DataWave
SciWorks ®

Integrated Software Tools for . . .

Data Acquisition

Experiment Control

Data Analysis

Data Management

DataWave SciWorks

The SciWorks® software application provides the framework for data acquisition and data analysis tools used in scientific experimentation and research. This toolbox approach provides a common software interface which allows these tools to work stand-alone or together to provide an **integrated solution** to your scientific research needs. Several Plugins are currently available and you can continue to add tools to your toolbox as they become available or as your research needs change.

Using SciWorks is easy! Simply select the default set of plugins you use on a regular basis and those plugins will be automatically started every time SciWorks is executed. If you no longer need a particular plugin simply go to the customize dialog and remove it from the list of plugins to load. Its that easy!
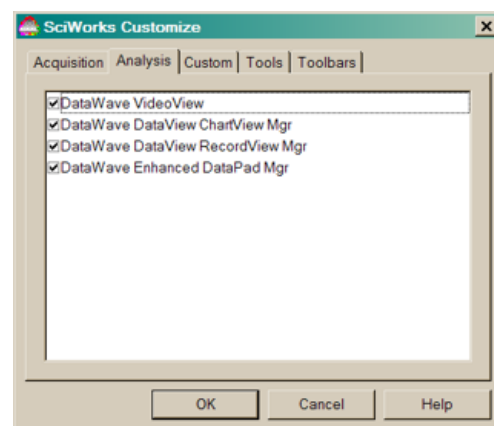
SciWorks

SciWorks Plugins

Experimenter Realtime
automated real-time data acquisition, stimulus generation, data analysis & experiment control

Experimenter Playback
automated experiment playback and data analysis

VideoBench
video capture, tracking and monitoring

AutoSort
real-time & post experiment spike sorting

DataView
interactive data replay and editing

DataPad
integrated spreadsheet without limits
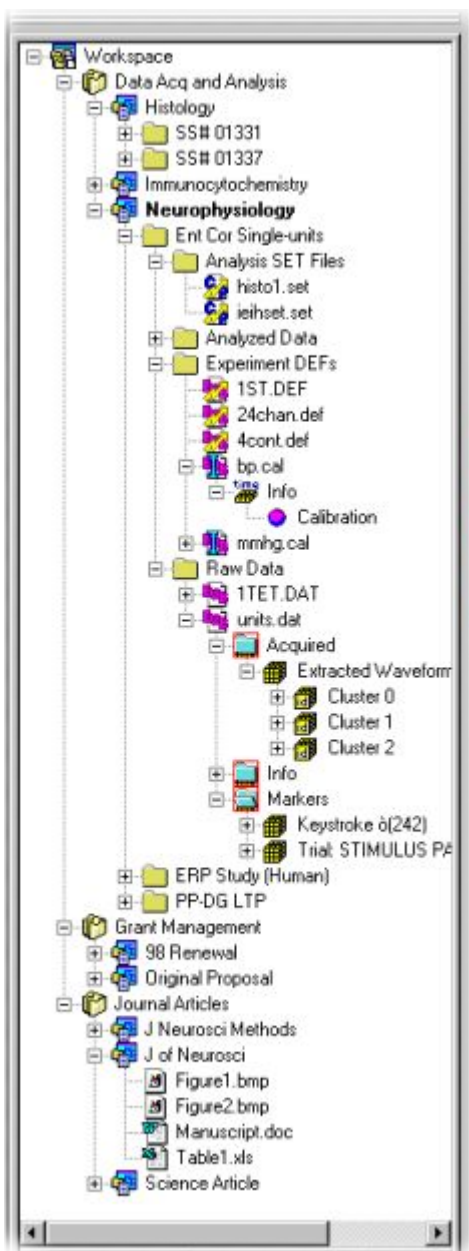
Research Applications

SciWorks plugins can been used to acquire, display, analyze and process data and signals from many different types of biological and mechanical sources. Some of the research applications include:

- Single & Multi-Units	- LTP & LTD	- ECG & EKG	- Blood Flow	- Blood Pressure
- Field Potentials	- Behavior	- ECoG	- Force	- Velocity & Acceleration
- Evoked Responses	- EEG	- Pulmonary	-Air Flow	- Temperature & Pressure
- EOG	- EMG	- ERG	- Organ Bath	- SpO$_2$ (Pulse Oximetry)
- Voltage Clamping	**And Many More . . .**			

DataWave Plugin Technology

- Hosts a range of interactive data acquisition and data analysis tools

- Allows software tools of different types to work together for a completely integrated solution

- Allows data of different types to be processed together

SciWorks Customize

Acquisition | Analysis | Custom | Tools | Toolbars

☑DataWave VideoView
☑DataWave DataView ChartView Mgr
☑DataWave DataView RecordView Mgr
☑DataWave Enhanced DataPad Mgr

OK   Cancel   Help

SciWorks' unique workspace and project oriented environment provides great flexibility and ease of use for working with large data files and unique data types typically encountered with data from scientific data acquisition and data analysis. Several different file filters are currently supported for working with files of different types. The graphical workspace and project approach overcomes limitations typically encountered with searching, accessing or managing large or numerous data files. Additionally the workspace approach allows data files and projects to be located in different locations and shared with others, both locally and on a network.

To use a data file or selected data within a file, simply select that data and send or drag-and-drop the data to the plugin that you wish to use the data with. The whole process minimizes the usual number of steps and the tedious task of searching, accessing and opening large or complex data files. Some data may be double clicked to execute non-DataWave programs much like Windows Explorer.

Workspace and Project Environment

- Management of large data files and files of different types
- Automatic collection of output files from Plugins
- Send whole files or selected data within a file directly to a plugin with minimal steps
- Create projects to organize and bring together files and information from different locations
- Information and data files can reside in more than one project while maintaining only one copy
- Workspaces and project provides data sharing capabilities between multiple users
- Projects can be shared between multiple workspaces
- Drag, Drop and Analyze technology implemented for files and selected data within files

Files

- Support for various file formats for direct read and write as well as importing and exporting (including DDF, WorkBench, Discovery, UFF, ABF, CED, Neuralynx, Plexon, EDF, ASCII and others)
- DataWave high performance file format for storing data of known and unknown types together (i.e. acquired signals with video and histograms)
- Graphical display of data to instantly access specific locations within a file
- Files using DDF format allow data from different files to be combined into a single file
- Files using any of the DataWave formats allow data to be easily separated into separate files

