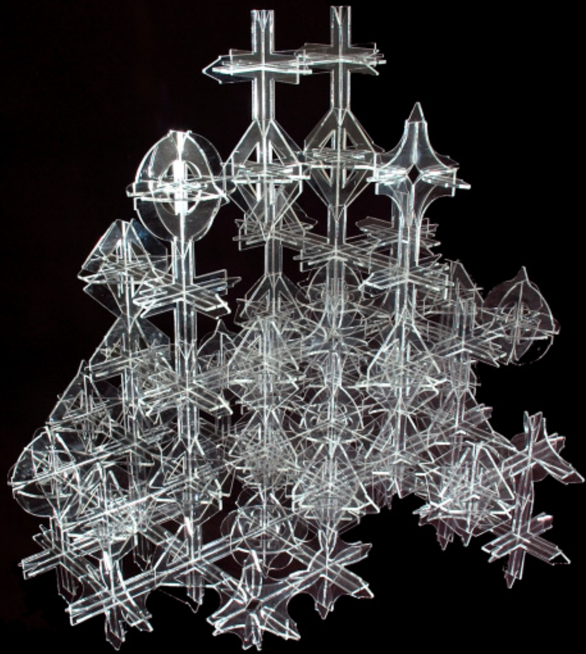
2D surface designs

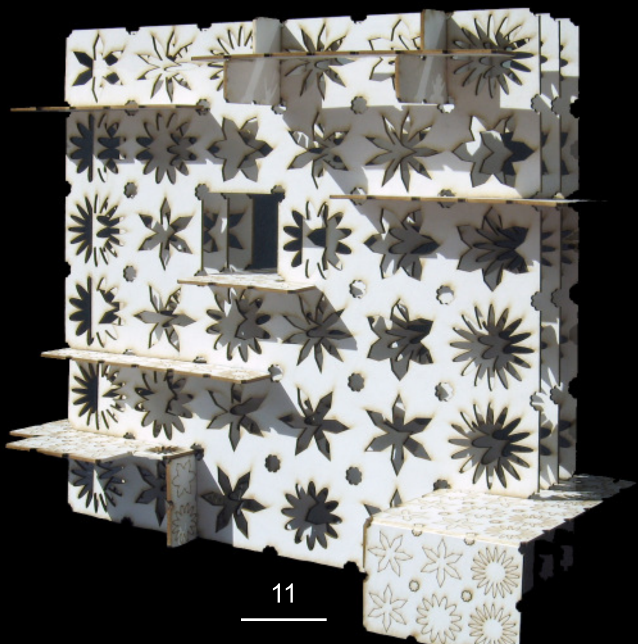
The software developed can also be used to derive 2D surface patterns and data to control 2D CNC cutting equipment, such as a laser cutter or router. One of the current restrictions of rapid prototyping technologies is the cost of producing large scale objects. Therefore strategies for developing larger scale three dimensional work based on two dimensional elements have been developed.


The first pair of images above illustrate how a number of 2D slices can be taken through a 3D matrix and the data used to laser cut acrylic sheets which slot together to produce a large scale representation of the virtual structure. The middle pair of images show a design developed through employing a similar process, the resulting pattern is manipulated in graphics software to create an image for direct digital fabric printing. The final pair of images illustrate a set of flower based units being used to produce random sequences and arranged to create laser cut flat patterns. These can then be slotted together to produce models for large scale work .

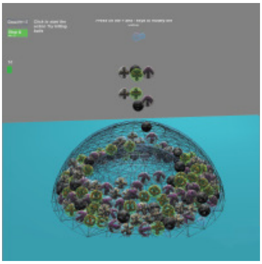
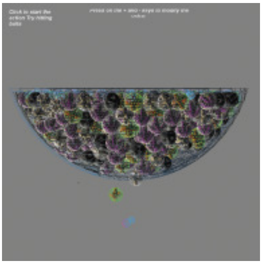
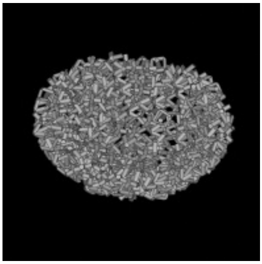
matrix build profiles 1, 2007
room divider model, 2008

