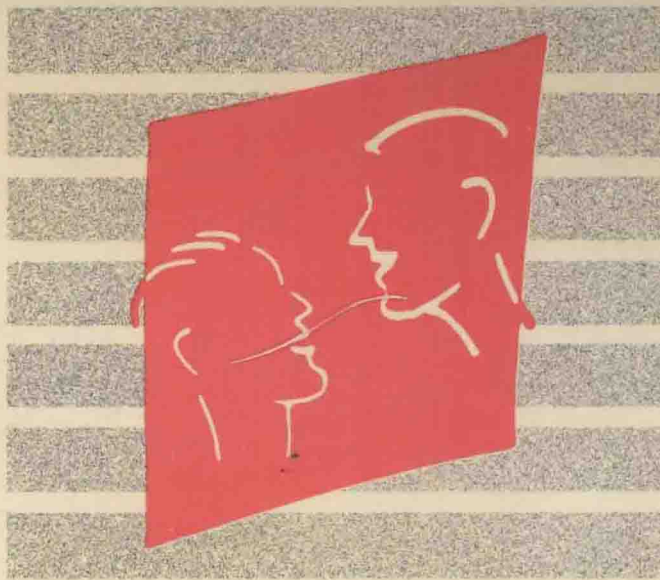


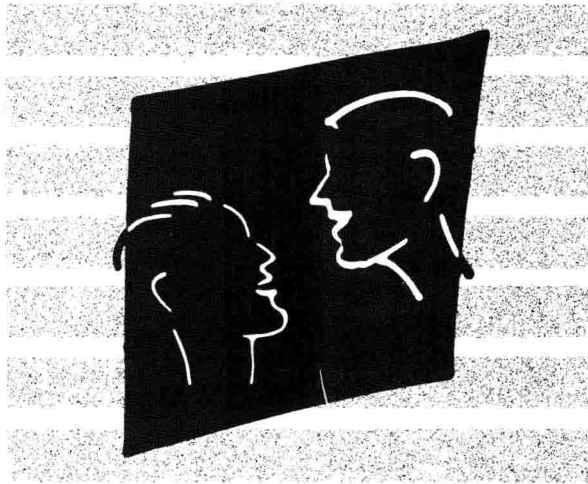
PROCEEDINGS OF THE CONFERENCE
HELD IN LONDON, OCTOBER 1988

COMPUTER



GRAPHICS 88

COMPUTER



GRAPHICS 88

江苏工业学院图书馆
藏书章


BLENHHEIM
ONLINE PUBLICATIONS

London

British Library Cataloguing in Publication Data

Computer Graphics 88: Proceedings of the
conference held in London, October 1988.

1. Computer systems. Graphic displays
Applications
006.6

ISBN 0-86353-152-0

© Blenheim Online Ltd 1988

ISBN 0 86353 152 0

Printed in the UK

The papers in this book are presented by the individual authors; the views expressed are their own and do not necessarily represent the views of the Publisher. Whilst every effort has been made to ensure the accuracy of the information contained in this book, the Publisher cannot be held liable for any errors or omissions however caused.

No part of this book may be reproduced, stored in any form, by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the publisher.



Blenheim Online Ltd is the world's leading specialist in the design, co-ordination and management of conferences and exhibitions concerned with the business implications and applications of leading-edge technology. With a schedule spanning some 20 technology areas, many Blenheim Online events have achieved international recognition. Blenheim Online is a member of the Blenheim Exhibitions Group PLC.

Blenheim Online Ltd
Blenheim House, Ash Hill Drive, Pinner, Middlesex HA5 2AE, UK
Phone: 01-868 4466 Telex: 923498 ONLINE G Fax: 018689933

Introduction

Computer graphic techniques are now widely and effectively employed in a wide range of activities from presentation graphics and slide production to computer-aided design and animation. The advances in this technology have been more than matched by developments in techniques and the rapidly falling cost of employing computer graphics which, in turn, has led to an explosion of interest in the field.