Execution

- Works in Windows 98SE, ME, 2000 and XP
- Compatible with all types of computers and CPUs
- True multithreaded and event driven internals
- Interfaces to existing laboratory hardware
- Can be integrated with DataWave's hardware solutions
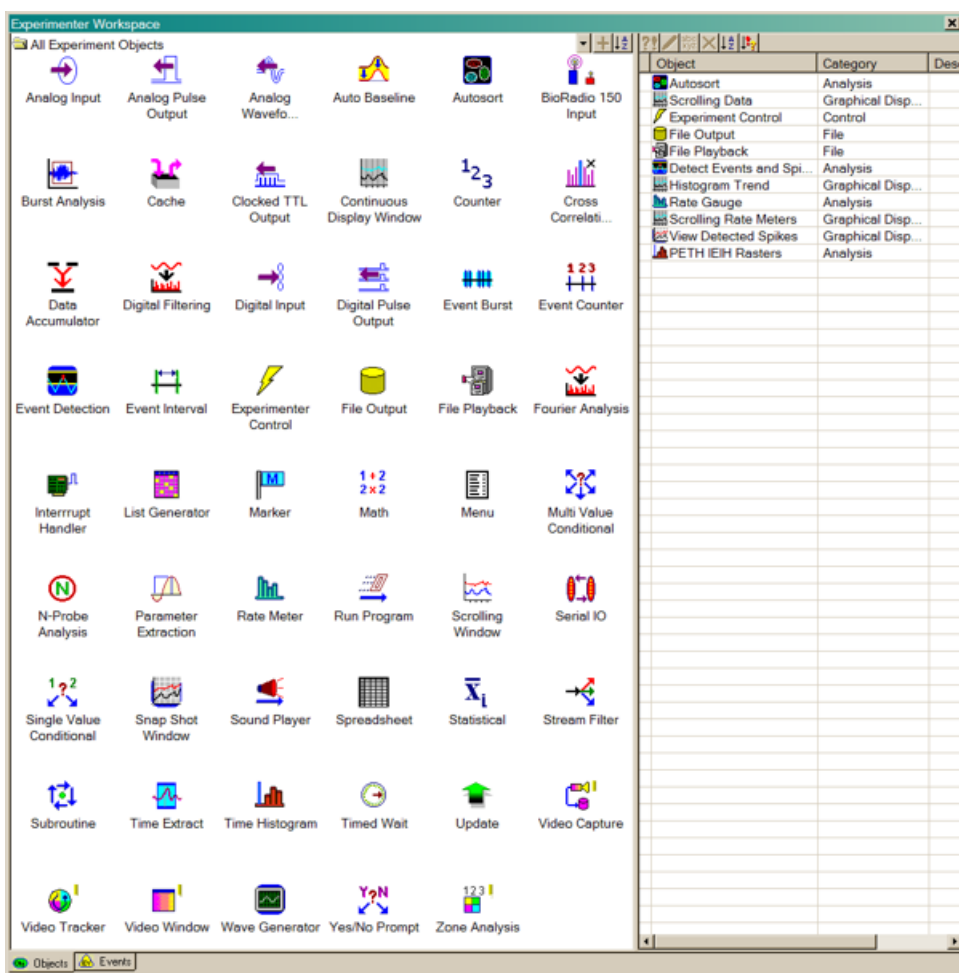- *See the last page for additional information*
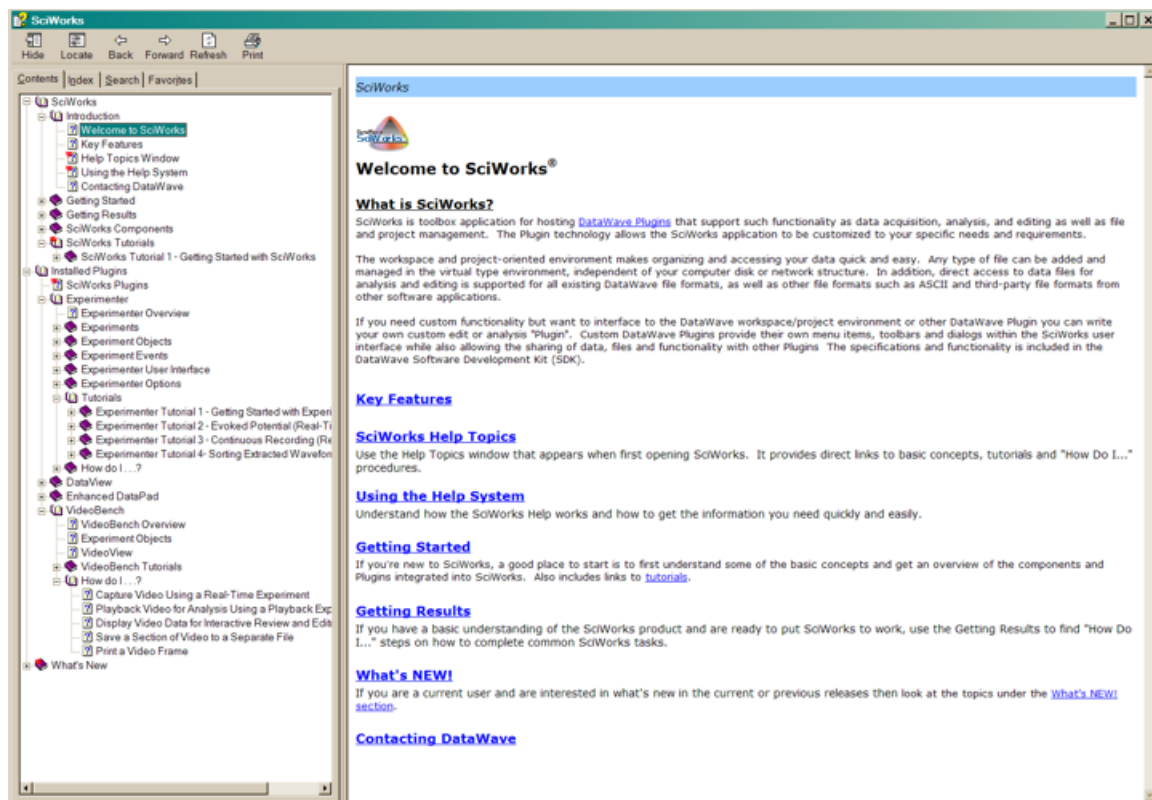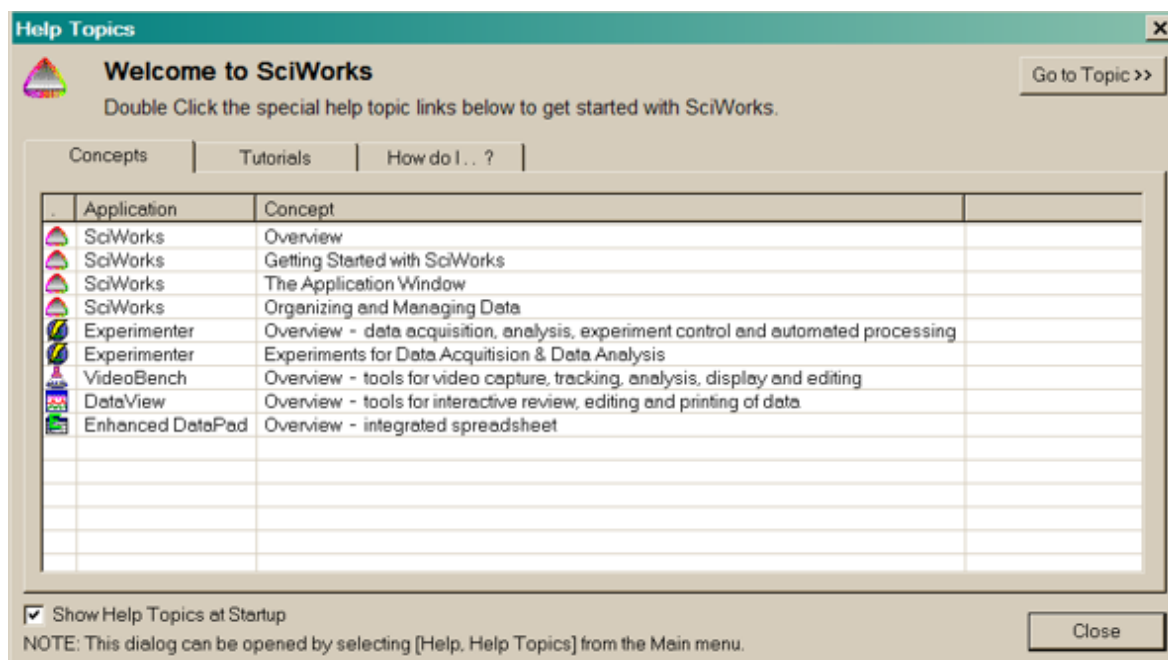
Experimenter

