25 Years of Computer Applications in Archaeology

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CAA 97

Abstract

Trends in application of computer methods in archaeology were analysed by studying the percentages of 703 CAA papers from 1973 to 1996 devoted to a group of major themes. The result closely mirrors emergent low-cost hard- and pre-packaged software availability. There are some constant areas of interest typified by database management. Recent years show an ever increasing dependence on applications of commercial soft- and hardware with innovation a relative rarity.

1 Trends in application of computer methods

One way to analyse trends in the application of computer methods to archaeology may be to look at the percentages of papers devoted to various subjects at the CAA meetings since their inception. From 1973 to 1997 there were 703 titles published or submitted but not yet published in 1996 and 1997. In this analysis, it will be assumed that the titles of the papers bear a reasonable relationship to their content, and when this can not be determined, a paper was classified as "Other". It is also implicitly assumed that the "supply" of methods or results described by the papers' titles anticipates or reflects "demand" for such methods or services in the archaeological community at or near the time at which they were presented.

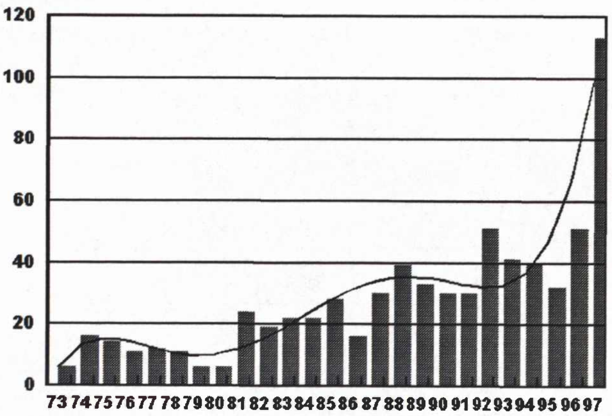

Figure 1: Papers published or submitted by year to CAA

Figure 1 shows a rough four-fold increase in the number of published papers for the first 25 years. The large peak in the submissions to the CAA 97 meeting may not be reflected in the number of papers which will actually be published. A high order polynomial has been fitted to the data to show the trend. The mild peaks in the mid-1970s and late 1980s perhaps represent a more favourable financial situation for travel grants in those years rather than any spectacular technological developments, although these are the years of widespread introduction of PC's. The long-term trend surely reflects both increasing computer awareness in the archaeological community and the availability of ever more reasonably priced hard- and software which can be used or developed to satisfy its needs.

A subjective factor in this analysis is the scheme used for classifying the subjects of the papers. A number of such classifications for this kind of material have been presented in the past as given in the references. These are:

Scollar 1982

1. Statistics
2. Databases & Site Recording
3. Scientific Data

Ryan 1988

1. Quantitative Methods and Simulation
2. Finds Analysis
3. Survey and Excavation Recording
4. Sites and Monuments Records
5. Geophysics
6. Expert Systems & Knowledge Representation
7. Education
8. Publication
9. Scientific Techniques
10. Museums
11. General

Kamermans 1994

1. Statistics
2. Database
3. Graphics and Image Processing
4. GIS
5. Artificial Intelligence
6. Education and Publication

In the current paper the following classes will be used:

1. Statistics

2. Database & Site Recording
3. Graphics, Image Processing, CAD and VR
4. Education, Publication and The Web
5. GIS
6. Prospection & Remote Sensing
7. Simulation and Artificial Intelligence
8. Pattern Recognition
9. Other

This last group differs slightly from Kamermans' classes through the addition of the "Other" category for papers which could not be classified by their titles, and by separating Prospection from Image Processing and Simulation & AI from Pattern Recognition. They are rougher categories than those specified by Ryan. This seems to justified, since many themes fell into two or more of his classes.

Taking all the years together, it can be seen from Figure 2 that Statistics and Database related papers dominate in equal parts to the extent of 46% of the total number of papers. The first was most popular at the beginning and in the middle years, the second has enjoyed fluctuating but continuous popularity throughout the last 25 years.

Graphics, Image Processing, CAD and Virtual Reality techniques are third in the popularity contest at 13% of the papers, with a tendency to increase up to the mid-90's.

Educational papers and especially Web related matters enjoy equal popularity compared to GIS techniques with 9% each, the popularity in both cases rising sharply from the mid-1980s.