Computer Graphics 88 examines the latest developments in graphics technology and applications. The book starts with a thorough review of the latest technology including visualisation environments, graphics processing, multi and variable resolution, and computer architectures. Next there is a substantial chapter on computer animation which explores the latest work on improving the realism of synthetic images through texture and illumination. There are also chapters on graphics design, low-cost CAD systems and presentation and information systems to make this a thorough treatment of the field.

Written by the leading specialists from hardware and software houses, the universities and the graphics users themselves, this latest review of computer graphics provides an up-to-date and authoritative appraisal of the latest significant developments in the field.

Contents

COMPUTER GRAPHICS TECHNOLOGY

An ador(é)able computer <i>David Howes, Ardent Computer</i>	3
Real images in real-time <i>Graham Rowan, Real World Graphics</i>	13
A picture to look at <i>Peter Cottrill, Crosfield Electronics</i>	25
Some ideas about low speed transmission of moving pictures <i>A Cole & Ian Buntin, University of St Andrews</i>	33
One frame ahead: frame buffer management for animation and real-time graphics <i>Kendall Auel, Tektronix, USA</i>	43
Conquering the polygon <i>Adrian Thomas, University of Sussex</i>	51
Silicon architectures <i>Roger Allison, Silicon Graphics</i>	65
Current technology in distributed windowing systems <i>Allan Davison, Kieron Drake, William Roberts & Mel Slater, Queen Mary College, University of London</i>	75
High speed ray tracing using coherence and parallelism <i>Duncan Gillies, Imperial College of Science & Technology</i>	85
Terrain modelling using fractal interpolation functions <i>Jelena Petric, ABACUS Research Unit, University of Strathclyde</i>	95
Spot the image: visualisation of topographic data <i>Tim Day, Jan-Peter Muller & Sam Richards, University College London</i>	107
Edge enhancement for human viewing of computer generated graphics images <i>David Brownrigg, City University</i>	117
Portable user interfaces <i>Steve Boniwell, Apollo Computer (UK)</i>	125
Integration through standards <i>David Duce, Rutherford Appleton Laboratory</i>	135

COMPUTER ANIMATION

Specification and control of texture and shading at the pixel level <i>Anthony Ford, Rushes Computer Animation</i>	147
Quaternion animation <i>Daniel Pletinckx, Barco-Industries Creative Systems, Barco Industries, Belgium</i>	153
Building with light <i>Ian Curington, Amazing Array Productions</i>	167
State-of-the-art in image synthesis <i>Stewart McEwan, Electric Image</i>	173
Face to face <i>John Yau, Heriot-Watt University</i>	183
Open software for computer graphics <i>Simon Ritchie, Coventry Polytechnic</i>	189
Objects, symbols and computer graphics <i>Paul Ashdown & Ian Banks, Symbolics</i>	199
Animating articulated structures with multiple goals <i>Laurent Alt & Alain Nicolas, Thomson Digital Image, France</i>	215
Case studies	
Painting with fractals <i>Semannia Cheung, Middlesex Polytechnic</i>	227
The Seoul '88 project <i>Roger Cabezas, Animatica, Spain</i>	231
To compute movies <i>Arthur Valkieser & Wijnand Ott, ComputerImage, The Netherlands</i>	235
Computer assisted animated images at Walt Disney <i>David Inghish, Walt Disney Pictures, USA</i>	237
Blobs: a brand new way to synthesize pictures <i>Jules May, Hierographics Synthetic Pictures</i>	241
Aspects of character animation <i>Jerry Weil, Optomystic, USA</i>	251

PRESENTATION & INFORMATION GRAPHICS

- Presentation graphics: terminology and technology 257
Robin Baker, The Royal College of Art
- The influence of desktop publishing on presentation and information graphics 265
Ian Phillips & Stuart Cox, Bournemouth & Poole College of Art & Design

