# CREWES computer systems

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## INTRODUCTION

The combination of bright, creative researchers and fast, capable computers continues to produce excellent research at CREWES. Computers play an integral role in all operations at CREWES -- from seismic data processing, to physical modeling control, to desktop publishing. As the need for greater computational speed and data storage has grown, the consortium has continually needed to upgrade and expand its systems. It has also acquired some of the world's best geophysical software, either by direct purchase or through the generosity of donors. This yearly report on the computer systems will describe the systems and software used to perform our research and produce our results.

## COMPUTER HARDWARE

The computers used by CREWES include a mixture of Unix, Windows, and Macintosh systems. Most of the seismic data processing is performed on Sun Ultrasparc systems running the Solaris operating system. Though not necessarily faster than the Intel Pentium-based computers (PCs), the CREWES Sun systems are able to run a wider variety of industry-standard seismic processing software. Over the last year, there is an increasing trend to take advantage of higher-speed PC's for seismic processing within the group. We expect this trend to continue, and we hope to purchase PC's with faster and larger disk drives to enable greater use of these low-cost systems for seismic processing.

CREWES has continued to expand the number of desktop PCs - each staff member has a PC, there are a pool of 8 PCs for student researchers and there are 2 more special purpose PCs for dedicated to physical modeling and networking. Of these systems, about 20 are Intel Pentium systems running Windows NT or Windows 95, four are Macintosh system running MacOS. These PCs most commonly run Microsoft Office applications (Word, PowerPoint, Excel), Matlab, and geoscience applications.

A new Geology and Geophysics departmental computer laboratory opened this year. It contains a total of 24 PCs comprised of 266Mhz and 300MHz Pentium II systems. This laboratory is used for teaching undergraduate courses, and is available to CREWES students when not in use. These PCs are configured to run either Windows 95 or Redhat Linux. Interconnected by a high-speed Ethernet network, these systems make could very easily be used for parallel processing. Initial parallel processing tests have been very successful, and we look forward to making greater use of these systems for parallel processing in the future.

The Geology and Geophysics department's mail, web, and network management system is also shared by CREWES. This system, a Sun 670MP, is now at the end of its life span. Within the next month it will be replaced by a set of PCs providing

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significantly faster and more reliable network services. These new network servers will be running Redhat Linux - an inexpensive, feature-filled, and surprisingly reliable Unix operating system. The department has been using Linux on the laboratory network server for several months with great success. We expect that the use of Linux will only increase in the next year.

| Number of systems | Model | Processor speed | RAM (MB) |
|---|---|---|---|
| 1 | Sun Ultra 60 | Dual 366 MHz Ultrasparc | 1280 |
| 6 | Sun Ultra 1/140 | 143MHz UltraSparc | 512 |
| 1 | SGI Impact | 195 MHz R10000 | 128 |
| 1 | Sparc 10 clone | Dual 72MHz Hypersparc | 284 |
| 1 | Sparc 10 clone | Dual 60MHz HyperSparc | 64 |
| 1 | Sparc 5 clone | 85 MHz Microsparc | 64 |
| 1 | Sparc 2 | 40 MHz Sparc | 32 |
| 3 | PC | 300 MHz Celeron | 128 |
| 8 | PC | 233 MHz Pentium II | 128 |
| 3 | PC | 200 MHz Pentium MXX | 64 |
| 4r | PC | 166 MHz Pentium | 64 |
| 2 | PC | 100MHz Pentium | 64 |
| 1 | Apple Macintosh 7500/100 | 100MHz PowerPC | 64 |
| 1 | Apple Macintosh 7100/80 | 80MHz PowerPC | 32 |
| 3 | Apple Macintosh 7200/90 | 90MHz PowerPC | 40 |

Table 1. CREWES Computer systems and their specifications.

## The MACI Project

The Multimedia Advanced Computational Infrastructure Project (MACI) is a five year, $20 Million collaborative capital project, shared among the University of Alberta, the University of Calgary, the University of Lethbridge, and the University of Manitoba. The intent of MACI is to provide computational, multimedia and network resources to support private sector, university, and government researchers throughout the country.

The first phase of MACI (MACI-1) was a $2 Million initial effort focused on computational and multimedia resources at the Universities of Alberta and Calgary. Under MACI-1, a cluster of Compaq / DEC Alpha systems was purchased and installed at the University of Calgary. The configuration has 30 500-MHz Alpha processors, with an aggregate of eight gigabytes of RAM and 100 gigabytes of disk. CREWES was one of the first groups to use the system. A test run, performing reverse-time migration in parallel, showed that these systems are capable of completing immense computing tasks in very little time (Gavrilov et al, 1998). In addition to the Alpha cluster, a 42 processor SGI Origin 2000 system was purchased and installed at the University of Alberta. CREWES will continue to work with the MACI project to gain access to these high performance systems.

