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Spring 2004
Bulletin of the Computer Arts Society

LINEAR CONSTRUCTION IN IRON

The iron sculpture shown in photo 1 has been in George Mallen's garden in Twickenham since about 1970. Members of CACHe and CAS came to see the work on Wednesday 19 November 2003, but none of us knew who made it. George thinks that the piece was left with him after Event One or soon afterwards, Here it is called Ironwork.

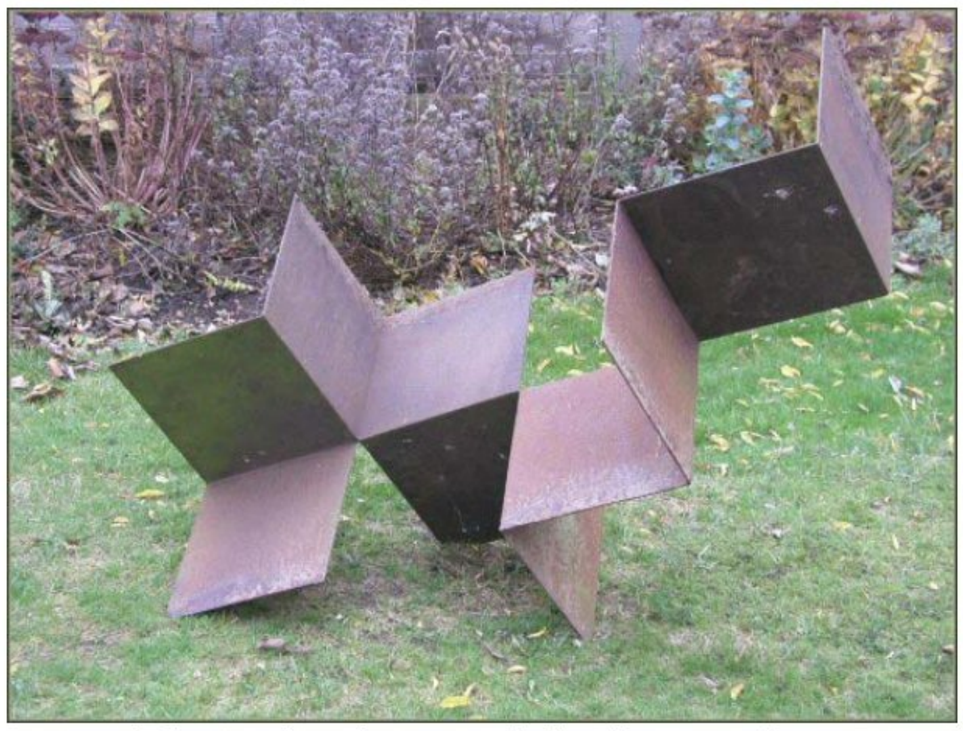


Photo 1 Ironwork in the garden

Summary

Suggestions are made about the rules used in making the sculpture. Somewhere between reverse software engineering and natural history applied to art. Variations in the realisation are given. Output from a program using the basic rules is shown, The numbers of distinct forms are given from a program that lists all the possible forms. There is a discussion of how to avoid the piece colliding with itself. From this, some closed or looped forms that can arise are shown.

It is assumed that Ironwork was designed using a procedure, probably with a computer program.

Construction

The work is made from ten iron plates each 1 foot square by an eighth of an inch (about 300 x 300 x 3 mm) welded together. It weighs roughly 25 kg. The construction is linear in the sense that there is only one route from one end of the work to the other, always moving from a plate to another one connected to it: there are no branches or intersections.

All the joints are at right angles so that no two consecutive plates are in the same plane. The plates can be grouped by their orientation. Taking the one at the lower left of the photograph as plate 1, then plates 1, 4 and 7 are in the same plane, plates 2, 5 and 9 are in the same plane, while plates 3, 6, 8 and 10 are all parallel but no two of them are in the same plane. Labelling these three directions X, Y and Z gives the sequence XY**Z**XY**Z**X**Z**Y**Z** where the X plates and the Y plates are coplanar while the **Z**s are parallel. Such a clear distinction between the X and Y planes and the Z direction suggests that this may have been an explicit decision by the maker as part of the rules, or it may have arisen by chance within other rules that did not require it. The latter is assumed here.

Rules

The main rules can be expressed as follows.

All joints are at right angles

Without loss of generality the first plate may be taken as horizontal and the second as connected to its back edge and above it, as shown in the diagram.

There are then three allowed ways of attaching the third plate, one for each free edge of plate 2. The other three ways, with plate 3 to the front of plate 2, are not allowed. This ensures a linear sequence of plates.

Thus in any set of three consecutive plates the first and third must be on opposite sides of the plane of the plate connecting them.