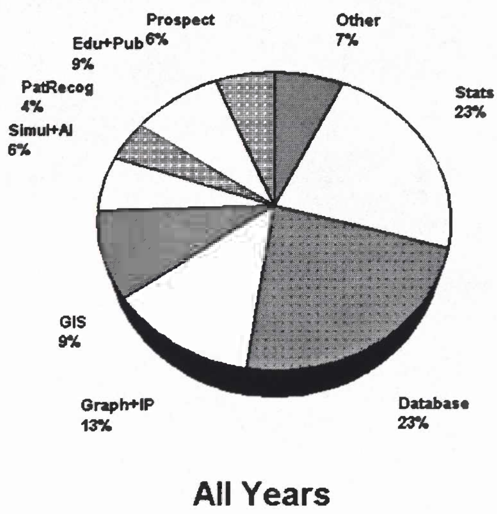

Figure 2: Categories of subjects, all years

Archaeological Prospecting (Remote Sensing) is a small special interest segment of nearly constant proportion, equal over the years in total magnitude to AI and Simulation. Pattern Recognition is the least popular category, and it has practically been abandoned today.

Examining the trends of each item individually, one can see peaks and valleys for which plausible explanations will be offered.

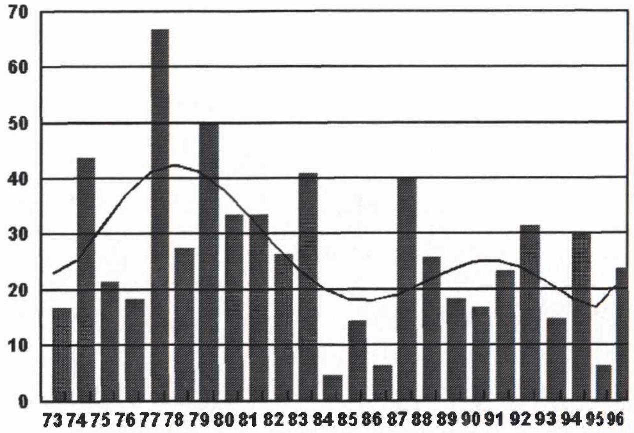

Figure 3: Statistics

In the 1960s statistical methods developed for mainframes, and various computational techniques associated with ancillary sciences, were among the few practical applications of computers in archaeology (Scollar 1982). This reached its peak in the late 1970s after the appearance of seminal publications such as Doran and Hodson (1976) and Hodder and Orton (1976). A few programs, usually in Fortran, were available and widely used. Interest flagged in the 1980's but revived slightly during the early 1990's with the emergence of standard commercial statistical packages having modest graphics for PC's. At the same time the impact of Correspondence Analysis, developed in the 1970s, made itself felt in the archaeological world, both factors probably leading to the second visible peak.

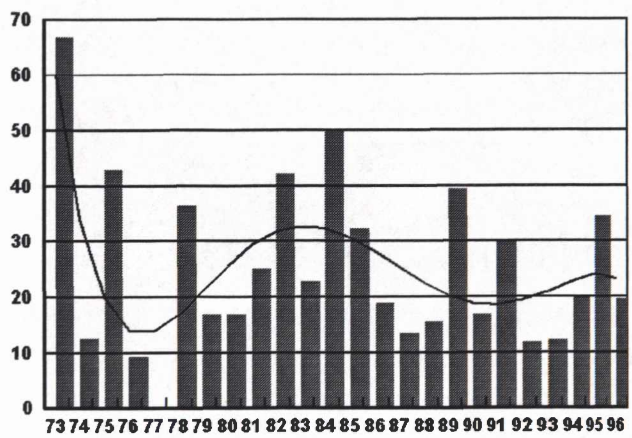

Figure 4: Database

Database methods enjoyed their first boom in the early 1970s, being primarily applied to museum and site inventories on mainframes. Interest flagged until the introduction of Dbase and similar products for microcomputers and the IBM PC in the late 1970s and early 1980s. After that, a roughly constant level of papers continue to deal with database themes. More recent developments in metadatabases in the mid-1990s have revived interest in the general site recording problem which now appears to have been solved. Large networked databases, which achieved some degree of maturity by the early 1990s, also contributed to a recent peak in papers. This has presumably been the consequence of both soft- and hardware availability and the backing of relatively prosperous monuments protection services in several countries.