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Figure 1. MACI systems: (left) A tightly networked cluster of 30 Compaq / DEC Alpha systems running at 500MHz is installed at the University of Calgary. (right) a 42 processor SGI Origin 2000 is installed at the University of Alberta.

## COMPUTER SOFTWARE

### Seismic Image Software

SIS is now supporting CREWES and the University of Calgary with copies of their VISTA and OMNI packages. VISTA is a complete 2D/3D processing package, which runs under Window 95or NT. OMNI is a survey design and analysis package. Together they provide a number of new software tools for CREWES researchers.

### Landmark Graphics Corporation

CREWES has a long history of support from Landmark. Landmark is continuing to provide their latest version of their geophysical, geological and reservoir engineering applications. Among the most used Landmark applications are ProMAX 2D, 3D and VSP (for seismic processing) and SeisWorks 2D and 3D (for interpretation). This year Landmark expanded it's software support by providing new licenses for it's MIMIC+, QUIK+ and VESPA+ modeling software.

### Geophysical Micro Computer Applications (GMA)

GMA has donated several copies their suite of seismic modeling and 2D/3D interpretation software to the University. GMA's LogM, Struct, AVO and WavX packages provide solutions for stratigraphic modeling, structural-modeling, offset synthetics and modeling, and wavelet extraction. GMA's 2D/3D seismic interpretation system offers an integrated modeling and interpretation environment for Windows 95 or Windows NT.

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**Hampson / Russell**

Hampson-Russell Software Services donated several licenses for Unix based geophysical software packages. Their software includes AVO - for AVO analysis, STRATA - a post stack seismic inversion program, GEOSTAT - for geostatistical analysis and mapping, and GLI3D - for 3D refraction statics analysis. New from Hampson Russell is the EMERGE package - a multi-attribute analysis and reservoir parameter prediction program. Using well logs and seismic data, along with seismic attributes calculated within the program, reservoir parameters such as porosity, lithology, and permeability can be computed. We look forward to working with this package, and testing its capabilities.

**Jason Geosystems**

Jason Geosystems has supplied CREWES with the Jason Geoscience Workbench (JGW). Using the workflows contained within JGW one can interpret seismic data, build geological and velocity models from various data, estimate wavelets from single or multiple wells, perform trace-based and model-based inversions and model using a variety of stochastic techniques.

**Paradyme**

Paradyme supports the University by providing several copies of the SeisX 2D and 3D seismic interpretation package. This package allows one to interpret 2-D and 3-D data, map faults and horizons and visualize them in 3-D. Among the other features of SeisX are grid balancing and interactive phase/amplitude matching between multiple surveys.

**Additional Software**

CREWES uses a number of other packages in addition to those already mentioned. Some, such as MicroSeis Outrider and Panther's SDL, have been donated, while others have been purchased (often with an educational discount). A full list of software is available in appendix A.

## PUBLISHING

The writing and publishing of the CREWES research report is a major operation. This year, 54 authors contributed to the report, producing a total of 52 chapters, and well over 700 pages. The report contains countless diagrams, seismic sections and images. The report is produced completely in the digital domain - CREWES is in its fourth year of abandoning the "scissors and glue" technique of document production. The advantage is that all printed copies are first-generation originals - produced by a high-volume printer at a local print shop. This results in sharper text, and higher quality images (Foltinek, 1996). In order to produce a uniform and professional looking report, we have standardized on Microsoft Word as our word processor. Using a template document, authors write their individual chapters with a consistent and professional looking appearance. Other software tools used in the creation of the report are Adobe PhotoShop or Corel Photopaint (for image manipulation), Deneba

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Canvas or Corel Draw (for creating drawings), and Adobe Acrobat (for generating the CD and web versions of the research report).

## NETWORK

The CREWES computer systems are all interconnected with an Internet-protocol network. This network is directly connected to the Internet via a 10 Mbit/s network. Within the University, different departments are interconnected with a combination of 10Mbit/s Ethernet, 100Mbit/s Ethernet and FDDI. A number of network routers, bridges and switches are also involved in providing connectivity throughout the University campus.

The Department of Geology and Geophysics (the location of CREWES), connects its major systems using a 100BaseT Ethernet running at 100Mbits/s. A series of network hubs and switches are distributed about the Earth Sciences building interconnecting laboratories and offices using a star topology. Older systems are connected to the network at 10Mbits/s via dual-speed network hubs. All newer computers have been purchased with 100Mbit/s network adapters. CREWES has led the way (out of need) to this migration from 10Mbit/s to 100Mbit/s Ethernet. The vast majority of seismic processing systems within CREWES now use this faster network.