Applications

- Presentation graphics - the exciting possibilities 275
Geoff Turner, Genigraphics UK
- An introduction to the VideoShow system and its application 283
David Webster, Reflex

LOW-COST CAD SYSTEMS

- Development & application on low-cost CAD systems 295
Arthur Llewelyn, The CAD/CAM Centre
- Desktop CAD software: an evaluation 301
Ifan Shepherd, Middlesex Polytechnic

Case studies

- Use of micro computers in an architect's office 321
Jay Patankar, Jay Patankar & Associates
- SERBI the European offer 339
Pierre Gracia, SERBI, France
- Experience with low cost CAD 343
Richard Hart, ELS Land Consultants

THE COMPUTER IN GRAPHIC DESIGN

- Exposing film 349
Jeremy Hibbert, Hibbert Ralph Animation
- The role of graphic design in convergent video production 357
Colin MacLeod, Duncan of Jordanstone College of Art
- Computer graphics chips in 363
Mike King, City of London Polytechnic
- The bold face of print: a look at digital pre-press technology 371
Stuart Cox and Ian Phillips, Bournemouth & Poole College of Art & Design

Case study

- The making of "Monkey Business": (Television post production techniques) 381
Grant Watkins, The Moving Picture Company

Authors

Allison R	Silicon Graphics	UK	65
Alt L	Thomson Digital Image	France	215
Ashdown P	Symbolics	UK	199
Auel K	Tektronix	USA	43
Baker R	The Royal College of Art	UK	257
Banks I	Symbolics	UK	199
Boniwell S	Apollo Computer (UK)	UK	125
Brownrigg D R K	City University	UK	117
Buntin I M	University of St Andrews	UK	33
Cabezas R	Animatica	Spain	231
Cheung S L	Middlesex Polytechnic	UK	227
Cole A J	University of St Andrews	UK	33
Cottrill P F	Crosfield Electronics	UK	25
Cox S	Bournemouth & Poole College of Art & Design	UK	265 & 371
Curington I J	Amazing Array Productions	UK	167
Davison A	Queen Mary College, University of London	UK	75
Day T	University College London	UK	107
Drake K	Queen Mary College, University of London	UK	75
Duce D A	Rutherford Appleton Laboratory	UK	135
Ford A	Rushes Computer Animation	UK	147
Gillies D	Imperial College of Science & Technology	UK	85
Gracia P	SERBI	France	339
Hart R	ELS Land Consultants	UK	343
Hibbert J	Hibbert Ralph Animation	UK	349
Howes D G	Ardent Computer	UK	3
Inglish D	Walt Disney Pictures	USA	237
King M	City of London Polytechnic	UK	363
Llewelyn A I	The CAD/CAM Centre	UK	295

MacLeod C J	Duncan of Jordanstone College of Art	UK	357
May J C	Hierographics Synthetic Pictures	UK	241
McEwan S	Electric Image	UK	173
Muller J-P	University College London	UK	107
Nicolas A	Thomson Digital Image	France	215
Ott W	<i>ComputerImage</i>	Netherlands	235
Patankar J	Jay Patankar & Associates	UK	321
Petric J	University of Strathclyde	UK	95
Phillips I	Bournemouth & Poole College of Art & Design	UK	265 & 371
Pletinckx D	Barco-Industries Creative Systems Barco Industries	Belgium	153
Richards S	University College London	UK	107
Ritchie S	Coventry Polytechnic	UK	189
Roberts W	Queen Mary College, University of London	UK	75
Rowan G	Real World Graphics	UK	13
Shepherd I D H	Middlesex Polytechnic	UK	301
Slater M	Queen Mary College, University of London	UK	75
Thomas A L	University of Sussex	UK	51
Turner G	Genigraphics	UK	275
Valkieser A	<i>ComputerImage</i>	Netherlands	235
Watkins G	The Moving Picture Company	UK	381
Webster D	Reflex	UK	283
Weil J	Optomystic	USA	251
Yau J F S	Heriot-Watt University	UK	183