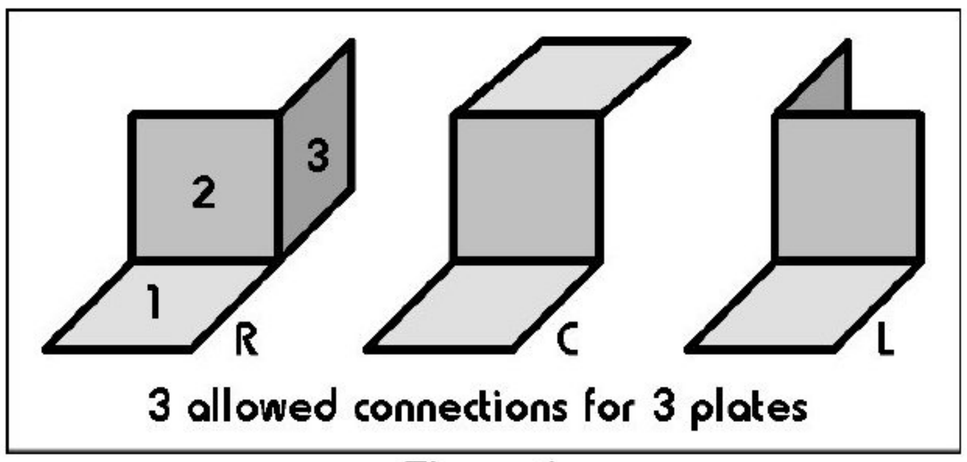


Figure 1

These rules do not ensure that a piece made from paper could be formed continuously from cutting and folding a single sheet, that is without any joins. In Ironwork, using the same numbering as above, if each of the first four welded joints could be bent flat then plate 1 and plate 5 would occupy the same space.

There is no way of determining from the work whether the number of plates used was the result of the application of another rule or was an explicit decision of the maker.

Of the eight sets of three consecutive plates in Ironwork, 1-2-3, 2-3-4, …8-9-10, three are type R, two are type C and three are type L, using the notation of figure 1. The sequence for Ironwork is RLRRLCLC.

I am sure that there are theorems to be proved about these structures. Perhaps they already have been, in the study of molecular geometry.

The work can also be seen as being composed of five pairs of plates, each pair welded at right angles, with differently framed rules that are equivalent to those given above.

Realising with other elements

The same scheme can be used with elements other that flat square plates. For example, each plate could be octagonal with an eight-sided pyramid raised on each side. This is a purely decorative variation. The centre of each plate could be removed to leave only the edges. Photo 2 shows such a model made with plastic hubs and edges. Not so impressive as the original but less than a thousandth of the weight.

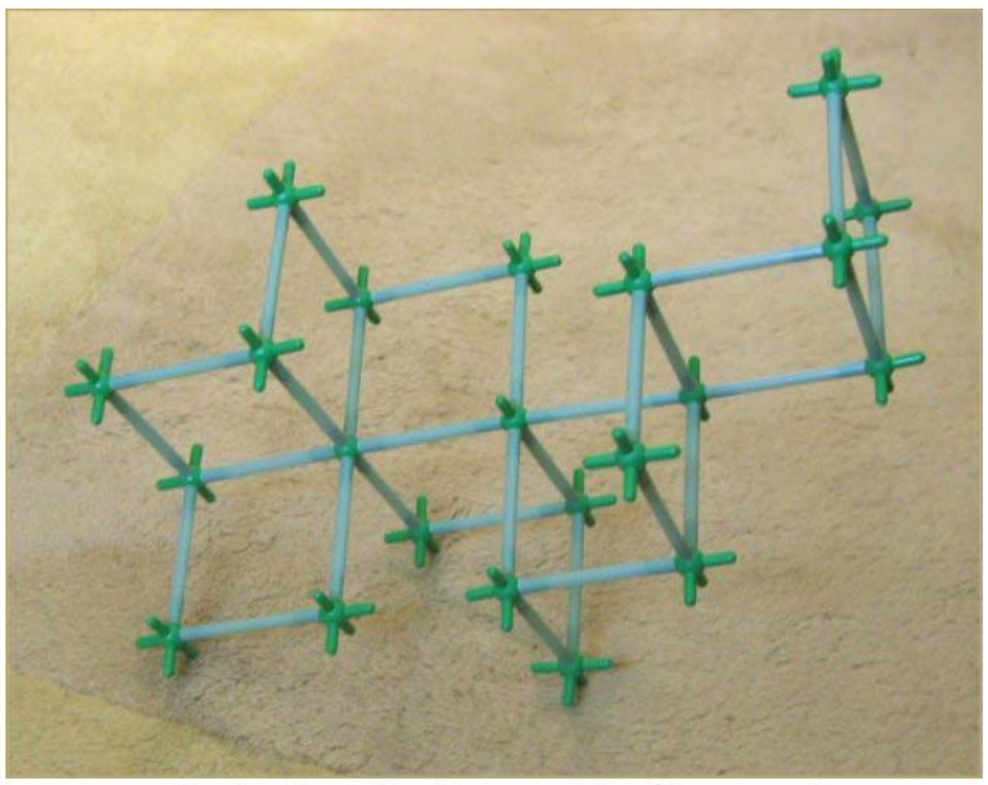


Photo 2 Plastic model of Ironwork

Each pair of plates form two faces of a cube and these cubes could be realised in full. With ten plates, as in Ironwork, there would be only nine cubes. Pairs of cubes that are not consecutive in the sequence might share a face. Some different sequences would give rise to the same solid object.

Starting with the front edge of the first plate, continuing through the sequence of joined edges in the original, and ending with the back edge of the last plate, construct on each of these edges a sphere with the edge as a diameter. In this case a form with ten plates would give one with eleven spheres. The result of applying this to Ironwork is shown in figure 2. Such a construction might be difficult to realise neatly in hardware but a software model has no problems with glue and gravity. Other elements, such as octahedra, could be used.

