Overview of new Acoustic Emission (AT) Systems , PAC Developments

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A 32 Channel Acoustic Emission AT-System in the seventies e.g. a Dunegan 1032 was a size of a man high 19" steel cabinet rack . Together with a high sophisticated DEC computer the total unit was mostly seen in two cabinets . Besides this volume a 32 channel tape recorder was
used for parallel storage of the signalwaves, just as a tool to be able to replay the transientsignals if needed .Transport these Systems and Boxes for a Field-test (Reactors) a good deal of logistic management was needed .
Today a 32 Channel unit called SAMOS , based on 8-channel PCI-8 Boards, has a size of a standard Desktop PC. The new micro SAMOS System, eg. based on 3 PCI-8 PC-Boards has a size of two Laptops.
In opposite to the size, the performance of the AT-Systems increased drastically, for example the possibility storage of transientwaves or Hits/sec from ~ 100 to ~ 35.000 Hits/sec .
Parallel to the extracted Signalfeatures, a realtime display of waveforms with FFT and the storage of these datas are today the Standard .
As high quality PC's with there Standards, like the common PCI-Bus and Windows Software, are used worldwide, a state of the art System can be created with the users own PC .
Depending of the application an AT- System can be easily expanded up to 64 Channels in one chassis . This chassis can be sychronised for future expansion to built a Multichannel System or use each of them as a stand alone independed System .

New AT- Systems :

System PCI-2, based on 2 Channel - PCI-2 , PCI-PC Board ,
a complete 2 Channel AT- System on one PC board, expandable up to 8 Channels.
This are the newest development from Physical Acoustics .
This PCI-2 is today a breakthrough in technical performance but also in low-cost .
The technical highlights are the pioneering of a 18-bit, 40 MHz per Channel - A/D architecture, 3 kHz –3 MHz Bandwith , very low noise 4 dB_{AE} (ASL =Amplitude Signal Level) with no Preampinput.. Useable minimum Threshold of 22 –24dB_{AE} with a 40/60 dB Preampinput.and Sensor or a Sensor with a 40dB internal Preamp. (17 dB_{AE} without a Sensor) . Built in , real time Signalfeature extraction and DMA transfer on each channel for high speed transient data analysis at high hit rates directly transferd and stored on Hard Disk

Built in 2 channel waveform processing with independent DMA transfer on each Channel for high speed waveform transfer and processing .
Programmable frequency filter selection, 4 highpass 6 lowpass, for each channel one board .
The PCI-2 board provides a connector with drivers for Audio , frontpanel activity LED / Channel and /or analog Signal output .
AST a Automatic Sensor Test are built in and is a Standard with all other PAC AT-Systems .
2 Inputs for parallel external parametric measurements (force, pressure etc)., with high resolution (16 bit) , are on each PCI-2 board. With an 8 Channel PCI-2 AT-System up to 8 external parametrics can be measured simultanously.
Parametric 1, of each Board, is a signal conditioner with has a programmable Gain (x1, x10, x100 and 1000) for analog inputs of ±10 V down to ± 0,01 V.
Parametric offset control and filtering Options for direct Sensor (strain gage bridges) Input .
The external parametric datas can be measured with any Hit and/or time driven with a programmable time rate of 10ms up to 60 sec. As time driven data you also can measure features as ASL , RMS and absolute Energy (aJ) eg. from background noise (without the need to cross the fixed or floating selected Threshold) in case of continous acoustic emission eg. from leak, friction etc.

Last but not least - with the PCI-2 and the related AEWIN Software - you can do continous recording of Waveforms with data streaming direct to the hard disk at up to 10 Msamples/sec rate (on one Channel , 5 Msamples/sec on 2 Channels).

All this PAC developments and performances of the PCI-2 makes the System ideal for Labor use, research application but also for the use of Fieldtest eg. as done now, even in Germany, from Fieldtest-Companies for smaller Liquid Gas underground storage Vessels .
The PCI-2 are now also the heart of a rugged industrial AT- Systems, operateabel with a touch screen, used for crack and process control as example during straightening , injection molding, punchpressing , loadtest of ceramic components eg. coolingplates or ceramic car-catalysators .

System DiSP, based on 4 Channel - PCI-4, PCI-PC Board ,
a complete 4 Channel AT- System on one PC board, expandable up to 56 Channels /Chassis.