Computer Graphics Technology

An ador(é)able computer

**David G Howes
Vice President European Operations
Arden Computer Limited
UK**

The opportunities for greater insight into complex engineering and scientific computations processed by supercomputers can only be released by a new paradigm embracing both hardware and software. General purpose computational and graphics hardware, coupled with a toolkit that takes the burden of visualisation from the applications developer is seen as the most appropriate route for progress in interactive supercomputer visualization. Such a toolkit, Doré, and the Arden Titan graphics supercomputer is described in this context, together with the availability of an open supercomputer bus with many times the throughput of today's workstation buses.

David Howes has been involved in scientific computation and visualization throughout his career, as a civil engineer, and then in sales, marketing and management roles with IBM, Scicon and Prime. He established Apollo Computer in Europe in 1981, and was a founder member of the Computer Graphics Suppliers Association. As vice president, European Operations for Arden Computer, he is responsible for that company's activities in the "old world".

Supercomputer Visualization

The burgeoning scale and complexity of calculations performed by users in fields such as computational fluid dynamics, molecular modelling, seismic studies, mechanical computer aided engineering and medical imaging has assured the future of that class of machine that we may define as supercomputers. However, comprehension of the many multi-dimensioned numeric arrays that typically represent the output of such computers is in no way aided by the extra computational power that we manage to engineer into them. Computer graphics, increasingly, provides the *only* route to understanding in this domain; the quest for new levels of sophistication in visualization is on.

Scientists and engineers are demanding more than just the ability to see the graphical results of their analysis. Their ideal is to watch a solution *evolve*, by causing the analysis to be displayed in "real time" as it is computed. As an example, computational fluid dynamics researchers want flow simulation - the results of the calculations from their particular solver algorithm - to be integrated with grid generation - the definition of the 3-dimensional granularity of the computation and the various boundary conditions. Biochemists want molecular modelling and molecular dynamics coupled in the same package. Geophysicists need seismic interpretation linked with seismic data processing. They *all* require the ability to modify, interactively, the parameters of their problem and to observe the computational effects in 3D, full colour graphics - and in real time! They are demanding *interactive supercomputer visualization*.

But existing architectural paradigms - both on a hardware and a software level - are unequal to these demands.

Here we discover the essence of the "visualization/computation paradox" since, as yet, no single platform has had the capability to provide both the supercomputer processing speed *and* the 3D full colour real time graphics needed for interactive visualization. It has taken two machines in concert to fulfill the joint requirements for high speed computation and for high level visual representation of the computational results. Supercomputers (or mini supercomputers) which provide high computational ability with no visualization, are teamed with graphics terminals or workstations which provide visualization with little computational ability.

On inspection, the shortcomings of such an arrangement become obvious, both for graphics and computation. With a "thin-wire" connection between the computational and graphics components of the combination, users fail to achieve prompt feedback as they change problem parameters. They are forced to re-submit a batch-process job to the supercomputer or computational server, wait for network-based data transfers and then direct the revised model of the process back to

the graphics component. Even when an interactive program is run on a supercomputer - a processing mode that doesn't necessarily bring out the best of this type of computational resource - the link to the terminal or workstation remains a bottleneck. (In this context, even solutions based on Hyperchannel™ provide a relatively slender path.)

When considering visualization, the basic difficulty presented by this style of supercomputer/workstation solution evolves from the fact that the majority of graphics workstations achieve their (relatively) high graphics performance with custom hardware. Whilst useful for some fixed functions like transformations and clipping, custom hardware is generally constrained to perform only those specific algorithms for which it was built. So an inflexibility may exist for advanced features such as light source shading and texture mapping. The custom approach lacks a smooth transition between the graphics functions which it can do well, and those that are not cast in silicon.