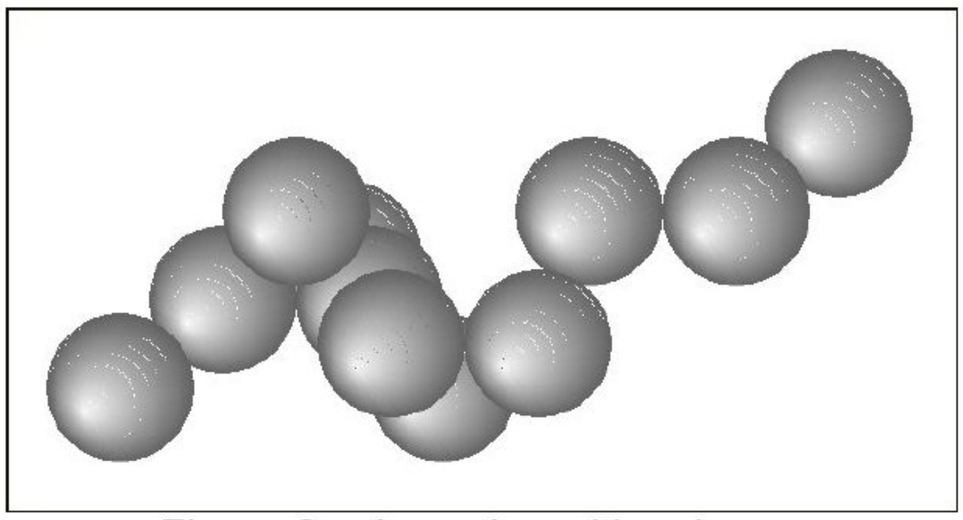


Figure 2 A version with spheres

A new program

The simple rules above have been implemented in a program. For the current plate select, at random or by other means, one of the three unused edges, R, C and L. The position of the next plate is then fixed.