Whether you are on the leading-edge of science or simply need a way to automate day-to-day lab procedures, Experimenter will help you improve productivity, simplify experimentation and minimize costs.

Experimenter Versions

Experimenter Realtime: Includes ALL Experimenter features for both real-time and file playback functionality.

Experimenter Playback: Includes ALL Experimenter features EXCEPT for the data acquisition and stimulus generation features.

DataWave Experimenter™ is a real-time data acquisition, data analysis and experimental control as well as post experiment analysis application. Unlike other data acquisition packages, the Experimenter combines ALL of the functions of data acquisition, real-time analysis, experimental control and graphic display into a SINGLE easy to use application. In addition, the unique event driven structure and multi-threaded environment provides an easy and flexible method for creating almost any experimental protocol, from the most simple to the most complex--in only minutes. **No programming or scripting required!**

Experimenter's modular object structure allows it to grow as your needs grow. And as new functionality becomes available you simply add new "experiment objects" to your toolbox of experimental tools. If you have special needs that may not currently be included in Experimenter, then it may have already been developed by another user or you can use the Experimenter API and DataWave SDK to easily customize the Experimenter to your needs. Develop your own or share custom "experiment objects" to interact during real-time experiment execution.

Gallery of Example Experimenter Experiments

Below is only a **tiny** **sample** of the types of experiments that can be created and executed with Experimenter. Note that these example experiments barely even scratch the surface and it would be next to impossible to show all possible ways in which Experimenter can acquire, stimulate, analyze and conditionally execute.

Multi-Unit Recording - The example experiment is recording four channels continuously. The unit activity is being detected and the units extracted from the continuous data stream. As the units are extracted they are also sorted using the DataWave AutoSort™ analysis.

Simultaneous with the acquisition of unit activity an auditory stimulus is being delivered with white noise in one ear and a tone in the other. A marker in the data stream is used in conjunction with creating peri-event time histograms (PETHs), inter-event interval histograms (IEIHs) and dot rasters. Finally, the unit activity firing rate is displayed (by sorted units) in a rate meter display (behind the other windows).
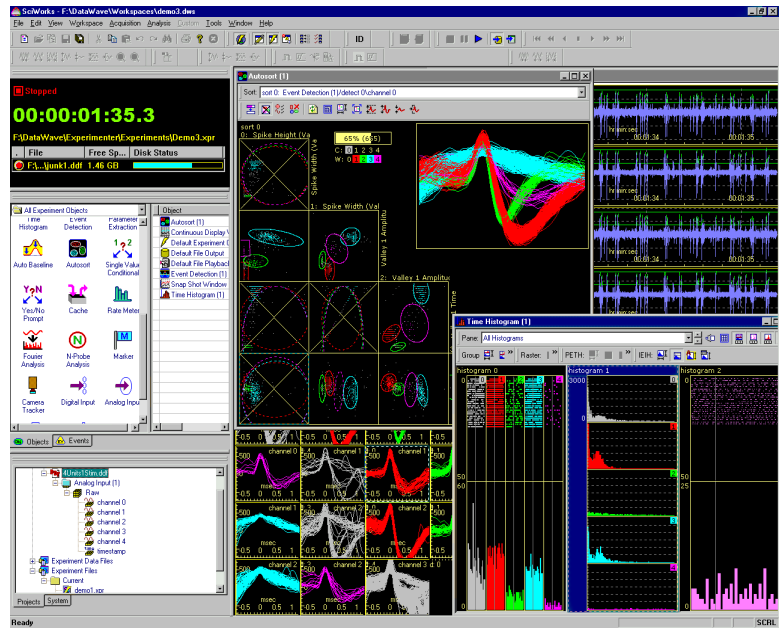
Evoked Field Potential and EEG - The example experiment is recording two channels of field potential and four channels of continuous EEG in an awake behaving animal. A biphasic pulse is delivered at a regular interval as defined in Experimenter. The amplitude of the pulse is maintained for a group of stimulations and then automatically changed to a new value.

For each group of responses an average is response is calculated. Automatic artifact rejection is applied so that only valid sweeps are accumulated. For each averaged waveform various waveform parameters are calculated (i.e. area, pop spike amplitude and slope) and displayed in the real-time spreadsheet.

Finally, a Fourier analysis is performed on the EEG channels and the power spectrum displayed.
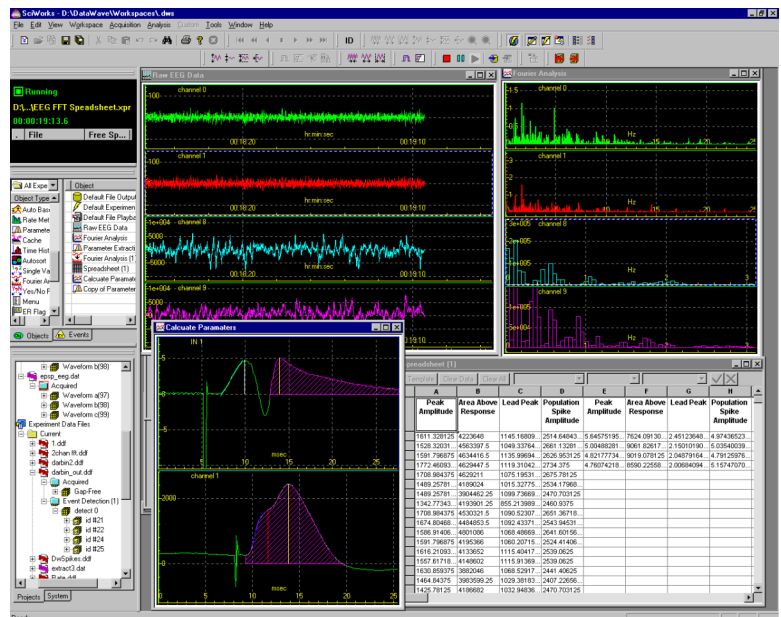
EMG and EEG - The example experiment is configured to continuously record both EEG and EMG. Simultaneously bursts of EMG activity are detected using the Experimenter burst analysis. The burst durations and inter burst intervals are calculated and counted with the values automatically displayed in the real-time spreadsheet.

