Customer Success Story

> **Industry**
Research and Development

> **Application**
Nuclear Physics

> **Product**
PV-WAVE

The prime objectives of the Institute for Reference Materials and Measurements (IRMM) are to perform specific reference measurements, to produce certified reference materials, to organize international measurement evaluation programs, to contribute reference data to trans-national databases and to carry out pre-normative research and develop advanced testing methods.

Visual Numerics
Developers of IMSL and PV-WAVE

> PV-WAVE used to Analyze the Interactions and Structure of Subatomic Particles

Pv-WAVE is capable of providing rapid representation of large multidimensional volumes of data, combining and analyzing the data interactively.

I QUICK FACTS I

The Van de Graaf group of the Institute for Reference Materials and Measurements (IRMM) in Geel, Belgium, works in the field of nuclear physics, investigating properties and interactions of materials using a 7-megavolt particle accelerator. This process generates enormous amounts of data in the form of meter-long lists of values. The Institute used PV-WAVE to develop a tailor-made software solution that produces meaningful information from the data.

I THE PROBLEM I

One of the most important resources in nuclear and high-energy physics is the particle accelerator that is used to study the various interactions and therefore the structure of subatomic particles. Particle accelerators are used in medicine for radiotherapy, in engineering for nondestructive materials testing and in chemistry for the polymerization of monomers. The Van de Graaf group at the IRMM uses its accelerator for materials testing and research into new materials. Experiments carried out here provide different forms of data. Both spectral analysis for the various materials (from which the data are output in a cumulated form) and individual data, recorded by the various detectors, are collected during the course of the experiments. In such cases, entire “data deserts” arise in the form of lists, in which even accomplished researchers can lose their way.

To manage and evaluate these masses of data, which are recorded by various measurement devices and passed on to data-acquisition software, the engineers at IRMM decided to provide a data-processing system for the experiments in a usable form — developing software that makes data analysis and visualization possible.

Customer Success Story

> **PV-WAVE/IMSL**
Key Benefits

- Interactive Analysis of scientific data
- Core functions can be expanded by adding new procedures
- Communicates between standard applications and C processors
- Strong graphical representations

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The requirements for this system, code named LISA (Listed and Spectral Data Analysis), were to:

- Analyze spectral data and experimental data in the form of lists
- Control the parameters in the experiment and display the data obtained in the course of the experiment on a real-time basis
- Obtain a high-quality output of the results on the screen and on the plotter
- Achieve a high level of automation
- Adapt to the requirements of individual experiments.

Furthermore, the program needed to be capable of communicating with the data acquisition module of the German company, Delta of Hamburg.

The goal was to allow researchers to solve the standard problems such as spectrum investigations, graphical representation, printing results and setting parameters and to define functions that do not follow these standard patterns. This flexibility made it necessary for LISA to recognize the different data forms, i.e., the cumulated spectral data and the list-mode data, which represent a sequence of events in the course of the experiment. Numerical values here correspond to an event such as a collision, values that are associated with each event in the experiment and result from the conversion of the analog signals from detectors.

I THE SOLUTION I

The developers at IRMM chose the PV-WAVE software from Visual Numerics as the basic software for the development of a system that meets their requirements. PV-WAVE is a software package for interactive analysis of scientific data. It contains both a programming environment and GUI tools for graphical presentation and analysis. It is capable of providing a rapid representation of large multidimensional volumes of data, combining and analyzing this data interactively.

The PV-WAVE core functions can be expanded by adding new procedures. The program itself already provides many of the desired functions for presentation, output and analysis, but some data processing, which must be carried out while the experiment is in progress (real time) on an event-by-event basis, were better catered for by the inclusion of analysis modules (known as processors) written in C. Communication between standard applications and the C processors is carried out by PV-WAVE, so that the user is unaware of the presence of this additional module.

The experiments may last for days or even weeks, and so the user often needs to be able to change calibration parameters during the run. This was achieved by the generation of parameter files that are accessed by the command files, allowing LISA to process massive quantities of data from a large experiment, with varied settings to compensate for drift.

Regardless of the analog/digital converter (ADC) used, more than 10,000 events can be processed every second; an event consists of up to eight ADC words (16-bit) and corresponds to a data rate of 150 kilobytes per second.

| RETURN ON INVESTMENT |

LISA currently runs in an Ethernet LAN on a Sun® (SparcStationTM) workstation cluster. Also integrated into the network are PCs (with X Terminal emulation), tape drives, external hard disks and plotters. The program is operated in a graphical user interface (GUI) mode via the input of keyboard commands and via the pull-down menus.
The program package was implemented under X Windows and UNIX®, using Visual Numerics' PV-WAVE with some analysis modules programmed in C. All data are managed from the LISA framework by assigning UNIX shell commands. LISA is therefore a powerful tool for on-line and off-line data analysis that, because of the portability of PV-WAVE, can also be used on other UNIX systems. With minor modifications to the UNIX calls, it can even be used on Digital® equipment VMS® machines.

| WORLD CLASS PRODUCTS, SERVICES, AND SUPPORT |

For over 30 years, Visual Numerics, with its PV-WAVE and IMSL product families, has provided trusted visualization and numerical analysis tools to thousands of technical professionals in a broad range of industries around the world. Scientists, researchers, educators, engineers, developers, Intranet managers, testers and analysts use Visual Numerics' development tools to solve problems, identify trends and share results.

The PV-WAVE Family has all of the functionality you need in one tool, including an open software environment allowing for integration with new technologies, and the use of the IMSL Libraries which have been trusted by developers for over three decades for its accurate and reliable mathematical and statistical algorithms, creating the most powerful data analysis software available.

The PV-WAVE Family provides a broad range of easy to use, high performance solutions for any type of data challenge, while delivering significant return on investment through maximum productivity.

Customer
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Story

Visual Numerics partners with its customers to provide world-class products, services and support. We have unparalleled technical support that can answer the hard questions fast, and responsive consultants that can provide in-depth expertise and timely delivery of time-critical solutions.