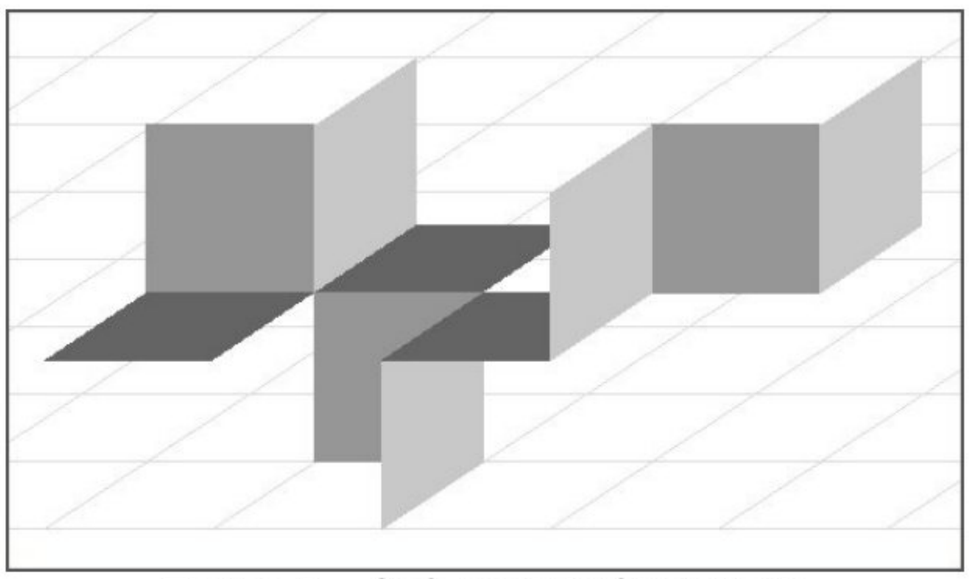


Figure 3 Soft model of Ironwork

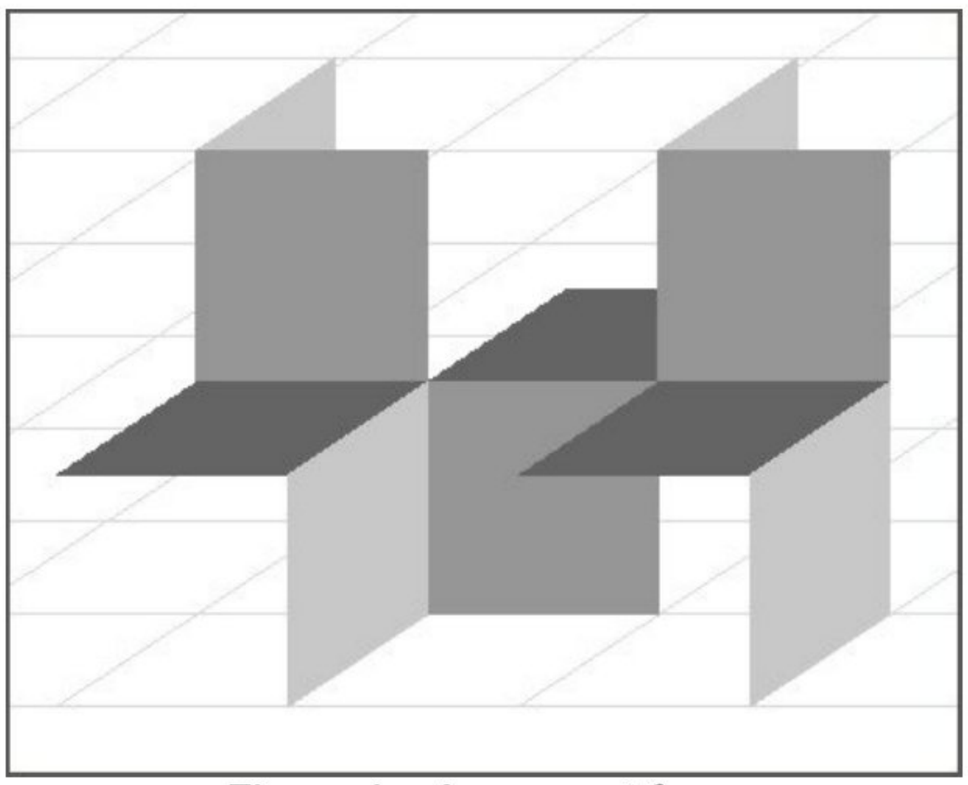


Figure 4 A compact form

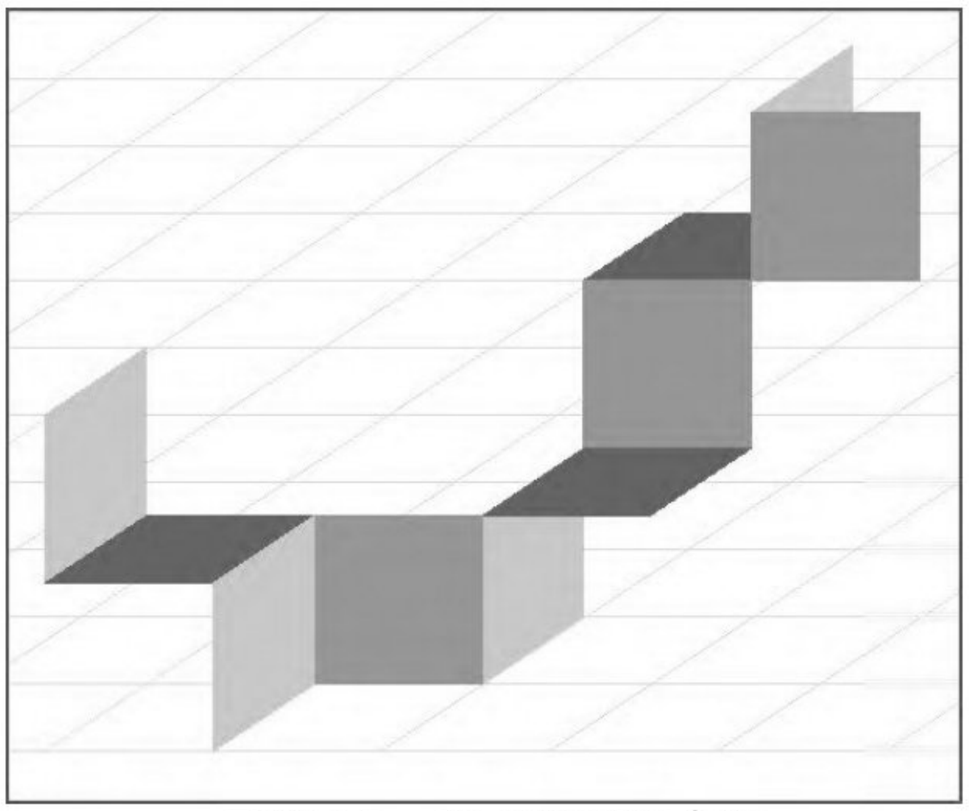


Figure 5 An extended form

Three sample structures generated are shown here, including a copy of the original Ironwork in figure 3, produced by fixing the data structure. The more compact form in figure 4 has a repeated sequence. It has a palindromic code, LLRLLRLL, which means that it is symmetrical by reversal, end to end.

Rotate the central horizontal axis 180° in a vertical plane, then rotate the work 90° clockwise round the central axis looked at from the right.

The form in figure 5 is more extended in space due to several choices of the centre edge in the code CRCRRCLR, which lead to a staircase effect. It has no symmetry.

Enumerating distinct forms

Another program first lists all the forms there are for each number of plates up to ten, Each form is represented by its RCL code, which has two fewer letters than the number of plates, so for *n* plates there are 3^{n-2} forms.

Most forms, having no symmetry, occur in four equivalent versions, three of which can be discarded. For example, RRC and CRR give the same shape while LLC and CLL give their mirror image. So forms have only two versions, such as RCR and LCL. CCC has no equivalent representation.

The program goes through the complete list of codes for a given number of plates and removes any that are equivalent to one higher in the list. The results are shown in table 1.

Notice that the number of forms for an even number *n* of plates is equal to $\left(1+3^{n/2-1}\right)^2/4$.

I hope to publish more details and a proof elsewhere.

Number of plates	Number of forms	Number of distinct forms
1	1	1
2	1	1
3	3	2
4	9	4
5	27	10
6	81	25
7	243	70
8	729	196
9	2187	574
10	6561	1681

Table 1 Numbers of forms

Collisions and their avoidance

None of this prevents a design folding back upon itself and colliding in some way with an earlier plate. First, just what is to be avoided must be defined, and there are several possibilities.

No plate can use an edge already in use

No plate can form the third face of a cube

No plate can occupy the space of another plate

Such rules can be taken care of in several ways. By finding another rule that prevents it occurring, or by using a data structure to record the positions already occupied and testing each new plate position against this. These ways entail more programming.

A third way has been used here: generating solutions and discarding those containing a collision by inspection. This contravenes a meta-rule often adopted by procedural artists: that the procedure should produce the design unaided by human intervention. Anything else is cheating, or at best, a partial procedure. I may remedy this one day.

Alternatively these could all be allowed, as in the current program, leaving a question in fabrication of whether to weld all shared edges. There are many algorithms from which the sculpture could arise. Seeing other works made with the same rules, if there were any, might narrow the field.

Another approach is to allow any connection to the current plate, coplanar or orthogonal; an unconstrained random walk of plates. Each set of rules gives rise to a set of possible solutions, some of which are subsets of others.

Closed forms

A particular form of collision is where the end of a sequence of plates joins to a free edge of the first plate in a way that this join is within the rules, to form a closed loop.

Working by hand, with a set of plastic hubs and edges, such loops have been found with 6 and 12 plates. These are shown alongside. In the notation used above these loops have the sequences RLRLRL and RRLLRRLLRRLL. The latter sequence can be written as $[R^2L^2]^3$.