The detected EMG burst is extracted from the continuous EMG data streams. A Fourier analysis is performed on the extracted waveform and the Fourier transform is added to a running average. The power spectrum is also calculated from the EEG data stream.
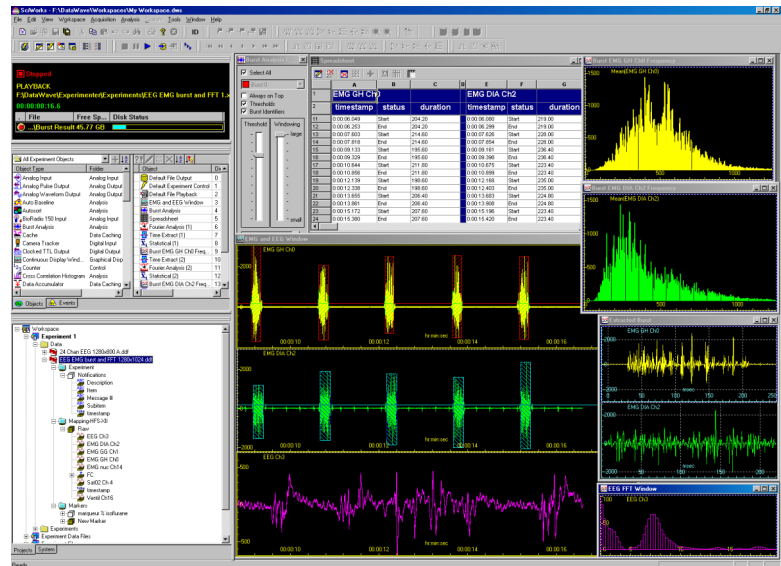
EEG - The example experiment is configured to record 24 channels of EEG continuously over a 24 hour period of time while looking for a seizure.

A spectral (Fourier) analysis is performed on each of the channels and the power values calculated for each of the common power bands. The power band values are plotted continuously over time (hidden by other windows).

The Experimenter burst analysis is used to detect the seizure activity. When a potential burst is detected, markers are automatically entered in to the output data stream for both the on and off of the seizure.
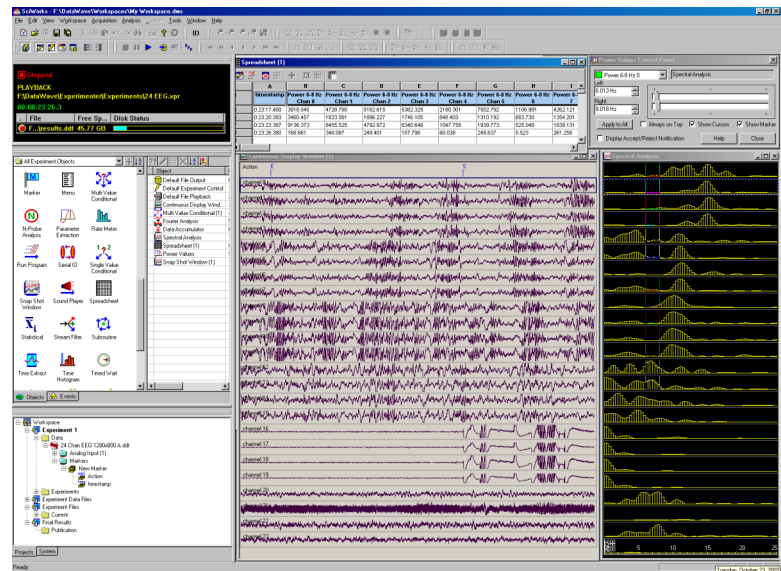
EEG and ECG - The example experiment is configured to continuously record four channels of EEG and one channel of ECG over several days. The experiment is using both the EEG and ECG to look for a seizure.

A spectral (Fourier) analysis is performed on each of the channels and the power spectrum is plotted in a spectrogram .
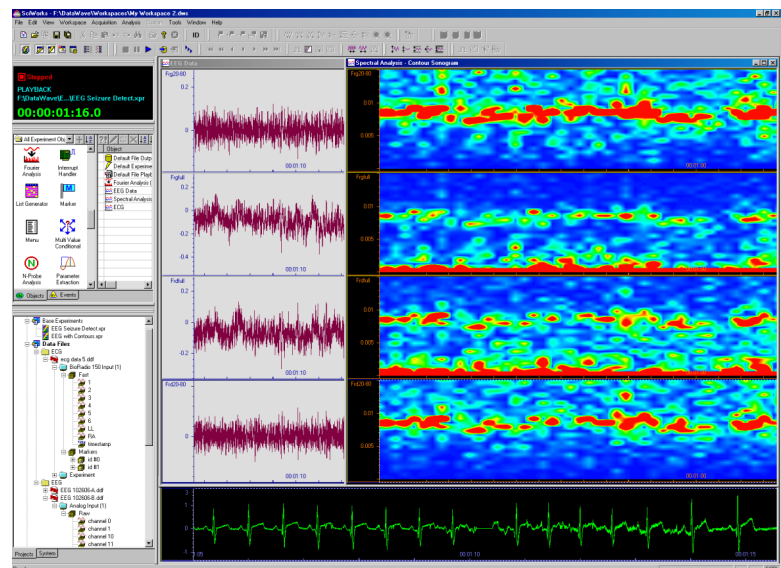
Experimenter Key Features

Data Acquisition (Analog and Digital Input)

- Acquire from 1 to 128 channels of continuous ("no gap") or discrete ("single sweep" mode) data
- Universal support for Analog to Digital (A/D) hardware from various manufacturers
- Support for various A/D bit resolutions including both 12 and 16 bit
- [++]Read multiple digital ports for experiment control
- Acquire different channels using different sampling rates and A/D gain factors
- Calibrate data in terms of "user units" such as temperature, pressure, etc.
- Record both acquired and analyzed data to disk for off-line processing
- All data items are timestamped to 1 microsecond resolution with a high resolution clock
- Integrated support for DataWave's VideoBench (Video Capture, Tracking & Monitoring)

Data Analysis

- **All Analysis can be performed while data is being acquired or from file playback**
- Detect and extract events such as Unit activity, EEG spikes or ECG complexes based on software window discriminators
- Real-time Multi-Unit Spike Sorting & Separation using (DataWave's "Autosort[TM]" Cluster Analysis)
- Extract key waveform or histogram parameters such as peak, valley, area, dV/dt, pop spike amplitude, etc. Includes unique parameters for evoked potentials, ECGs and action potentials.
- Waveform averaging and event triggered averaging
- Digital Filtering including high pass, low pass and notch
- Detect Waveform Bursts such as EMG bursts or EEG spikes from continuous waveform data and calculate burst counts and burst duration
- Detect Event Bursts from detected events (i.e. unit activity) and calculate burst counts, burst duration, interburst interval (IBI) and more
- Rate meters including binned or interval rates in Hz or bpm
- Perievent time (PETH), Inter-event interval (IEIH) histograms and Dot Rasters
- Simple event counting between start and stop times or between markers
- Cross Correlation Histograms
- Cross Correlation of waveform data
- Signal conditioning such as auto-baseline and waveform smoothing
- Statistical calculations for both waveform and single value data
- Fourier Analysis including various power calculations (i.e. total power, max power, etc.)
- Real-time spreadsheet for acquired and calculated values. Can be used for creating custom analysis functions and reporting
- N-Probe[TM] Analysis for custom multi-array and multi-channel electrode analysis for tetrodes, stereotrodes and multi array electrodes
- Create custom equations to perform math operations defined by custom equations to operate on single value or array data (i.e. histograms or waveforms). This feature can also be used to calculate derived channels from raw data.