The PCI -4 performance are, the frequency bandwith 10 kHz – 2 MHz for the use all kind of applications Research and Fieldtest, minimum Threshold is 18 dB . ADC Type 16 bit at 10 Msamples , Dynamic range >82 dB . Parametric Inputs are 8 Channels on the master PCI-PCI-4 Board (1th Board) Channel 1-4 are differential , 5-8 are single inputs .
A parametric time gate for different triggerabel inhibit settings of the data acquisition can be done by the use of a parametric value . Also a cycle counter with 24 bit resolution with a programmable Trigger is a Standard

A four Channel Waveform Pluginmodul / Board are optional . This Waveformmodul has his one DSP on Board . The sample length is programable from 1-64 ksamples per Channel with a stepwise selectable samplerate from 10MSPS to 100kSPS.

System SAMOS, based on 8 Channel - PCI-8, PCI-PC Board ,
a complete 8 Channel AT- System on one PC board, expandable > 64 Channels /Chassis.

The PCI-8 – 8 Channel AT-System on a PCI-PC board with simultaneous digital signal processing (DSP) of waveforms and features (up to 17) are the new series of multi-Channel AT-Systems . A extrem compact new Systemdevelopment at low power consumption (10 Watt)
Key features of the PCI-8 boards used for SAMOS Multichannelsytems are :
8 complete (16-bit A/D 1 MSPS) digital Channels of Signalfeatures and waveforms on a single PCI- Board . A 8-Channel Waveformmodul / Board is Standard
Gain programmable of 0-, 6-, 12 dB is independent selectable for each Channel
4 High-pass , 4 low pass filter selections for each Channel are programmabel
2 parametrics (16 bit) on each PCI-8 Board for up to 8 Parametric Channels are provided
Frequency bandwith response is 1 kHz – 300 KHz .
Minimum threshold is 21dB. AST - Automatic Sensor Test is build in . LED activity driver on frontpannel indication and a Audio Monitor Interface are provided .
Due the compactness, very user practical industry standard SMB-Connectors for multi Sensor/ Preamp connections are used on the System backside.
SAMOS Multichannel Systems are mostly used for all kind of Fieldtestapplication but it can be also used for AT-UT applications .
A SAMOS – 48 Channel System is a portabel AT System size 534 mm long , 356 mm wide , 193 mm tall . Equipped with a integral keyboard and carrying handle. Inside this chassis is a powerfull industrial Computer with the todays PC performance .

Audio/Alarm PC-PCI Board :
A new development of a 2 Channel audio on full size PC-PCI Board .
Homodyne and Hetrodyne operation are available . Hedrodyne allows to select the frequency of the signal to be monitored . Homodyne (Envelope dedection) does not require frequency

tuning it allows monitoring of any Signal at any frequency . Any specific or all Channels can be selected .
There are no adjustments inside on the board or outside on the Front as all controls are under computer control . This allows you to use for the same application exactly the same audi settings for comparison as all the settings are stored together with the initation file.
A loudspeaker is on board . If more audible power is needed 2 external Loudspeakers (powerfull 100W-PC Loudspeakers) can be used. An Alarm can be programmed and provides a tone if a front end alarm is triggered .
An programmable squelch setting can be used to eliminate the background noise and a Volumen control allows the settings for both the audio Signals and the Alarm tone .

Arbitrary Wavegenerator ARB 1410 , PC-PCI Board
A new waveformgenerator , capable to providing a endless variety of simple or complex waveforms of all shapes and amplitudes up to ± 150V using Windows based WaveGen Software .
Highly precise 14 bit 100 Msample/sec. Standard outpout ± 10V Signal Output up to 20 MHz. Optional on board medium Voltage ± 35 V up to 2 MHz while high Voltage Option provides ± 150 V up to 700 kHz . These Voltages are available direct on the Board (no external high Voltage amplifiers are required) for connecting directly to the transmitting Sensor without the need for extra hardware. In addition a 4 Channel output multiplexer option allows the board to control up to 4 separate transmitting sensors .
Waveforms can be generated based on an external trigger , gate input or internal computer generated trigger with a programmable repetition rate .
Applications : The ARB 1410 can be used to synthesize waveforms for Acousto –Ultrasonic signal generation, guided wave inspection , as an AT-Calibrator Signal-Functiongenerator, Waveform simulator , replay of captured waveforms from your AT-System , or even as a high performance electronic signal generator or synthesizer .