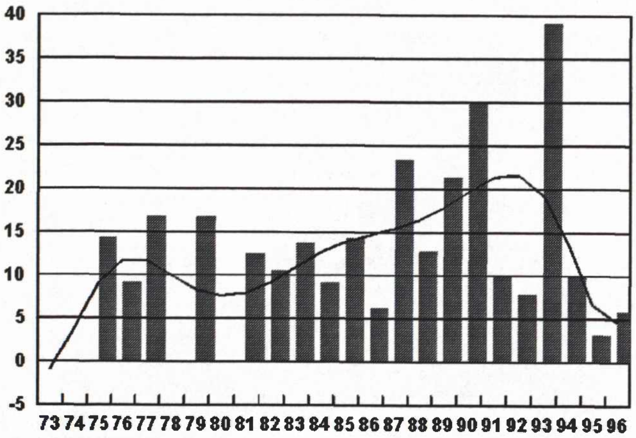

Figure 5: Graphics, Image Processing

The application of graphics, image processing and, more recently, virtual reality techniques was obviously driven by hardware availability at reasonable prices. In 1975, the first semiconductor display originally developed for NASA was bought at a — for archaeology — astronomical price. Scanners and film recorders were similarly expensive. There was only one such installation (at the author's laboratory) in late 1975 (Scollar 1977a; 1977b).

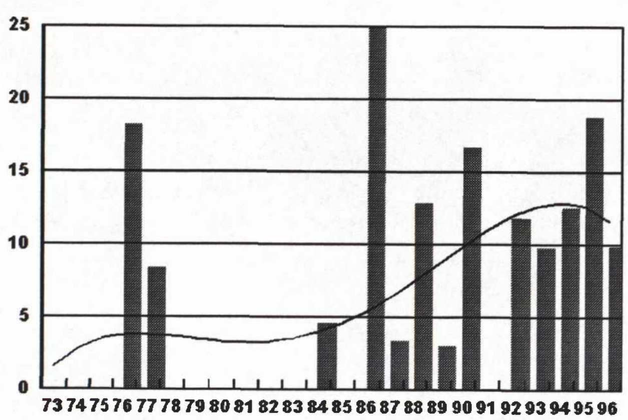

Figure 6: Education, Publication, The Web

When hardware prices dropped throughout the 1980s and 1990s, usage rose to reach a peak in the early 1990s. Today, image processing and high level graphics are on everyone's desk, software has matured, and processors are easily able to handle the computational load which was a challenge for the minicomputers of the mid-1970s. Virtual reality methods are not yet reflected in the diagram, but they will surely contribute to a new peak during the next few years.

A few isolated papers in the mid-1970s reflect the appearance of text editors and primitive text formatting software for minicomputers, and mainframes permitted some simple publication experiments. The spread and acceptance of word processing in the early 1980s, coupled with page-making software, produced the peak which started in the mid-1980s. The introduction of the World Wide Web in the mid-1990s brought publications oriented toward web browsers, probably the most popular new application in this area.

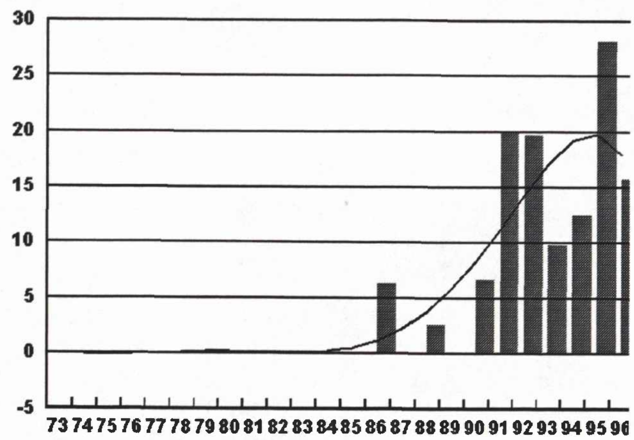

Figure 7: Geographic Information Systems (GIS)

Geographic information systems applied to archaeology emerged as a natural consequence of cheap high level graphic displays, falling hard disk prices facilitating storage of maps and map related data, scanners and related digitising equipment, all of which resulted in an explosion of interest supported by effective commercial software in the early 1990s which continues to this day. Although the novelty is wearing off, it still remains one of the most prominent topics in recent meetings