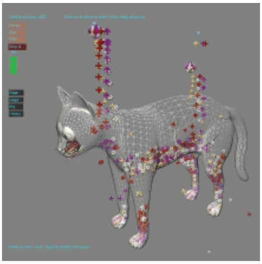
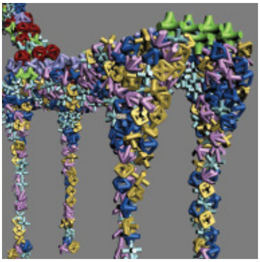




random fill

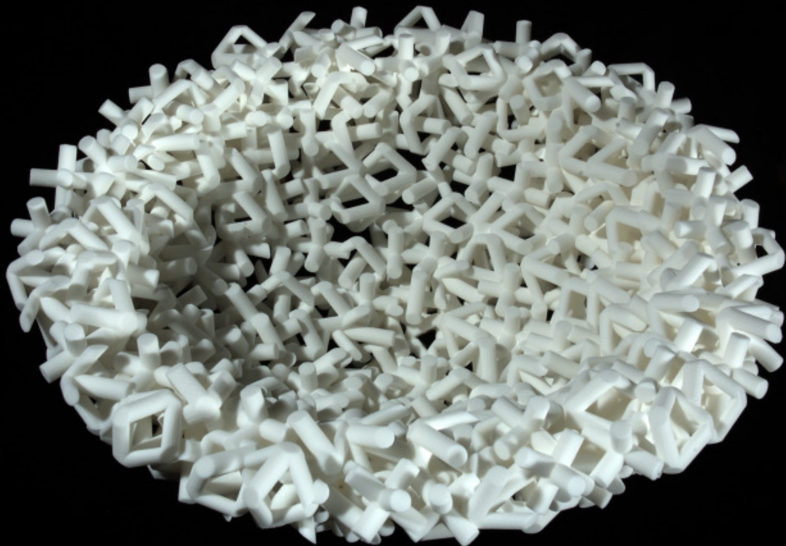
This most recent build system takes a very different approach to creating unique structures. It uses the ability of the software to endow the units with physical characteristics (e.g. weight) and allow them to interact with each other. Instead of using constraining meshes to control the shape of the generated structures, 'moulds' are used into which units are dropped. The units jostle and move within the mould to create comple packed structures.


The moulds can be distorted in the same way as the constraining meshes and therefore a wide variety of forms can be generated all with unique and highly complex non-linear structures. The top three images illustrate the development of a bowl form using this method, whereas the bottom three provide an example of how a figurative mould can be used in this process. Further work will look at the potential of this system as a mechanism to construct forms which are not only aesthetically novel, but also have useful physical characteristics (e.g. structural coherency, increased strength, superior rigidity etc.)

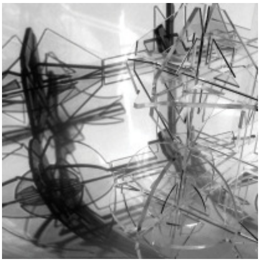
random fill bowl 1, 2008



Post-Industrial Manufacturing Systems

The future of design is at a crossroads

For thousands of years the vast majority of artefacts have been conceived, developed, tested and crafted by individuals. Only since the eighteenth century industrial revolution has the role of the designer been clearly separated from that of the manufacturer. The last few centuries have seen constant progress made in refining the processes of design, specification and mass-manufacture of products to a predetermined plan.



Complex global infrastructures have been instigated to support the manufacture, distribution and retailing of enormous numbers of identically reproduced goods. This pursuit of perfection has significantly shaped the world in which we live.

Ironically, it is the latest cutting-edge developments in manufacturing practice that have presented the opportunity to completely reassess these processes of product creation. Computer Aided Design, 3D Solid Modelling, Generative Design software, Rapid Prototyping and Direct Digital Manufacture have inadvertently enabled completely new ways to formulate everyday objects. These methods simultaneously question the role of the designer and of the consumer.

Should we strive to make manufactured products identical? Should the designer or craftsperson control every aspect of the appearance of the artefacts they produce? Should we place different values on designs created in their thousands and objects created individually? Should the involvement of the consumer in the creation of a product detract from or add to its value? Should the involvement of the computer in the creation of a product detract from or add to its value?

Automake and FutureFactories are examples of Post Industrial Manufacturing Systems. They are systems that transcend the limitations and expectations of established industrial design and production processes. In their conception, they liberate the designer from ultimate responsibility for the manufactured form. In their execution, they liberate the consumer from the singular manifestation of design concepts. Post Industrial Manufacturing Systems have the potential to change the meaning of design.