Stimulus Generation and Analog/Digital Output

- Generate stimuli and acquire data at the same time
- Generate analog waveform output for auditory or behavioral queueing
- A stimulus "List Generator" automates stimulus output and provides both random and pseudo-random output
- Interface to various stimulators such as video or auditory type stimulators
- [+]Multiple channels of analog output for variable amplitude pulses, pulse trains or waveform output
- [++]Programmable counter/timers interface for complex pulses or pulse trains
- [++]Write to multiple digital ports for experiment control
- Universal support for Digital to Analog (D/A) and other types of counter and IO hardware from various manufacturers
- Universal support for multiple types of counter and IO hardware from various manufacturers

Data Display

- All data can be displayed while data is being acquired or analyzed
- Windows for displaying all types of data, including both acquired and analyzed
- Windows can be zoomed, autoscaled, and x, y and z axes can be controlled independently
- Extremely fast display options
- Numerous window controls for controlling windows independently or as a group
- Automatically hide, show and bring to top windows during experiment execution

Markers, Messaging and Data Annotation

- An unlimited number of flags and trial information can be recorded simultaneously with data
- Extensive updating capabilities of stimulus, counter, digital I/O in trial markers
- Trial markers and messages recorded in data files provide extensive off-line analysis capabilities
- Unique ability to assign identification (ID) information to different types of data

External Equipment Interfacing and Control

- Interface for acquiring video with the DataWave VideoBench (Video Capture & Tracking)
- External triggering of data acquisition
- Interface for controlling external hardware using TTL triggering and Digital IO

File Output and Data Replay

- Write to or read from one or more files simultaneously during experimentation
- High performance file format allows for multiple data types (including raw, analyzed and markers) to be saved to the same file
- Multiple formats supported for both input and output (i.e. DDF, WorkBench, Discovery, Axon ABF, CED SON, Neuralynx, Plexon, EDF and ASCII)
- Data can be replayed from file just as it was acquired using slower, actual, or faster timing
- Drag & Drop or Copy & Paste complete files or selected data for replay and analysis

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[+]Dependent on the type of analog-to-digital converter card installed

[++]Dependent on the type of digital I/O cards installed

Experimental Control, Execution and Timing

- Multiple procedures can be executed simultaneously and independently of each other
- Dynamically change experiment parameters while the experiment is executing
- Conditional experiment execution based on experimental results and external equipment allows for automated experiments
- Conditional experiment execution works great for behavioral experiments
- Timers, counters and looping controls for automated experimentation

User Interface

- Design your own menus to use during real-time and/or file playback
- Design your own dialogs to use during real-time and/or file playback

Calibration

- Work with calibrated and non-calibrated data in the same experiment
- Both manual and automatic calibration techniques
- Calibration information saved to data files for easy replay of data in calibrated format
- Calibration settings can be stored in files and recalled for different types of experimentation

Timing Calibration

- Timing calibration provides synchronization for all timing mechanisms
- Timing calibration guarantees high resolution timing for experiments lasting hours, days, or weeks
- Automatic timing calibration methods simplify the calibration process
- Timing calibrations can be stored on a "per device" basis

Customizing Features

- DataWave SDK for easily accessing DataWave data files for custom processing
- Experimenter API for easily programming custom Experiment PlugIns

Experimental Design and User Interaction

- Complex experimental protocol can be easily created using a combination of events and objects
- Real Time logging of experiment protocols and execution
- Design status warn when settings are incomplete or incorrect even before execution
- Experiment definitions are easily defined with common defaults and intuitive settings
- Unlimited number of experimental definitions can be created, saved and recalled at any time
- Multithreaded and event driven execution for Windows 98, ME, 2000 and XP
- Experiment execution allows complete user interaction
- Complete and thorough online help system, tutorials and samples make Experimenter **easy to use**

VideoBench

Video tools for real-time video capture, tracking, editing and analysis

DataWave VideoBench™ is a suite of tools for real-time video capture, tracking as well as post experiment replay, editing and analysis.   It is fully integrated with DataWave's SciWorks and Experimenter data acquisition and analysis.   Its flexibility, ease-of-use, and plug & play compatibility eliminates the barriers often encountered with other software packages.   VideoBench is perfect for a wide variety of experimental applications.
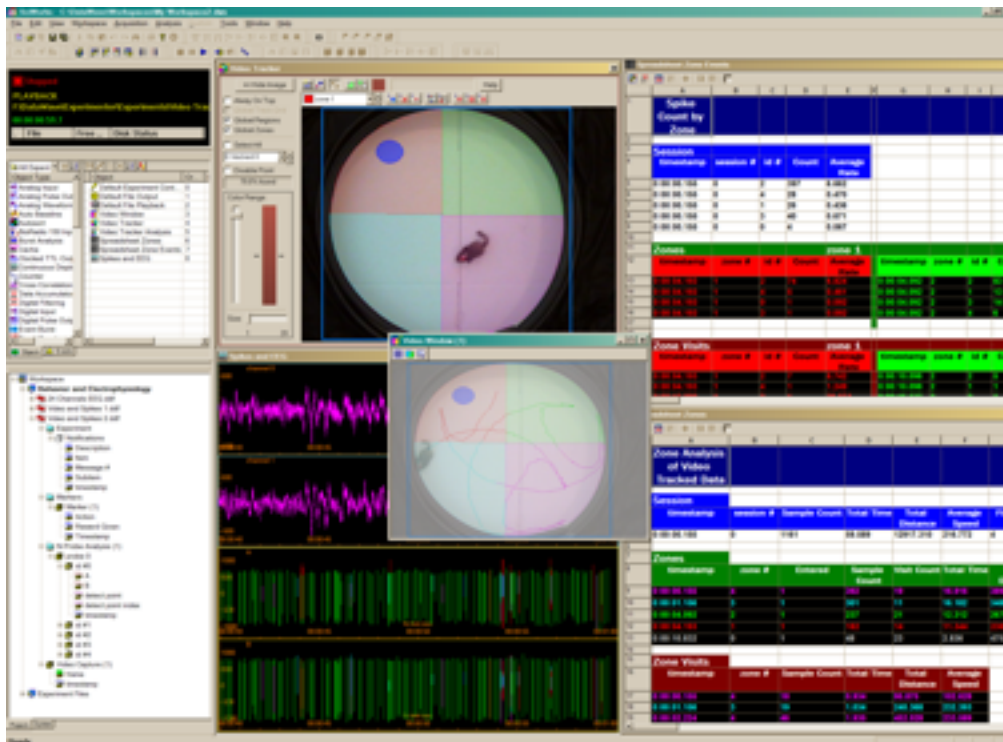
Capture

