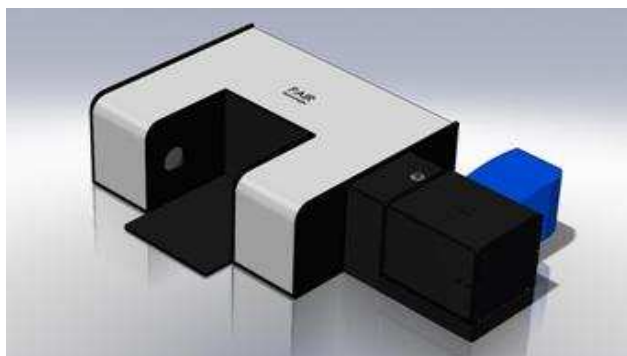


# The PAIR Journal

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## New Fast Frames™ Software



The unprecedented speed of the Pair System technology took a great leap forward with the improvements we've made to the Fast Frames software, included with the basic systems package.

Based on our own explorations, as well as input from Users, we've added the following capabilities:

1. We now have the ability to observe spectra in real time. This not only lets the user know when significant

changes are happening in the sample, it is also very useful when aligning sampling accessories or when adjust spectral resolution by using the entrance slits in the spectrometer.

2. A User can "replay" the experiment by step-

### Extended Wavelength Ranges

A planar array system has a fixed number of pixels. Therefore, a user can choose wide wavelength range coverage or "zero in" on a particular region with much higher spectral resolution.

ping through the spectra as a function of time. So, if you have an experiment where the start of an interesting reaction occurs some time (milliseconds?) after initiation, you can easily pinpoint exactly when that happened. If you want to look at only those spectra that show the changes or reactions, you will know exactly where they are.

3. Thousands of spectra can be saved in Fast Frames, so you don't need to pinpoint the ex-

*(Continued on page 4)*

Now, through improvements in the sample compartment optics, we are able to get much more light through the sample and therefore increase the spot size on

*(Continued on page 4)*

#### Special points of interest:

- New Fast Frames Software!!!
- Extended Wavelength Ranges
- New, Hotter Source for IR work.
- Extended Wavelength Ranges for PA-IR System

# Pair Heats Up with a NEW HOTTER Source!

One of the limiting items in S/N ratio measurements is the Signal. Noise, which comes from a variety of electronic components as well as Shot noise. (**Shot noise** is a type of electronic noise that occurs when the finite number of particles that carry energy (such as photons in an optical device) is small enough to give rise to detectable statistical fluctuations in a measurement. There is a really complicated explanation for all of this and we encourage those who are interested to look it up (it makes my head hurt!)

The bottom line is that engineers do many things to reduce electronic noise from power supplies, A/D converters, etc. but Shot noise comes from the source and it isn't very easy to get rid of it.

All of this doesn't really matter very much when relatively large signals are being measured because the contribution of noise to the overall measurement is extremely small.

However.....

When you're trying to measure a very SMALL signal (such as the difference between a highly absorbing reference and sample), Shot noise becomes (figuratively speaking) a BIG deal.

*Greater intensity IR sources change the S/N ratio by increasing the signal—something not available on FT-IR instruments.*

While the PA-IR technology can solve a lot of problems, this one comes from fundamental physics and, like gravity, cannot be ignored. But, those of you who have been following PAIRTech, know that we have an Ace up our sleeve!

The solution is simple; if we can't reduce the noise, increase the signal!

For those of you who are struggling with an FT-IR, this solution, unfortunately won't work. The reason is that an interferogram has a center burst which contains the entire signal. If the intensity of the centerburst exceeds that capacity of the detector element, the detector becomes saturated. So, providing more energy in the source of an FT-IR won't work..

However, in a planar array, there is no centerburst. The dispersive system spreads the light out over all the illuminated pixels. So, if we increase the total amount of light (signal), it is spread out over a number of pixels. (Of course there is a limit but it's really, really high!)

So, by using a hotter source, we can increase the signal while the noise remains the same. Thus the S/N ratio improves to the point where we can demonstrate detection limits as low as 200 MICROABSORBANCE!

## Detection Limits Extended!!!

Recently, we were asked to analyze some samples that had a very small amount of organic material in a water matrix. (Because of non-disclosure agreements, we can't tell you more than that.)

Conventional analysis by IR spectroscopy wasn't very helpful but, by using our new, hotter source, we were able to detect the analyte of interest.