Automake and FutureFactories represent two different responses to these new regimes of production and consumption. The work produced by Justin Marshall and Lionel Theodore Dean question accepted design practices at a point in time where the established system of mass-production is coming to an end. They present two possible future approaches to the creation of manufactured goods.

The objects produced by the Automake and FutureFactories systems highlight a number of crucial questions for a debate on the future of design: What is the future role of the designer or craftsperson? What new skills will they require? Where exactly are the boundaries between art, craft and design? Are new designations of practice required?

The designs showcased in this exhibition, and more importantly, the systems used to create them, allow us to contemplate the present state of design while we strive to answer these questions and speculate on the future.

Paul Atkinson, April 2008

Icon

To this point, FutureFactories' individualised design runs had been limited to a handful of prototypes (though several designs had been commercialized for serial production). The most recent project 'Icon', a piece of pendant jewellery, represents an attempt to prove the project's concept of individualisation on an industrial scale.

Icon is a limited run of one hundred pieces produced directly in titanium using Direct Metal Laser Sintering (DMLS). Whilst not a precious metal, the value of titanium is recognised in contemporary jewellery. Titanium cannot be soldered which limits the forms that can be created conventionally. The use of titanium in pendant and necklaces is consequently rare. The forms created in Icon would be virtually impossible to achieve outside of Rapid Manufacturing (RM).

Icon is believed to be the first commercially available example of mass-individualisation. This set of pieces proves that it is possible to achieve recognizable difference over an extended run whilst maintaining a coherent, identifiable meta-design.

icon, titanium, 2008

holy ghost

In Holy Ghost the back and arms of the iconic Stark/Kartell “Louis Ghost” chair are replaced by a FutureFactories individualised addition.

The design is driven by a script which combines the building block approach with the morphing strategy of earlier works. The process begins with a standard build unit termed a button because arrayed on the chair back they are (deliberately) reminiscent of traditional button leather furniture.

n a first step the number of buttons that will make up the back is determined. This set of units is then placed one at a time into a 3D build envelope, pre-determined by ergonomics. In a second phase the placed buttons expand in a uniform manner (whilst maintaining the ergonomic envelope) until they touch, save for a predetermined clearance.

In a third and final phase the buttons expand in a ‘non uniform’ manner as individual control vertices (cvs) on the geometry are pulled to close up the gaps in the back form. The buttons are linked by a matrix of curved links which, built in nylon, act as live springs allowing the whole back to flex like a sprung mattress.