- Supports a wide variety of Plug & Play digital camcorder devices or video capture cards
- View and capture video to file simultaneously
- Unique frame-by-frame compression allows for hours of recording
- Video frames are time synchronized to other experimental data (i.e. electrophysiological signals)
- Video timing is calibrated to experiment time with microsecond resolution
- Capture continuously, in blocks of time, or as a snapshot
- Scale images to actual size

Display

- Display one or more video windows
- Overlay tracked points with video
- Dynamically size windows even during capture
- Display grid, tracking grids and tracked regions
- Various tracked point display features including connected points and vectors

Tracking

- Track one or more points simultaneously
- Track bright, dark or colored spots
- Track points to full frame or limit tracking to one or more regions within a frame
- Define multiple tracking zones of any shape
- Paired-point tracking for tracking orientation
- Save tracked points to file along with other experimental data
- Track points real-time or from an already existing video file
- Output tracked points in scaled, pixel or grid format
- Tracked point data is compatible with existing analysis applications

Analysis

- Calculate various tracking values (i.e. avg. speed, number of visits, time in zone, etc.)
- Calculate event values (i.e. number of firings or events per zone, avg. firing rate per zone, etc.)
- Values can be calculated on a per zone visit, across all visits to a zone and per trial or experiment
- Values can be written directly to a spreadsheet, both real-time and post experiment

Replay and Editing

- Replay captured video real-time, fast-as-possible or frame-by-frame
- Instantaneously access any point in time
- "Link & Sync" technology allows for time synchronization to other experimental data
- Insert and edit marker or scoring information in conjunction with video or tracked points
- Cut, copy and paste video data into an existing or new file
- Image printing capabilities
- Jog buttons allow scrolling a single frame at a time
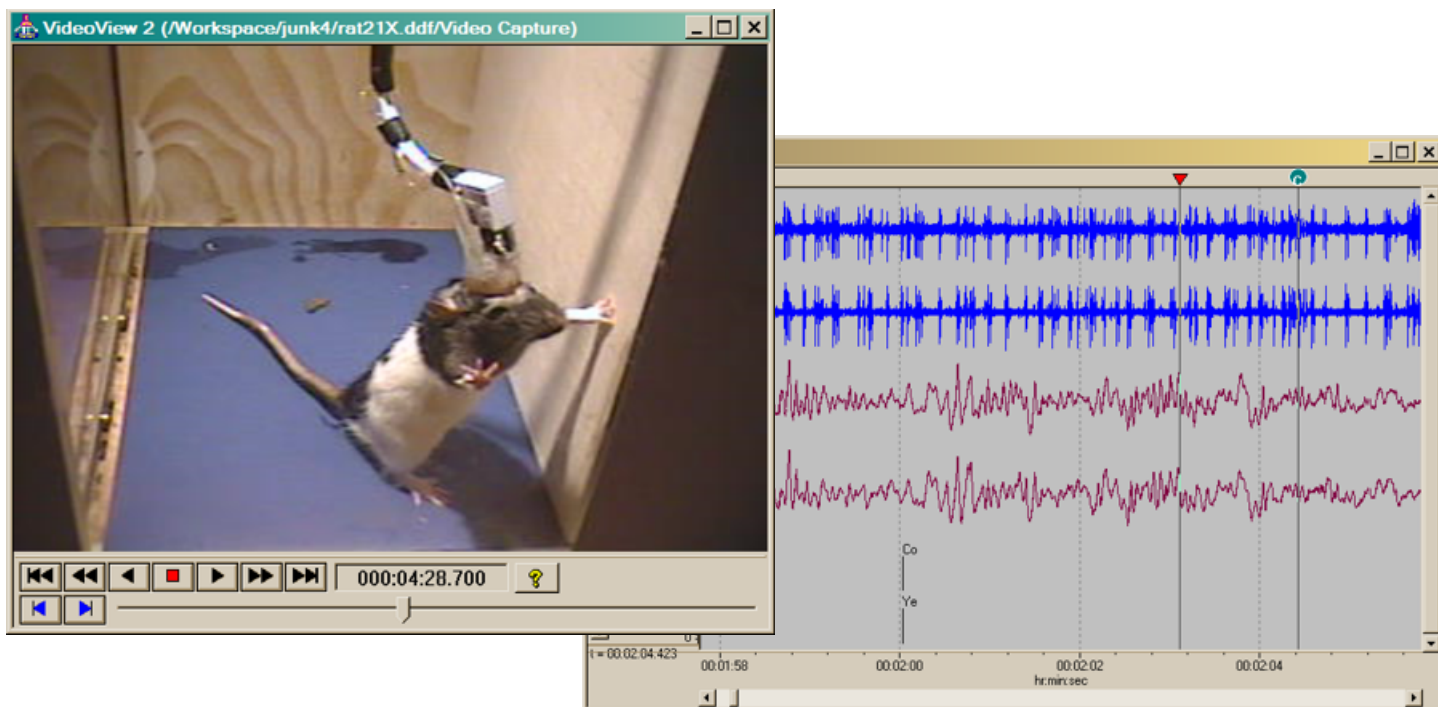
AutoSort

Multi-dimensional spike sorting for single unit, multi-unit or multi-channel spike data

DataWave Technologies has been the leader in spike sorting technology for over a decade and continues to lead with DataWave's Autosort. Autosort is a multi-dimensional spike sorting plugin that can analyze waveform data real-time while data is being acquired and post experiment from file playback. Up to 128 electrodes can be sorted simultaneously using a single Experimenter experiment object. And if that isn't enough, just add as many experiment objects as it takes to analyze the number of electrodes that you need to process and analyze.

Autosort builds on past sorting technologies to offer even more power and flexibility. Unlike other sorting programs, Autosort doesn't put unnecessary limits on your sorting capabilities. Autosort allows you to sort across multiple dimensions (from 2 to 256) using any combination of both elliptical and rectangular boundaries allowing you to sort even the most complicated waveforms. Additional power and flexibility is provided by the ability to sort waveforms of any length and from multi-site electrodes.