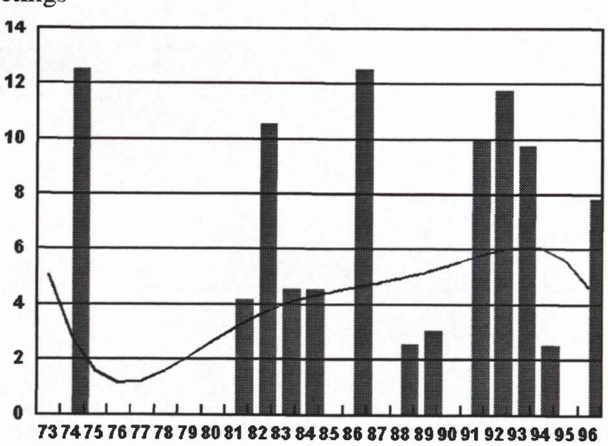

Figure 8: Archaeological Prospection, Remote Sensing

Along with statistics, evaluation of data from geophysical measurements on sites is one of the oldest practical application of computers in archaeology. This began well over a decade before the first CAA meeting in 1973. The moving force was the 'home-grown' development of measuring instruments specialised in digital recording of a large amount of data. It is the only area in this survey where hardware progress was pushed by archaeological requirements up to the 1980s, when commercial equipment replaced early pioneering efforts. At the author's laboratory, resistivity data was evaluated via computer and published as early as 1959. Magnetic data followed in the early 1960s. The work done in the late 70's is classified here under Image Processing, since this was mainly devoted to treatment of aerial photographs and infrared scans.

Activity rose slowly throughout the 1980s and mid-1990s. During the 1980s, work reflects efforts in mapping of oblique aerial photographs and magnetic data. The peak in the 1990s reflects the coming of age of commercial ground penetrating radar with digital recording instruments.

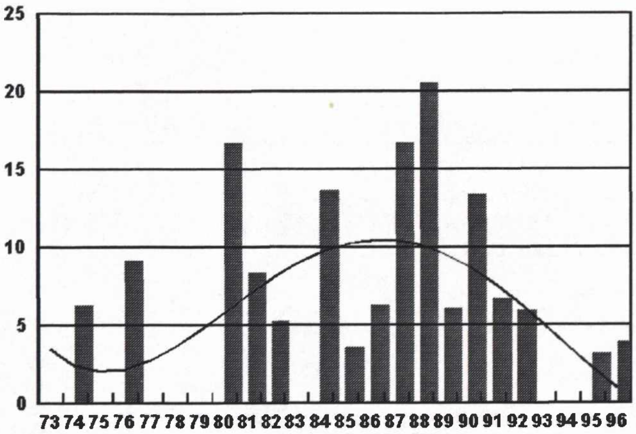

Figure 9: Simulation and Artificial Intelligence

Artificial intelligence methods enjoyed a mild boom during the 1980s, but interest died out almost completely afterward. Simulation techniques have had a low level of interest throughout the CAA period. AI methods have not met with acceptance in the archaeological community as a whole, and this resistance is probably the reason for the abandonment of such techniques.

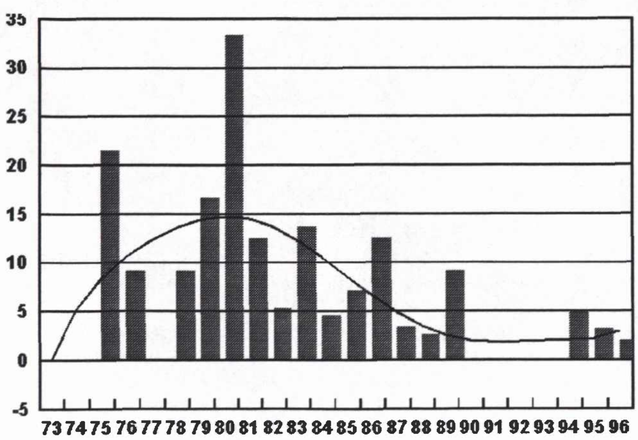

Figure 10: Pattern Recognition

Great hopes too were placed in pattern recognition methods in the 1970s and 1980s, but interest has waned, probably due to resistance in the archaeological community to the replacement of human skill by what is generally considered to be inferior techniques when applied to shapes and appearances of archaeological objects. Like AI, these approaches have never satisfied archaeological requirements, despite the great enthusiasm of their proponents in the early years and the ever-repeated invention of devices for measuring and recording of archaeological objects. Site recording devices for use in the field were also a fertile source of invention, but only commercial digital measuring instruments have achieved wide acceptance.

2 Sources of error

The analysis in this paper has a number of defects, of which the reader should be aware. These are:

Data:

1. The title of a paper may incorrectly reflect its content.
2. Years with few papers have high variance in percentages, and these distort the diagrams.
3. The "Others" category possibly hides meaningful data.
4. Published papers are not equal to papers actually presented, but because of lack of appropriate records it is not known how large this factor is in any given year.