holy ghost, sls nylon, 2006

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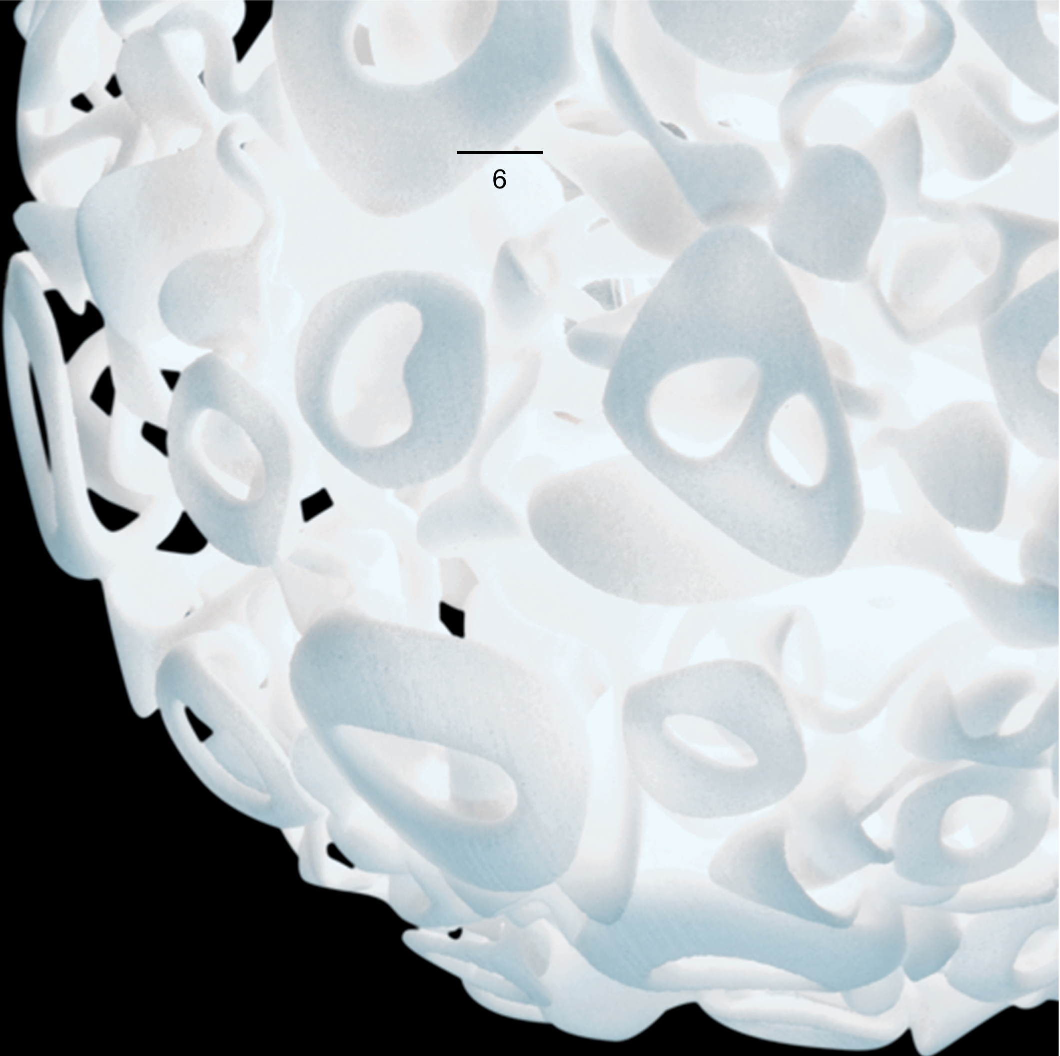
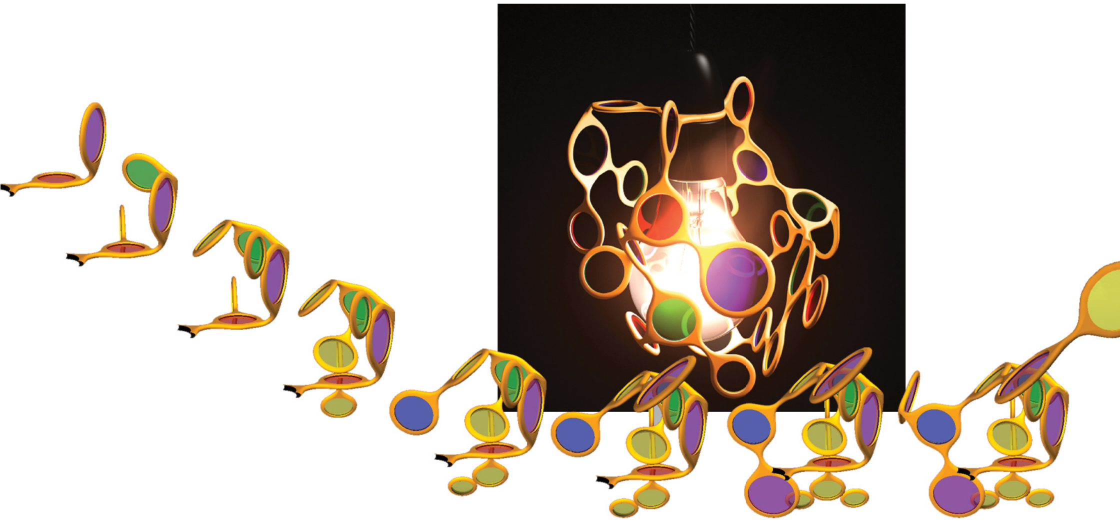