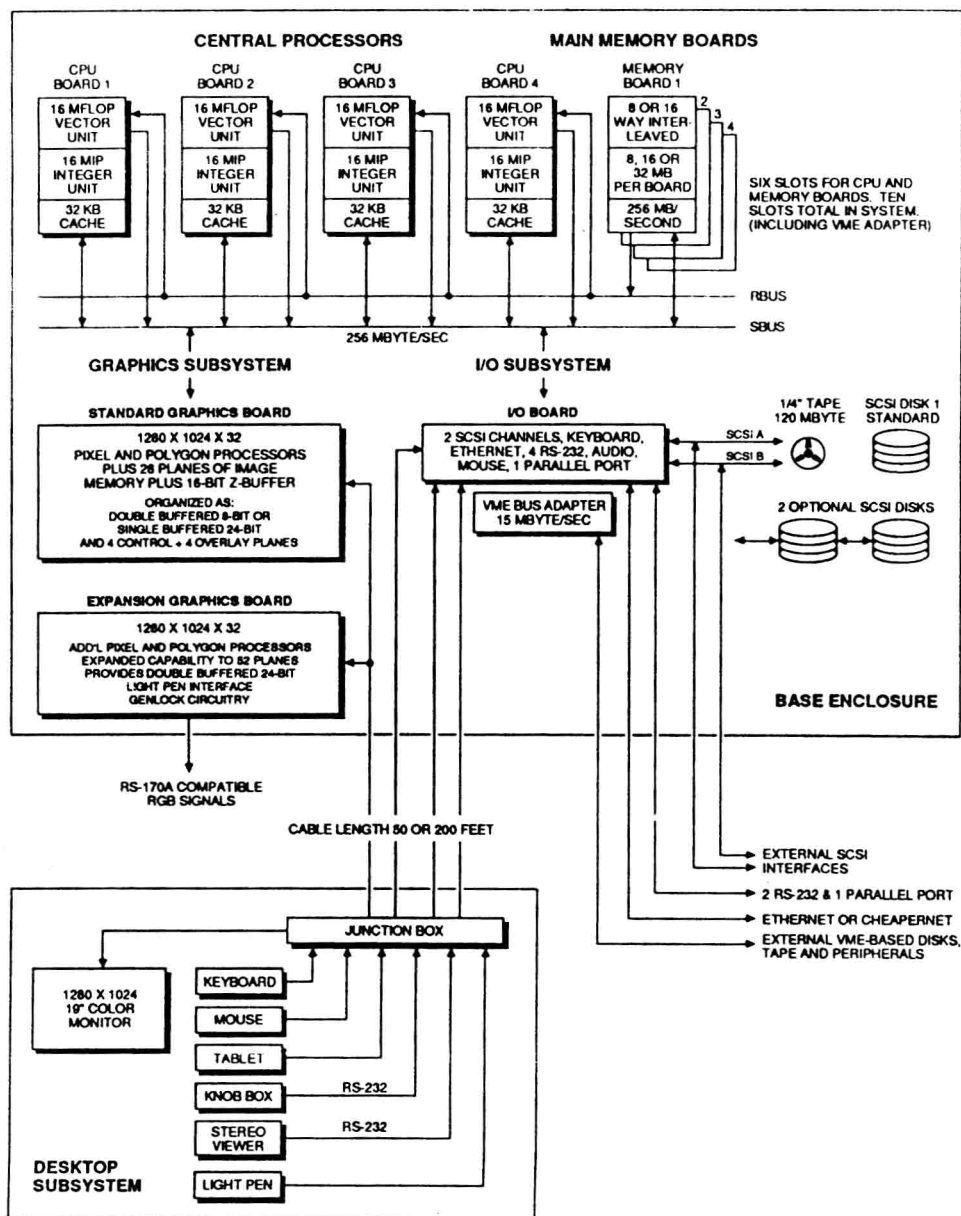
Also, from the software viewpoint, this approach fails to deliver against the needs of interactive visualization, since the practice of putting fixed-functionality graphics standards in a workstation is equally constraining. Users again encounter a communications bottleneck - the "thin-wire" link between graphics and adequate computational power - whenever they need to visualise beyond the capabilities of workstation-level, fixed functionality, non-extensible interfaces. And doesn't this approach pre-suppose that graphics interface standards are adequate to the demands of high-end visualization? In reality, the standards are effectively outmoded by the time they come into use. Indeed, the visualization requirements of some application areas such as computational fluid dynamics and computational chemistry may well be too young, too dynamic, for standards.