The sequence RRRLLL = $[R^3L^3]^3$ does not fold back on itself but goes on without end, because the first and seventh plates have the same orientation. Whatever distance and direction the first six plates take the next six will go the same distance and direction again, and so on. The same is true when the number of repeated turns is a multiple of 3, the number of spatial dimensions.

The sequence R^4L^4 forms a loop (not shown here) and so do similar sequences with a higher index not divisible by 3. All these constructions are symmetrical. I think it would not be difficult to make unsymmetrical loops but I have not made any. I believe the two loops shown here are the only ones with 12 or fewer plates.

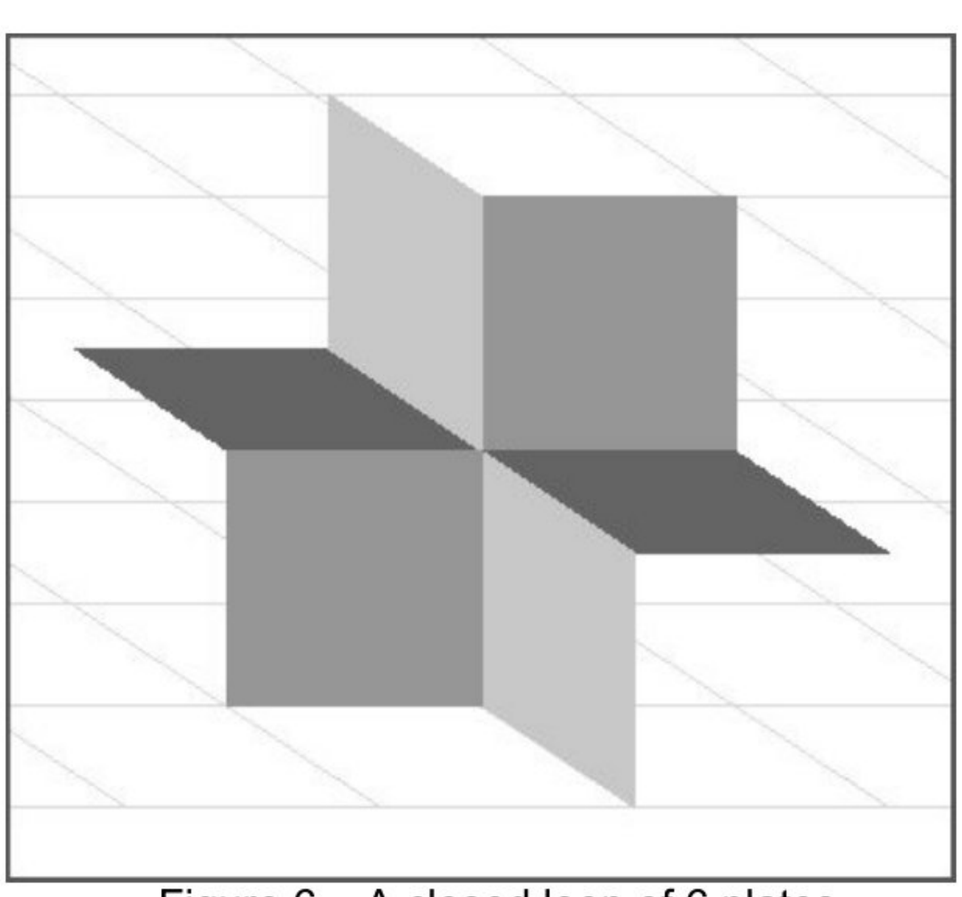


Figure 6 A closed loop of 6 plates

Information wanted

If you have any information about the origin of Ironwork please contact PAGE.

If the maker does not claim it back I hope that Ironwork will be handed over to CACHe as part of the CAS archives.

Material for CACHe

If you have any material relating to computer arts before 1980 that you can lend or donate to the CACHe collection please contact them or PAGE.

See page 8 for contact details.