the building block approach - dna

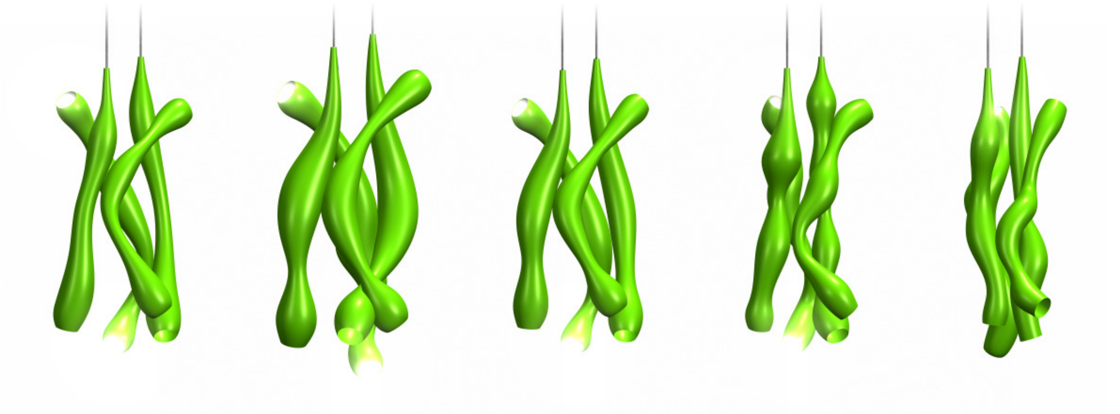
To achieve the goals of more fundamental change, and less onerous model creation, a simple building block design was developed using Virtools software; an intuitive building block alternative to formal scripting. A simple modular design was considered comprising a network of multi-coloured lenses arranged around a standard GLS incandescent lightbulb: this design was titled ‘DNA’. A series of linked rims, rather like spectacle frames build, a step at a time, around the bulb starting from the shade ring.



Rim modules differ in size and in their attachment to the previous rim which may be straight or twisted about one of two axes. The resulting framework of rims is digitally manufactured in a single piece. Coloured lenses are clipped into the rims as a post production process. The growth rules are simple. There has to be sufficient clearance around the bulb as a thermal constraint and the design has to be restricted to a practical, saleable size. To achieve this, inner and outer boundary spheres are created with the design allowed to grow in the intermediary.

morphing

FutureFactories forms are defined by sets of curves in 3D space. Computer scripts are created to modify these curves over time in a procedural animation. A set of developmental rules and relationships are set out along with an initial condition. Solutions are then generated automatically.



A limitation of this morphing approach is that it operates by manipulating the geometry of pre-existing models. The geometry of these models is predefined and only capable of adjustment rather than fundamental change. To achieve more dramatic changes than the gently writhing forms of the early FutureFactories work requires a different methodology.