To take an example; a computational fluid dynamics researcher using a remote supercomputer, a workstation and applications with standard graphics interfaces faces several constraints. The scientist here could not compute a flow field and view it interactively. He could not develop a large zonal grid scheme, compute the grid points, display them and optimise the whole in real time. A desire (not unreasonable!) to display a 3D flow field would force him to devise and compute volumetric primitives himself, since graphics standards interfaces lack support for the complex primitives specifically needed in such diverse areas of scientific research.

To answer the frustrations of scientists and engineers trapped by the visualization/computation paradox, Ardent has developed a computer system and software which, in combination, address the demand for interactive visualization. The company believes there *is* a paradigm for achieving a better balance of computing and graphics: one platform that closely couples graphics to a supercomputer class processor.

Closely Coupled Graphics Processing

The Ardent Titan™ is not merely two traditional-style compute and graphics engines wired together, but defines a new class of machine: the graphics supercomputer.



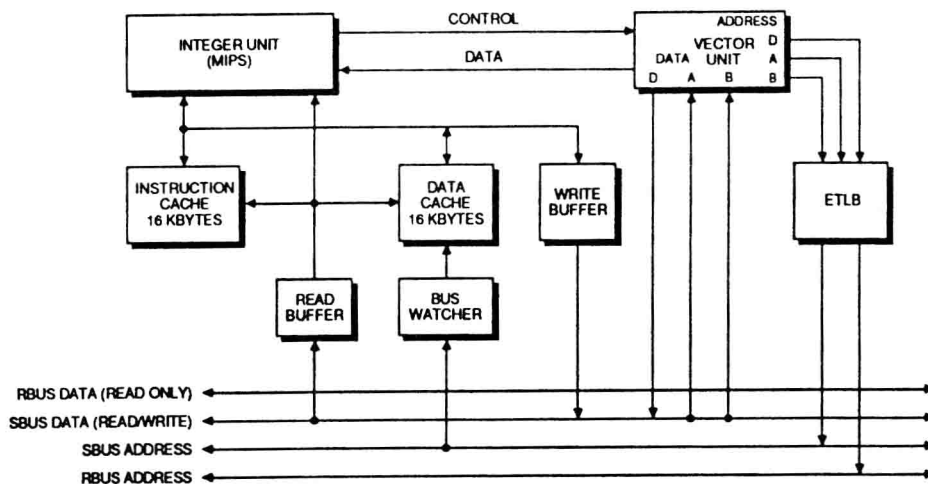
Titan System Block Diagram

Titan is a 64-bit symmetric parallel, vector processor.

Up to four processors can be configured in a single system. Each processor comprises a pipelined integer unit *and* a pipelined and chained vector unit. The integer unit is a RISC processor. The vector unit is a vector register machine that operates on floating point vectors, integer vectors and floating point scalars. Multiple processor configurations make parallel processing possible. This includes:-

- (i) Multiprocessing - the parallel execution of multiple processes on multiple processors.
- (ii) Microtasking - the division of a process into multiple threads (microtasks) that can be executed in parallel on multiple processors.
- (iii) The parallel execution of *integer* operations (address calculations, bitwise operations) and floating point operations within each processor.

Titan's vectorising and parallelising compilers accept "standard" C and FORTRAN code (F.77 with Vax™ extensions and Cray™ directives) and automatically compile for vector and parallel processing. The operating system is based on the standard AT&T System V.3 UNIX operating system with Berkeley 4.3 operating system extensions.



Titan Processor Subsystem Data Flow