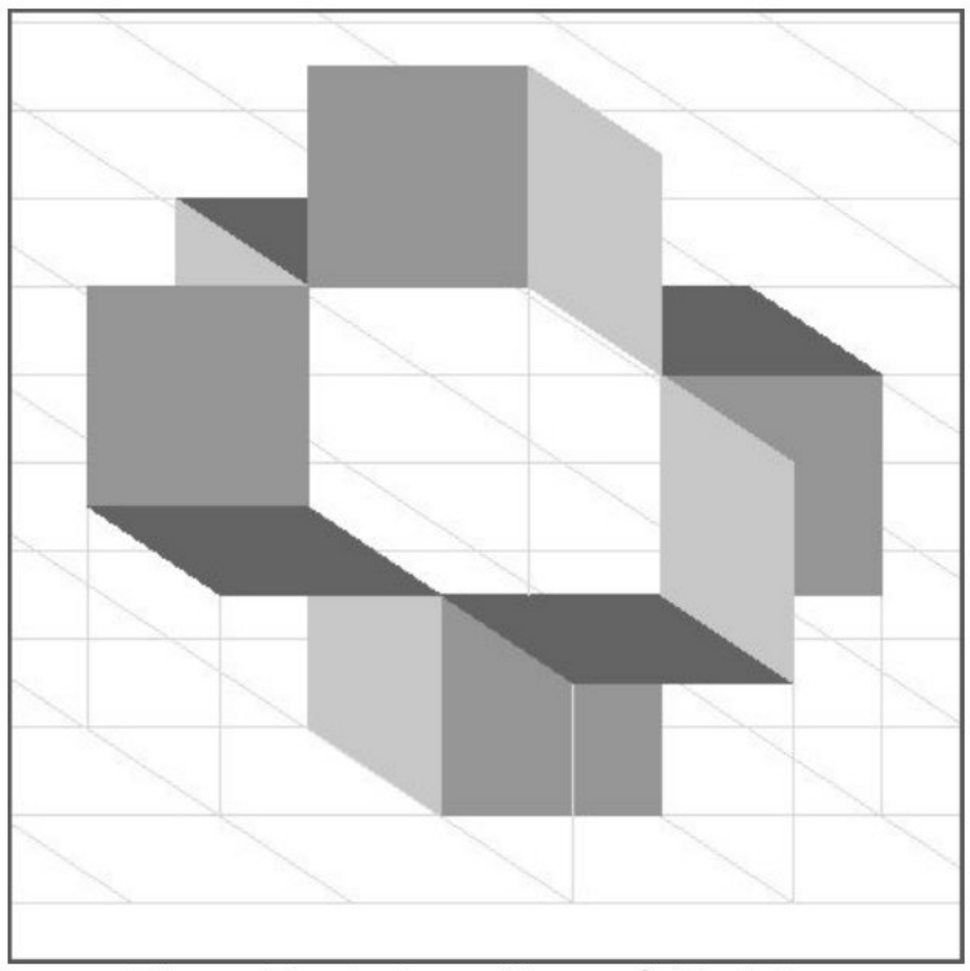


Figure 7 A closed loop of 12 plates

OPINIONS

I have never understood and never liked the conventional forms of informal, subjective, soggy, irrefutable art criticism. But as Peter Medawar almost wrote, there is a big market for such sort of criticism-fiction among “a large population of people, often with well-developed literary and scholarly tastes, who have been educated far beyond their capacity to undertake analytical thought”. The weekend supplements are full of it.

But I do have opinions about the merit of Ironwork. It has weathered well and looks good. The choice of ten elements, however made, is about right. Less and it would be too simple, more and I think it might look too elaborate, fussy even. And I wouldn’t be able to lift the thing.

I never comment on the significance of any artwork of mine: its meaning, merit, that sort of thing. The work must speak for itself and if it doesn’t then too bad. I don’t mind explaining how a work was made – rules, materials and so on – and the circumstances of its making. I believe this is a form of anti-intentionalism. Cave painters were the same, I fancy. I do not know why I make things except that it is a compulsion, sometimes an obsession.

3-D Computer Graphics: A Mathematical Introduction with OpenGL

Samuel R. Buss 371 pages £35
Cambridge University Press 2003

This work is in two parts: the printed book and the associated internet site. The book gives the mathematical basis for some of the main tasks in 3D computer graphics while the website contains source code for a substantial ray tracing package and some smaller programs.

The author is a professor of mathematics and computing at UCSD and has worked as a programmer and consultant on computer graphics projects, some in the demanding area of game development. The work is based on his teaching. The selection of methods was influenced by his experience in the computer graphics industry. The text is aimed at roughly graduate level.

There are chapters on the main topics in the computer graphics pipeline: transformations, interpolation, texture mapping, Bézier curves, B-splines, ray tracing, intersection testing and radiosity, The final chapter is on animation and kinematics.

The presentation is rigorous, with many theorems and proofs, while being firmly based on the practice of computer graphics. Throughout the book there are exercises, some with hints. "Very little of the material in this book is original", Buss writes, but the organisation and presentation are accomplished, while some of the proofs are simpler and shorter than those known before.

As well as geometry, the mathematics used in computer graphics also includes "calculus, linear algebra, numerical analysis, abstract algebra, data structures and algorithms". Homogeneous coordinates, with their application to projective geometry, are dealt with thoroughly since their use is normal in computer graphics.

The treatment of perspective is as good as I have seen. Geometrically correct perspective transforms most straight lines into curves: lines passing through the central point of focus are an exception. The vanishing point method taught to art students is a convenient approximation. This straight line approximation is used in computer graphics, Buss explains, because it is convenient at a later stage when a line or edge is placed in the screen space. He does not explain how to render two parallel lines which extend in both directions from their nearest points to the viewing position. Artists seem to avoid this problem by not depicting such awkward objects.

In places, Buss turns aside from his main mathematical narrative to give more personal views. One such perceptive musing relates to colour and our acceptance of mediocre colour rendition on CRTs while high quality sound reproduction is common. He suggests a monitor in which each pixel can emit two frequencies, each at variable amplitude, to give a nearly complete colour range.

The main resource on the website is a ray tracing package, written by Buss. It is implemented in three levels, the higher ones calling the lower. The top level is designed so that the reader can modify and extend the package but the two lower levels are not meant to be altered. The book has a 20 page appendix documenting the package. There are lesser programs on the website relating to other topics in the book, as well as all the code that appears in it.

The rigorous exposition of much of the mathematics underlying computer graphics is a welcome achievement. Binding this with a guide to implementations in OpenGL makes for an outstanding resource, for teaching and for reference. The modular nature of the chapters is an added advantage, allowing the main topics to be tackled piecemeal.

CAS membership list April 1970

In the early years the CAS list of members' names and addresses was given to members and was available to others for two shillings or 25 cents.

Daviv Hanley, a CAS member from the beginning, recently gave me a copy of the list for April 1970.

There were 377 members in 17 counties, including about 15 libraries and institutional members.