Figure 1 shows the baseline with a co-add of 500 frames (about 8 seconds of collection time).

Figure 2 shows the absorbance of a really small amount of analyte—

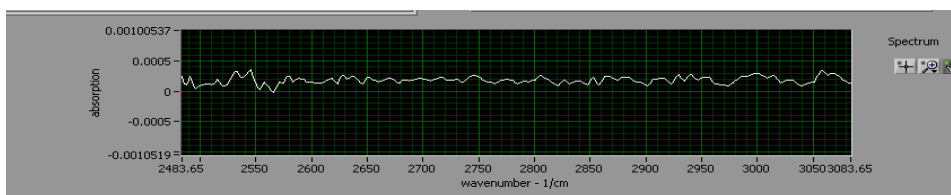


Figure 1. Baseline spectra, open beam, 500 scans

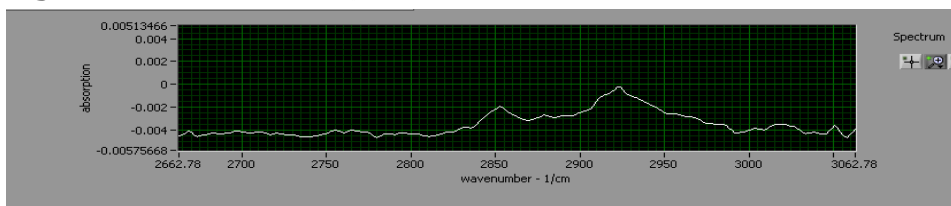


Figure 2. Absorbance spectra, 500 scans

we can't say how much is present, but "needle in a haystack" comes to mind.

# Diffuse Reflectance made easy!

Diffuse Reflectance (DRIFT) is used to measure powders, some solid samples, and those really wonderful KBr mixtures.

Have you ever tried measuring a trace amount of contaminant on a piece of shag carpeting?

Neither had we until we were challenged by a prospective customer to find out if we could see a very small amount of organic material deposited on surfaces such as wall-board, carpeting, and furniture.

We thought the carpeting would be the hardest challenge, so we tackled that first.

The problem with shag carpeting (and other rough surfaces) is that the incident beam is absorbed, scattered, and reflected so that very little of it reaches the detector. It is, in essence, a sample in a highly absorbing matrix.

To see what we could do, we collected a scan from a piece of shag carpeting using a set of mirrors to direct the light from the source onto the sample and then collected the scattered light and send it to the planar array detector.

First, we collected a background spectrum using the shag carpet as a reference. We did this because we wanted to see any differences after the organic materials were added.

Figure 1 shows the background, normalized for the shag carpet.

Note that the measurement noise is less than  $\sim 0.0003$  A for 500 scans.

Figure 2 shows 500 scans with the organic material added to the shag carpet. The C-H stretch region is clearly evident.