Evaluation:

1. The subjective categories may be too coarse or too fine.
2. The use of a polynomial fit to the data is arbitrary.

Interpretation:

1. The volume of papers may actually fluctuate with available travel money! Papers are given to get a travel grant and do not reflect real work!
2. "Supply" may not be correlated with "demand", i.e. acceptance by the archaeological community of the various techniques may depend on other factors.

Nonetheless, it is felt that even if the data should not be relied upon quantitatively, the curves do correlate well with the subjective impressions of many of those who have witnessed the developments described.

3 Conclusions

The field has been driven by hardware availability at prices which archaeological institutions can afford, and has been limited by available software. Like almost all other disciplines, the field has been financially restricted since its inception. Methods and means derived elsewhere have gone in search of existing archaeological problems to which they can be applied. Archaeological problems do not successfully drive means and methods except in prospecting, because other areas had to profit from the greater Research and Development effort applied elsewhere. Nonetheless, despite this 'hand-me-down' position, archaeological computing has indeed come of age.

If one asks, "Did computer methods make archaeological tasks known prior to computers easier, faster or cheaper", the answer is probably "Yes". If one asks, "Did computer methods reveal or lead to new archaeological knowledge", the answer is probably "Rarely".

4 Survey

An informal survey was conducted by the author on the Archcomp-L listserver. Out of ca. 350 server subscribers, only 8 replied. Nonetheless, the results are interesting.

Considered Acceptable by the respondents:

Statistics:

1. Statistical packages
2. Simple data analysis with explanatory graphics via spreadsheets.
3. Bayesian calibration of 14C dates.
4. Bootstrapped confidence intervals.

Database methods:

1. The development of easy-to-use DBMS
2. Intrasite metadatabases.
3. Museum collection databases.
4. Large scale networked site databases with GIS.

Graphics, Image Processing, CAD

1. Widespread availability of mapping/CAD/image processing software
2. VR as extension of CAD and GIS
3. Electronic imaging

Prospecting

1. Image processing applied to geophysical and air photo data.
2. Publication, The Web
3. The academic Internet
4. Improving communication between scholars around the world.
5. Reducing the costs of publication.
6. Ubiquity of word-processing and desktop publishing software
7. Electronic publishing

GIS

1. The development of GIS for microcomputers

Other positive results:

1. Persuading archaeologists to think quantitatively.
2. Fostering the creation and curation of mass quantities of raw data.
3. The commercial success of microcomputer inexpensive computing
4. True interaction with analytical procedures
5. Experimenting with data

Considered unacceptable by the respondents:

1. Use of statistics software by people who don't know statistics.
2. All of the above when mis-used, especially DBMS.
3. Impermanence of electronic data.
4. Failure of the community to use the systems for sharing information.
5. Fragmentation of efforts to apply technology to the discipline.
6. Application of artificial intelligence.

A dissenting opinion was offered by Torsten Madsen, Aarhus:

"If anybody thinks that computing has become part of archaeology, then they don't know anything of archaeology & computing. The majority are just as illiterate as ever, so apart from everyone who has learned to type ... on the PC instead of the typewriter, little has changed. There is another thing that everyone can do, and that is to use the Internet. If that is progress then yes, indeed something great has happened with computing in archaeology, but personally I consider WWW to be one of the bad things that has happened to archaeology. My annoyance with WWW is not with the media itself but the reaction towards it from the many who have never cared about computers, but now have "realised" that the value of computers are equal to WWW."

Acknowledgements

I wish to thank Hans Kamermans, Leiden, The Netherlands, for generously sending me his spreadsheet data from an unpublished seminar held in London in 1994 which inspired me to analyse the data in this way, and the following members of the Archcomp-l list server for their helpful e-mailed comments: T.Dye, Honolulu, USA, H. Eiteljorg, Bryn Mawr, USA, J.D. Gillespie, Lethbridge, Canada, J.W. Hoopes, Kansas, USA, S. MacEachern, Brunswick, USA, J. Rehmet, Tuebingen, Germany, T. Madsen, Aarhus, Denmark. Susan Laflin most kindly provided photocopies of all the conference proceedings contents for analysis.

Method

The data was entered using the author's Winbasp entry program, with the years treated as units, the categories treated as types, and counts made by raising their frequencies. This was exported as a Dbase file, imported into Excel to compute the totals and percentages, then linked to Stanford Graphics to make the diagrams and fit the high order polynomial curves.

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