Austria	1	Argentina	1
Belgium	1	Australia	1
Bulgaria	1	Canada	8
France	10	Japan	2
Germany	5	USA	60
Holland	13		
Italy	13		
Ireland	1		
Spain	1		
Sweden	3		
Switzerland	2		
UK	254		

On the application form it was possible to indicate areas of interest from a list of 24: a for aesthetic theory, through j for jewelry, to y for cybernetics. The list shows these interests for 258 people. Music and graphics were the most frequently given.

PAGE

PAGE is now to appear quarterly. One editions a year will be edited by CACHe, but for the sake of continuity please send all contributions to the editor, Alan Sutcliffe, who produced this issue. The new CAS logo on page 8 is by Paul Brown.

Demisemiotics and the Translation of Umberto Eco

> Fors' is this the blind alley in which the vanguards have insaccate themselves, historical and neo -. To the shadows of the decostruzionismo, the postmodern one are outlined here, until put into effect them eclectic compresenza, downstairs Empire, of all and of the contrary of all, entropy does not know how much generative and fecund one, poeticamente quietistica how much is not known aesthetically and, in the cauldron of the indifferenziato one.

This is a machine translation of a paragraph from a recent article *Calcolo ed epifania* looking back to the publication of Umberto Eco's *Opera Aperta* in 1962.

'downstairs Empire' comes like the shock of lightening, triggering a cascade of associations, as unexplored neural pathways branch beyond the edges of comprehension. It goes further than the crafted compressions and conflations of Eco's beloved James Joyce, reminiscent of Lucky's thinking in *Waiting for Godot*, reaching the dislocations of William Burroughs' cutup texts. Meaning blurred but enriched by automatic translation. Retaining the form of the original sentences gives an underlying strength, something comforting to our own translation processes from words to half-meaning. In this it differs from Burroughs' accidental prose. It also gives a natural variety of constructions and a sense of progression absent from Lucky's soliloquy.

If I have a criticism of this passage it is the automatic author's over reliance on words from the original Italian, especially when there seems to be a perfectly good English word.

Machine translation as an artform, an open artform.

Eco has translated much and been much translated.

The opening sentences of the article are relevant to the daunting task that the CACHe project has undertaken.

> No handbook, no report or memory will give back the atmosphere to us of the Italian culture in ventennio between the end of II the World war and *the economic* Boom. The written documents can only palely reflect the experiments and the controversies, been born from the less ingenuous and amazed sense more or than freedom and abundance, from the discovery of the new capacities of oltralpe and oltreoceano, from desire of svecchiare at all costs, adapting themselves to the step of the times. True it is, like diagnostic Pontiggia in a page of *the flying Island,* than the health it is discerned in opposition to the disease, and that mortal disease them of the language is its mercificazione, against which the vanguards rebel. But the disease of the language, concludes Pontiggia, "paradoxicalally strengthens the function of that literary one, the only one in a position to giving back to the words their energy".

As Dot Lansdown has said to me a couple of times recently 'How can they' (who were not there) 'know what it was really like in those early days' of the Computer Arts Society. The dizzying possibilities, the support of some, the jokes, the collaborations, our shared values, the joy, the incomprehension and indifference of most of the arts world, 'freedom and abundance'. No, I who was there cannot give a true sense of it either.

The article continues:

> With the publication in volume of *Opened Work,* in 1962, (constituted in good part from tests appeared previously in review), Echo has assumed the ungrateful task of ram head, in the attempt to give back dignity to the languages of the limbs, not only to that literary one, while around to scalpitavano he the neo-vanguards.
>
> Faithful to its title it, *Open Work* has crossed complex publishing vicissitudes: more times riedito and modified, in the running edition reproduce that one of 1976. This, regarding two first editions (1962 and 1967), has lost the corposo test *the poetiche of Joyce* , ripubblicato independently. In compensation it has received, like appendix, the text *Generation of aesthetic messages in one Edenic language* , of understood them importance for the successes to you developments of the semiotico thought of the Author.

I particularly like the translation of the name of the author: Eco = Echo.Is the relationship between Umberto Echoed and Vladimir Nabokov's Humbert Humbert causal or accidental?

The copyright notice on the original is translated and more questions arise. Does the original copyright apply to the approximately translated quotations above? Does the approximately translated copyright notice apply to the approximately translated article?

I have always seen computers as a means to make open works: open for a new version each time the program is run, open to interpretation in performance, open to participation, eroding the boundaries between authors, performers and audience.

For the original article see www.italialibri.net/opere/operaaperta.html

ABOUT THE COMPUTER ARTS SOCIETY

Aims

The Computer Arts Society (CAS) promotes the creative uses of computers in the arts and culture generally

It is a community of interest for all involved in doing, managing, interpreting and understanding information technology's cultural potential

Membership & Fees

Membership is open to all who are interested in the aims and activities of the group

Optional membership fees will be introduced in May 2004

Activities

Page the Bulletin of the CAS will appear again quarterly

Monthly meetings will be held in London & a larger event is planned for late 2004/early 2005

Archiving computer arts

The CAS was active from 1968 until the mid 1980s

There are significant archives of material from this era, mainly stored in homes and offices of people then active in the group

The CAS is working closely with CACHe, a project in the Art History Department of Birkbeck, University of London, which is documenting UK computer arts in the years to 1980

The collection, identification, collation and handing over of material to the CACHe team will continue in 2004 & beyond
This leads to a wider interest in the archiving, study and presentation of computer arts from earlier years

Computers in heritage management

More widely the society will be a forum for those concerned with using computers in all aspects of our cultural heritage, from technical solutions to helping develop public policy

Present & future computer arts

With so many novel and exciting developments in the creative uses of computers in the arts the society will continue its original aims of bringing together those active in this area