Figure 3 shows the results of the same experiment but using a micro-

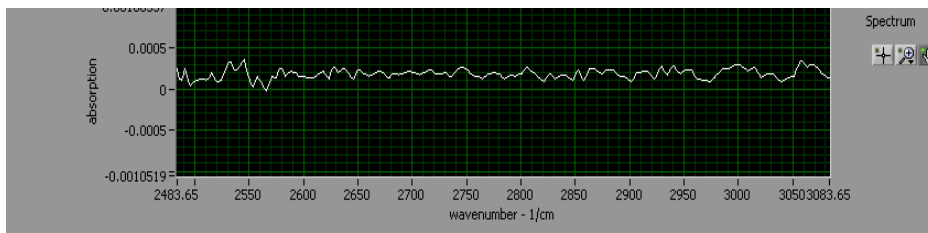


Figure 1. Normalized Shag Carpet sample

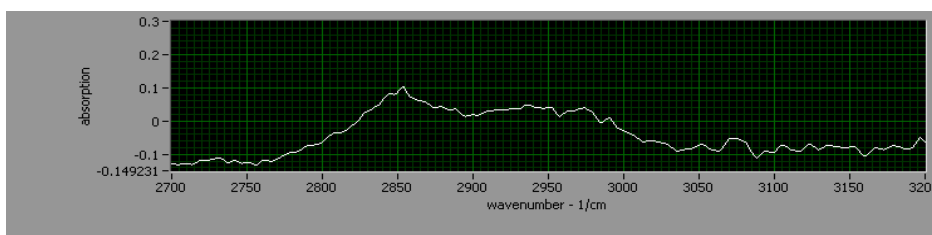


Figure 2. Shag Carpet with organic material

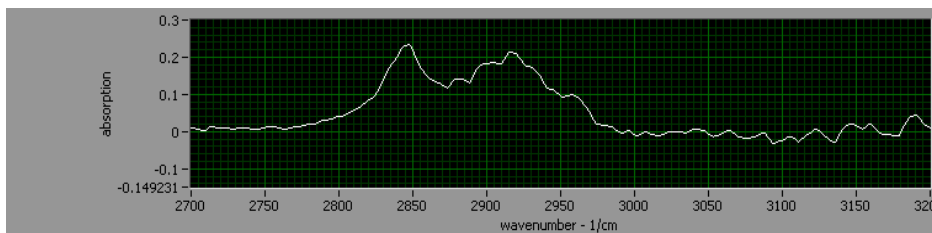


Figure 3. Micro Fiber Cloth with organic material

fiber cloth as a background. Again, the presence of organic material is obvious.

These samples were prepared by drawing a paraffin wax block across the surface in question. The amount of organic material added to the surface was less than 0.001g—and most of that was not included in the light beam!

These experiments not only show that the Pair 100 Series can detect the presence of organic materials at very low concentrations, they also show that the Pair 100 Series can reliably measure very small differences be-

tween sample and reference beams. These results have some interesting implications for measurements of water based samples, thin film differences by transmission, and detection of trace amounts of materials in office environments.

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[www.pairtech.com](http://www.pairtech.com)

## PAIR TECHNOLOGIES, LLC

1 Innovation Way  
Suite 304  
Newark, DE 19711

Phone: 302-377-3227

E-mail: jimmalone@pairtech.com

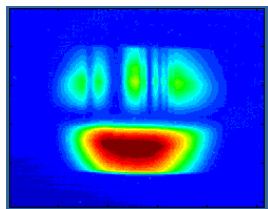
*Where Photons and Samples Meet and Exchange Information.*

Pair Technologies is a limited liability company (LLC) founded in July 2005 to research and design, manufacture, and market a mid-infrared analytical instruments that employs planar array detector technology.

The technique was developed and patented at the University of Delaware, which remains involved to this day.

Visit us at:

[www.pairtech.com](http://www.pairtech.com)



## WANT TO SEE HOW PLANAR ARRAY CAN SOLVE YOUR ANALYTICAL PROBLEMS?

Investing in analytical instruments is difficult in the current economic climate. To justify new technology, it is necessary to build an "air-tight" case for management.

You not only need to show that you can gain new information, you must also show a real, measurable benefit to your organization.

To help you, Pair Technologies, LLC has developed a program to make

your life easier.

First, we will gladly arrange to run samples or undertake investigations to show the data obtained with PA-IR and your samples. We can either host you at our facilities, or come to yours to collect the data. All data collected is treated as YOUR CONFIDENTIAL DATA—and you will retain all raw and processed files.

We have experienced staff who have

## New Fast Frames Software (*cont'd*)

act moment of interest before collecting data – you can go back and find it later!

While not strictly a function of Fast Frames, **Block Averaging** allows you to observe even smaller changes in absorbance. It has been well documented that, due to coherent noise sources, a group of 3 sets of 500 spectra will have a better S/N ratio than a single group of 1500 spectra. So, by using Block Averaging, changes in absorbance as small as 200 MICROABSORBANCE units can be observed.

If you're still struggling with step scan FT-IR, or not even bothering to try because of past frustrations, take a closer look at the Pair 100 System. It just might give you a whole new outlook on your processes.

The best news is that this new software is NOT available as an option – IT'S INCLUDED with every Pair 100 system!

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the detector. (This same technique will not work with an FT-IR because the detector is a single element.)

Now we can reach a wavelength range of  $\sim 1200 \text{ cm}^{-1}$  at spectral resolutions of  $4 \text{ cm}^{-1}$ . Of course, this all depends on the detector and the number of pixels available. The example given used an InSb detector with an "X" axis of about 320 pixels.

successfully written economic justifications for Management. We will work with you, under non-disclosure agreements if needed, to develop your presentation.

Our services are available at no charge, regardless of outcome.

Money is tight, but with the right arguments, you can join the forefront of infrared spectroscopy.