Don't allow other programs to put artificial limits on your sorting capabilities. Take advantage of Autosort's power and flexibility for all your spike sorting needs.
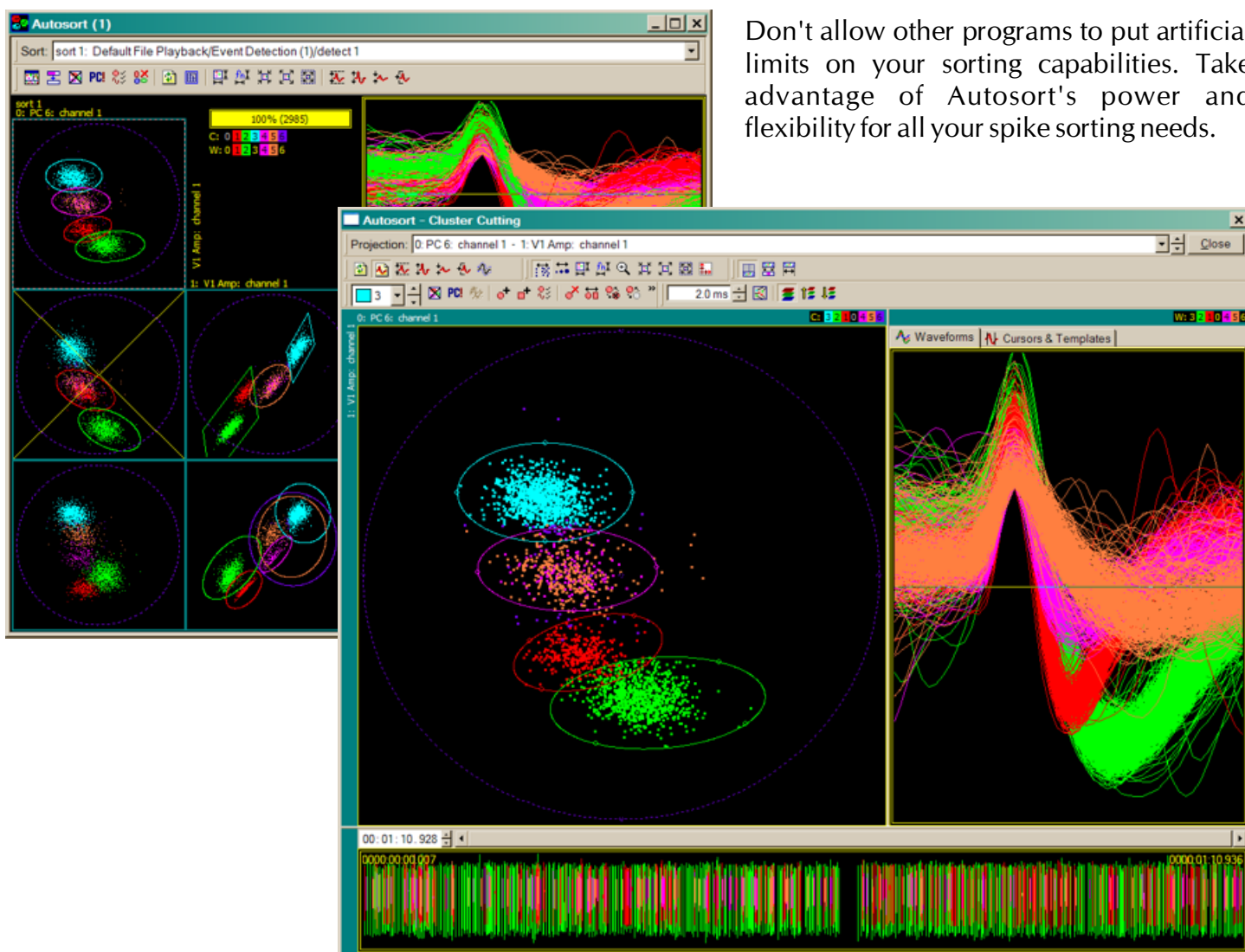
AutoSort Key Features

- Real-time sorting allows sorting (and interactive editing) while data is being acquired
- Sort from file playback
- Cross-unit or cross-channel analysis (including phase angle and difference measurements)
- Support for single electrodes, stereotrodes, tetrodes, multi-channel n-trodes and MAE probes
- Principal Component analysis (PCA 1-8)
- Waveform feature parameters as well as correlation coefficient and cursor values
- Minimum critical distance calculations to show when separate units are in the same cluster
- User defined number of projections/dimensions
- Cursor regions for improved parameter calculations
- Raster format of waveforms simultaneous with point plots
- Enable/disable any number of projections
- Operate on the whole file or a portion of the file and apply to all
- Both elliptical and rectangular boundaries
- Optimized for speed
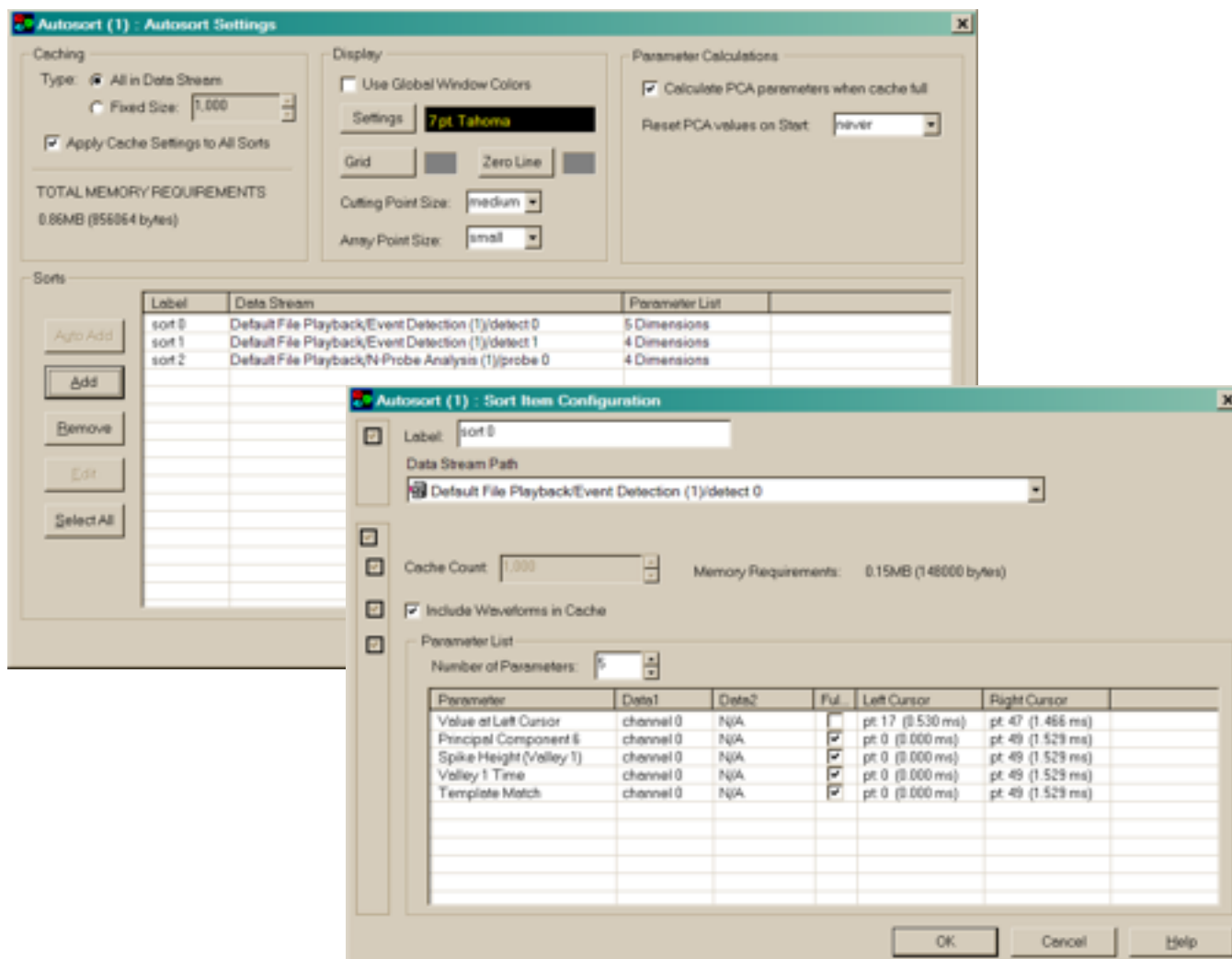
DataView

A set of tools for interactively replaying, editing and managing various types of acquired, analyzed and video data.