tuber, sls nylon, 2004

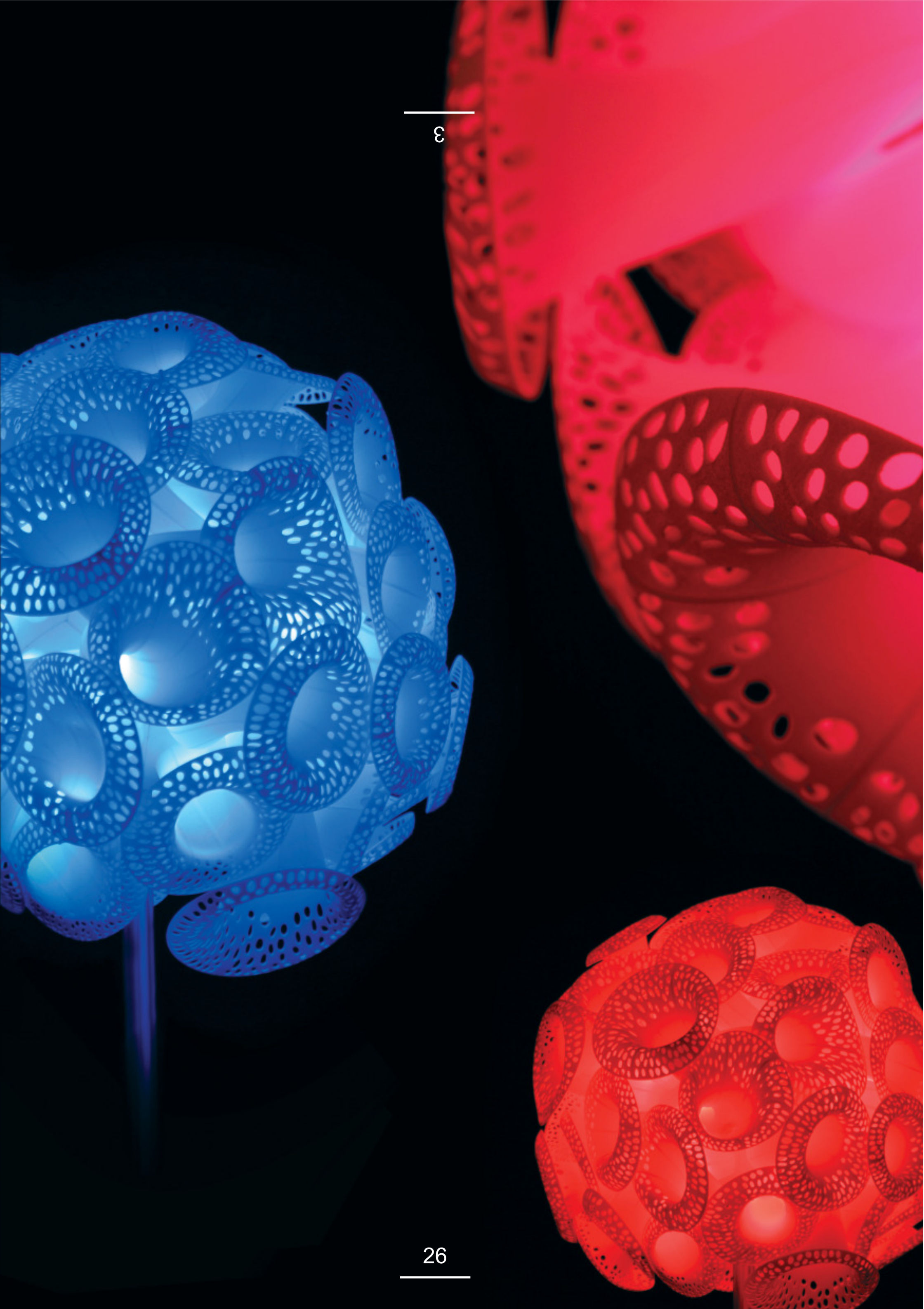
computational design

Rather than creating a single discreet design solution a meta-design is created that defines the function and character of the design over a potentially infinite range of outcomes. The aim is to create coherent recognizable designs but with obvious differences between iterations.

There is a balance to be found between freedom and control. A random element is necessary to create something unique; too random and the design identity is lost.

New approaches to design are needed to define and control meta designs. FutureFactories combines traditional computer aided design (CAD) with elements of computer programming in what has been termed computational design.

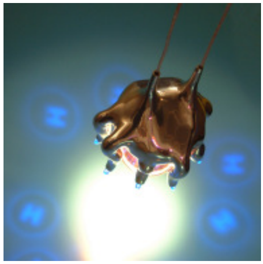
tangle, sls nylon, 2005

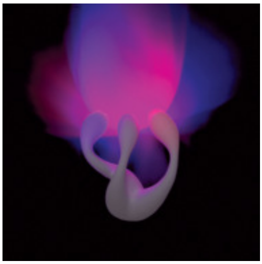


FutureFactories

FutureFactories proposes mass-individualisation: the automated industrial scale production of one-off artefacts. Using direct manufacturing (rapid prototyping techniques applied to the manufacture of end use products), it is possible to 'print' 3D artifacts direct from virtual designs. This technology uses no mould or dies and the economies of scale underpinning mass-production do not apply. The unit cost is the same for one-off or a run of hundreds.








Given that economies of scale do not necessarily apply, why produce two the same? Can the technical resolution and quality made possible by volume sales be combined with the idiosyncrasy and charm of craft production? It would be possible, at low volumes, for the designer to make adjustments to the computer model upon each and every order. This would be a craft process however with production reliant on the skills of an individual. FutureFactories aims for automated manufacture which once the design is created is independent of the designer and feasible in high volumes.

pallavi , sls nylon, 2007

Contents

FutureFactories began in 2002, when designer Lionel Theodore Dean presented an embryonic concept for the digital manufacture of consumer products. Initially a one-year design residency project at the University of Huddersfield, the project is now the focus of the designer's work both academic and commercial. With thanks to Dr Ertu Unver and Paul Atkinson of the Huddersfield University for their collaboration in technical and cultural aspects of the project respectively.

Lionel Theodore Dean
Lionel is a graduate engineer and has a Master's Degree from the Royal College of Art, London. His work explores the boundaries between Art and Design and focuses exclusively on additive digital manufacturing techniques. Using this medium he has created a host of iconic designs ranging from gallery pieces to retail products for well known manufacturers.

Dr. Ertu Unver
Dr Ertu Unver is a CAD/CAM specialist for 3D Design at the University of Huddersfield. He is a production and mechanical engineer with experience in computer programming. He is currently investigating the use of virtual reality and 3D gaming environments for use in teaching and learning.

Paul Atkinson
Paul Atkinson is an industrial designer, design historian and the subject leader of 3D Design at the University of Huddersfield. He has published widely in the field of design history (paulatkinsondesign.com). His practice-based research interests are in the impact of emerging technologies on design.

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