Intrinsically Safe Sensors and Systems
A selection of 151 Sensors cover the frequency range from 4.5 kHz to 2.5 MHz in different sizes with and without integrated Preamp. An 40 kHz Airborne MIC are used as example for Leakmonitoring or Partial Discharge Dedection .
Special Sensors for high Temp. 600°C -nuclear resistance or low temp. – 270 °C , underwater typ or for permanent installation on civil structures are also available .
The Physical Acoustics range of AT- industrial system may be used in continous monitoring applications requiring intrinsic safety (IS) by using an IS certified front- end . The range includes 10 typs of Sensors in IS version of popular Sensors (IS Sensor selection from 7.5-500 kHz or a differential wideband Sensortyp.) . IS preamps and RF barriers .
Certifications includes Baseefa and Cenelec for Europe.. The certification standards range up to IICT6 for use in hazard environments at continous Temp. at 125 ° C .

Overview AEWin ™ Software
realtime 32 bit Windows operation (Win 98/ME/NT/2000/XP) simultaneously AE feature and waveform processing , display and fast data storage , replay and controll of your Physical Acoustics AT -System .
Full windows resources including any screen size , printing , networking, multi-tasking and Multi-processing of previous collected data .

The windows format allows natural interaction with the software making the operational development much quicker . The multible options provided by the Software allow quick and detailed analysis of data with integral post test filtering software available : Both graph and

Line data can be viewed simultaneously and panned through during aquisition . The simple software interface allows flexible data viewing and rapid alterations to any layout file . Any layout files can be saved for future use.
With AEWIN you can replay your existing (previous) PAC DTA data files .
It provides a **Simplified Setup Screen** . **Multible Screens and Graphs** can be used .
An **Simplified Hardware Setup Menus** in a tabular form shows a clear overview of the settings .
Parametric data (Temperatur , pressure etc) any 1-10V Signal can be recorded and graphed to the AT datas. **Simultaneous Display of AE Signalfeatures and Waveforms** can be displayed . **Many Graphs per screen** can be viewed in realtime or replay as 2D and 3D graphs,waveforms, FFT . **Simutaneous Signal Processing** shows transientwaves and FFT . Graphing capabilities are **flexible 2D and 3 D Graphs** which can be rotated, zoomed and panned by simple Mouse operation. **Event Linking** allows if you to select via a coursor any data point (hit or event) in a point plot.The data contence of this selected point are viewed (listed) and provides a direct link to the associated waveform . Multible hit which forms a Event shows the corresponding waveforms and there datas as well as the event record . With an **flexible coursor** you zoom and pan graphics . **Color** (scatter) **point plots** allow to display any measured Signalfeature or parameter (e.g. channel number) as a color value .
Clustering of point plot graphs is a standard feature in AEWin : This feature works on hits or event based
graphs. In an **pop up line dumping window-list** you can scroll through the hit-datas up and down .
As **Location capabilities** linear location are standard . Optiononal 2- and 3D & spherical Location are improved .**Advanced 2-D planar Source Location option** based on Non-linear Regression (NLR) 3-8 hits vs. 3 hits for arbitrary placement are used . A**utomated Location Setup features** provides an easy, intuitive, interface for setting up the sensorlayout. Structur Graphics can be imported to show the structure ,draw welds and noozels and placing sensors is simple done by mouse . **Attenuation profile plot** constructed in tabular form and grafic are used to show the max.Sensor distance and on the structure the Signalresponse . AEWin determines the amplitude on the source (source amplitude) and provides this as a graphable feature.
The **3-D location Option** (used as eg. for power transformer) uses 4-8 hits per event . Multible 3D graphs in combination with 2D views allow easy set up of top , front and side views .
Spherical Location Option uses 3-8 hits per event . A Sphere can interactive panned ,zoomed and rotatet . A Coursor are usefull for coordinates but also for the data view. 3-D Cartesian frame is also available.. **AEwin post Analysis Option** load DTA and TDA files views the data in scatter (point), cumulative plots and tables together, if collected, the waveformes. Select data and their signature / waveform correspondens , delete / filter data and export results to a new file and does time ordering of datas .
AEwin in summary upgrade your present DOS programs . Enhance your valuable existing assets . Ease data analysis and visualization tasks. Import and export data files to Windows programs : Expand your network capabilities including intranet and Internet data acquisition . AEWin can be used to replay your previously collected data files dating back to 1983