The DataView components (ChartView and RecordView) provide the ability to interact with previously acquired or imported data. In comparison to Experimenter which automates the processing of data, the DataView components provide access to manually interact with your data.

DataView Key Features

- Manually interact with previously recorded data in data files
- Display any type of data that has been acquired or derived from within SciWorks. This may include waveform data, single values, histogram, markers, digital I/O values and video.
- Display data by ID and optionally color coded
- Full control over graphical data format
- Instantly access any location in the data file independent of file size
- Mark one or more sections of data for copy-and-paste to other windows or for export
- Mark one or more sections of data to "send to" Experimenter for automated processing
- Take cursor measurements for y-value, time and time-between and optionally automatically add to a DataPad spreadsheet
- Time-synchronize the scrolling of data in multiple windows (including video) independent of data type and data range
- Manually insert or delete markers (i.e. scoring) within previously recorded files
- Print from one or more DataView windows
- Complete control over formatting ov data and windows
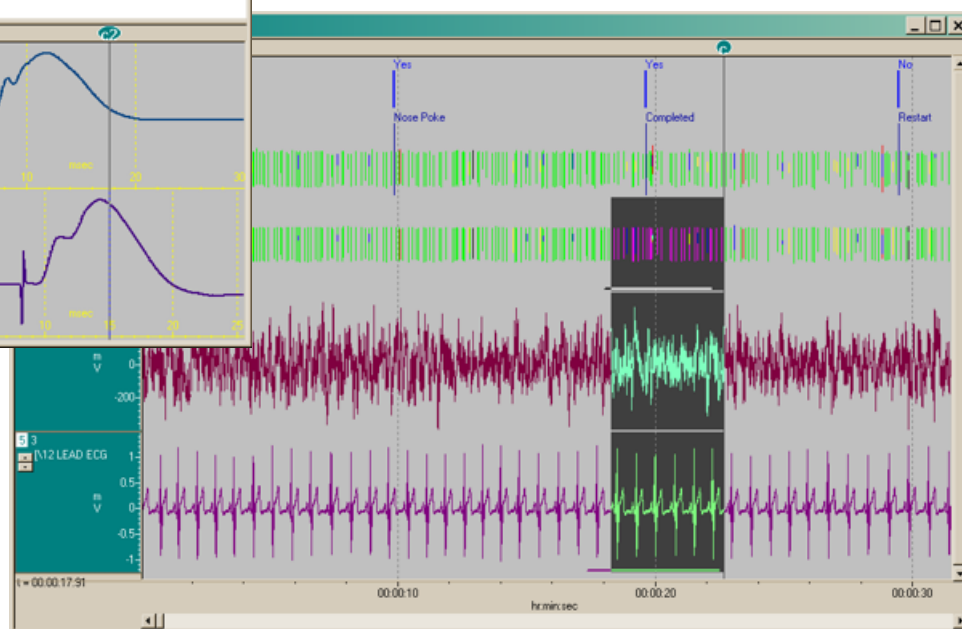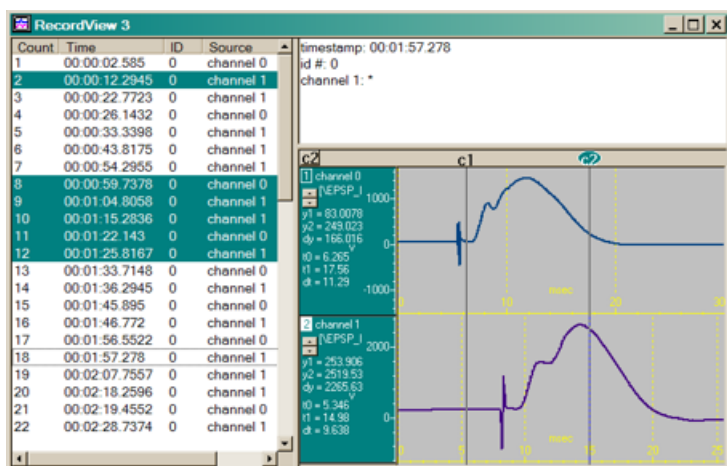
DataPad

Real-time and Post Experiment Spreadsheet . . . Without Limits

The Enhanced DataPad is a spreadsheet plugin that interacts directly with DataWave data. The spreadsheet functionality is typical with the ability to write functions, format data and cells and save and restore from file. Unique to Enhanced DataPad is the ability to put large quantities of data into the spreadsheet without limits to the number or rows typically encountered with other spreadsheets. It is an indespensible tool when working with waveform data as well as other large data sets typically encountered during data acquisition or post experiment.

DataPad Key Features

- Write spreadsheet equations with many of the supported functions
- Format cells (i.e font, colors etc.)
- Support for drag and drop of all DataWave data types including waveform data and text
- Save and restore multiple spreadsheets in a single DataWave file
- Support for large data sets typically limited by other spreadsheet programs

SciWorks Computer System Requirements

Computer System requirements vary depending on the number of channels acquired, how fast they are acquired, whether video is being captured and the types of analysis being performed. Additionally, performance and requirements can be affected by what other software and hardware applications are installed and running simultaneously with SciWorks or any of the SciWorks plugins.

Minimum System Requirements:
- Windows 98 SE, ME, 2000 or XP
- Pentium II, 500 MHz
- 128Mb memory (operating system dependent)
- CD-ROM
- 80 megabyte of free hard disk drive (for program and sample files)
- Additional free disk space for data files (experiment dependent)
- Video card with at least 1024x768
- USB or parallel port

Preferred System Requirements
- Windows XP Service Pack 2
- Pentium 4, 1.6GHz or better
- 512Mb memory (operating system dependent)
- CD-ROM
- 80 megabyte of free hard disk drive (for program and sample files)
- Additional free disk space for data files (experiment dependent)
- High resolution video card with 1280x1024 resolutions or dual monitors
- USB or parallel port

SciWorks Data Acquisition Front End Requirements (Experimenter Realtime)

The SciWorks Experimenter Realtime (data acquisition) plugin interfaces to various types of hardware as described below. Contact DataWave Technologies for additional information.

Wired Systems are connect to the DataWave Analog-to Digital Converter card or USB device and require only an amplified signal or digital source. The amplified signal can come from existing laboratory hardware or from supporting hardware offered by DataWave.

Wireless Headstage Systems are connected directly to the DataWave Analog-to Digital Converter card. The only requirement is the actual wireless headstage and receiver sold by DataWave and whatever electrodes or sensors are required by the experiment.

Wireless Ambulatory Devices (i.e BioRadio) are connected directly to the computer and have no additional requirements except a USB port and whatever electrodes or sensors are required by the experiment.

SciWorks Video Capture, Tracking and Replay Requirements (VideoBench)

The **VideoBench** plugin REQUIRES XP Service Pack 2. The VideoBench video capture also requires:

- a video card that supports video composite input and an analog camera

or

- a digital video camera that connects directly to the computer using a USB or Firewire port

DISCLAIMER
Specifications and requirements are subject to change. Contact DataWave Technologies to verify before purchase.

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