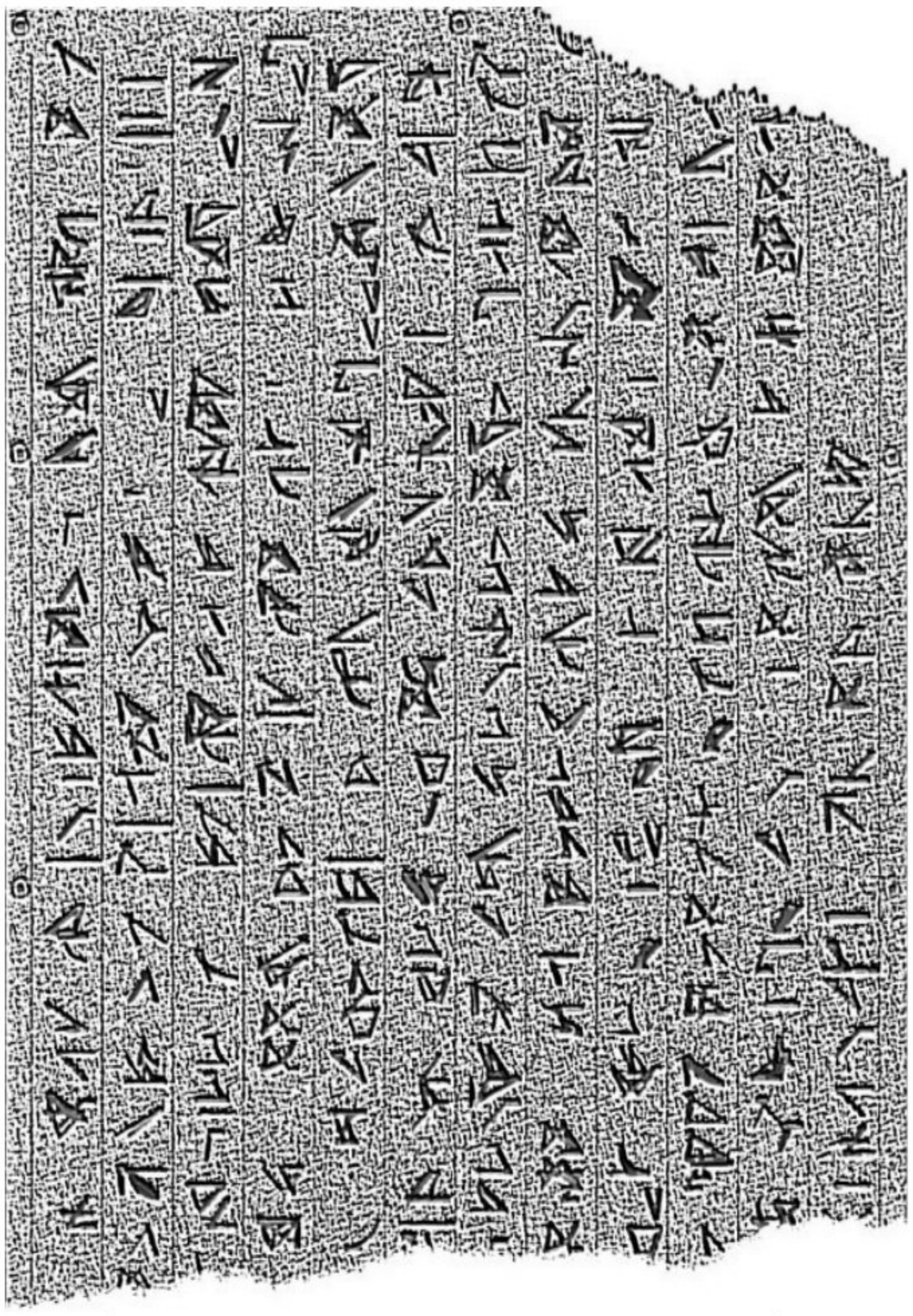
Helping to get work known
Bringing together artists and technologists
Enabling the exchange of techniques and ideas across art forms
Exploring new forms
Formulating needs for support

Collaboration

The society plans to hold joint events with other BCS Specialist Groups and hopes that this might develop into wider collaboration

Education

The CAS plans to have an educational role in making students more aware of early work in computer arts and in helping artists to use computers creatively



RECENTLY UNEARTHED: NEAR READING

COMPUTER ARTS SOCIETY

British Computer Society Specialist Group

Bringing together
artists and technologists

Exchanging
techniques and ideas

Exploring
new art forms

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Committee

Chairman
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george@ssl.co.uk

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Dr Nick Lambert
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Catherine Mason
cs.mason@hist-art.bbk.ac.uk

Meetings Spring 2004

Joint meeting with the CACHe Project at Birkbeck

6pm Monday 8 March
Birkbeck 43 Gordon Square London WC1H 0PD

On Light Shows
Robin Oppenheimer

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Joint meeting with the
Computer Conservation Society

2pm Thursday 25 March
Science Museum
Exhibition Road London SW7 2DD

UK Computer Arts to 1980

Dr Nick Lambert
Computers in the graphic arts

Alan Sutcliffe
Music and starting the CAS

Robin Shirley
Pushing the envelope of computer-assisted poetry

Catherine Mason
The role of Art Schools in this pioneering period

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Joint meeting with the Tate Modern

Tuesday 27 April
Tate Modern
London SE1 9TG

The Aaron Painting System
Harold Cohen

•

For more information about these events and the newly re-formed Computer Arts Society contact Alan Sutcliffe

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CAS
www1.bcs.org.uk/link.asp?sectionid=301

CACHe
www.bbk.ac.uk/hafvm/cache/

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Computers and the Arts in Society

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