## SUMMARY

The CREWES Project has acquired a capable collection of computers and software. The continuing support of our sponsors has allowed us to upgrade and expand our systems. With these improvements, we have been able to investigate new data-intensive, real-world geophysical problems. We would like to thank the sponsors of CREWES and valued software donors for making our research possible.

## REFERENCES

Gavrilov, D., Lines, R.L., Bland, H.C., Kocurko, T., 3-D Depth migration: parallel processing and migration movies, CREWES Research Report, 1998, v. 10., ch. 14

Foltinek, D.S, An overview of cross-platform document technology, CREWES Research Report, 1996, v. 8, ch. 30

## APPENDIX A - SOFTWARE LIST

The following list describes all the software we use on a regular basis. This list excludes system software, compilers, system utilities and lesser-used software. Although care has been taken in preparing this list, it is likely that portions of the list are inaccurate or out of date. For this reason, this list should not be considered a source of authority for product information. Some listed packages are available on operating systems other than those indicated – only listed are the versions used by CREWES.

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| Modeling | | | |
|---|---|---|---|
| Package | Vendor | Description | Operating System |
| LogM | GMA | Stratigraphic modeling system | Windows |
| STRUCT | GMA | Seismic modeling of structural geology. | Windows |
| AVO | Hampson Russell | Interactive AVO modeling, analysis, and inversion. | Unix |
| GLI3D | Hampson Russell | Static corrections using a near-surface geological model | Unix |
| EMERGE | Hampson Russell | Multi-attribute analysis and reservoir parameter prediction | Unix |
| Geological Workbench | Jason Geosystems | Geological models from interpretation or well data. Velocity models from interpretation or seismic data. | Unix |
| Osiris | ODS Holdings | 2-D and 3-D solution to the wave equation for an arbitrary horizontally stratified medium | Unix |
| Outrider | MicroSeis Technology | Multicomponent modeling | Windows |
| MIMIC+ QUIK+ VESPA+ | Landmark | Geologic modeling and ray tracing | Unix |

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| Processing | | | |
|---|---|---|---|
| Package | Vendor | Description | Operating System |
| ProMAX 2D/3D | Landmark | Complete 2-D and 3-D seismic processing. | Unix |
| ProMAX VSP | Landmark | VSP processing system | Unix |
| Poststack | Landmark | Interactive poststack seismic processing for interpreters. | Unix |
| Vista | Seismic Image Software | Interactive seismic processing from shot record to final stack, synthetic seismograms. | Windows |
| STRATA | Hampson Russell | Post-stack stratigraphic analysis and inversion package, model building, wavelet extraction, seismic inversion | Unix |

| Data Loading / Analysis | | | |
|---|---|---|---|
| Package | Vendor | Description | Operating System |
| Caravel | Discovery Bay | Synchronized display and analysis of multiple seismic data sets | Unix |
| Formatter | Discovery Bay | Data access from multiple SEG-Y formats. | Unix |
| SEA | Discovery Bay | Seismic Energy Analysis | Unix |
| Matlab | Mathworks | Mathematics and statistics package with 2D and 3D graphing capability | Unix, Macintosh, Windows |
| Seismic Data Loader | Panther | Simple data loading to/from SeisWorks / SeisX / SEG-Y formats. | Unix |
| GEOSTAT | Hampson Russell | Geostatistical analysis of parameters from well logs or seismic | Unix |

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| Interpretation | | | |
|---|---|---|---|
| Package | Vendor | Description | Operating System |
| 2D/3D | GMA | Interpretation of 2-D / 3-D seismic data | Windows |
| SeisWorks/3D SeisWorks/2D | Landmark | Seismic interpretation with horizon picking, fault interpretation and correlation, seismic attribute analysis and data display | Unix |
| StratWorks | Landmark | Geologic Interpretation, well log correlation, cross sections and mapping. | Unix |
| SeisCube | Landmark | 3-D cube animation | Unix |
| Rave | Landmark | Reservoir characterization | Unix |
| Zmap+ | Landmark | Interpretive surface and fault mapping | Unix |
| SeisX | Paradyme | 2-D and 3-D seismic interpretation and visualization | Unix |

| Well Log Analysis | | | |
|---|---|---|---|
| Package | Vendor | Description | Operating System |
| LogM | GMA | Entry, computation and management of well logs. Can generate synthetic seismograms. | Windows |
| PetroWorks | Landmark | Graphical well log editing, analysis and interpretation | Unix |
| Syntool | Landmark | Synthetic seismogram generation | Unix |

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