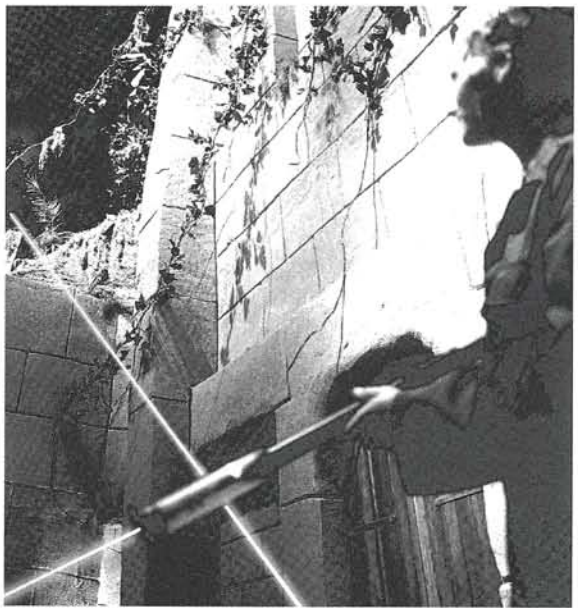
PSD sensing for Adventure Shooting

Brunelco Electronic Engineering develops all kinds of electronic equipment for third parties. Last year, we were asked to develop a recreational team shooting game. It wasn't easy. In the game participants are supplied with a gun which shoots an infrared beam. Moving animal and character targets are projected onto screens around an arena and players try to shoot them. Our objective was to find out which player hit the target, and at which point, so we needed to detect the beam's horizontal and vertical position on the screen, without picking up any signal from the projections. Looking at several solutions we concluded that few detection systems were up to the job.

Because we also needed to know who pulled the trigger we had to use an ID code for each player. Since several players can shoot at the same time, we had to add



a mechanism, which doesn't corrupt the information in case shooting pulses collapse. To overcome this problem, we placed infrared transmitters in front of the screen to enable each player simultaneously. This has to be done quick enough that players won't notice they are actually playing one after the other. This is why other sensing devices where not an option. CCD sensors were not fast enough to scan the whole screen in this short time, and still be sensitive enough to detect the low milliwatt infrared spot from the gun (the budget was limited of course, as well as the battery power source in the guns).

Finally we decided to use a two dimensional PSD from SiTek for the detection. Because of its analogue nature, it could be made fast enough to detect the 100 microsec. infrared pulses and at the same time measure the position of this spot.

Because the infrared ID transmission, for releasing each gun, is synchronous with the Sitek PSD detection, we can see which ID is active the moment we receive a "hit". Finally we have to receive the incoming pulses and find out at which x-y position they hit the screen. Because there is a big difference in light intensity between players we needed a high dynamic detection and processing range. Therefore we decided to calculate the light current ratio with an analogue processor. We implemented this part in a Zetex programmable

analogue device (TRAC). The calculated result is captured with a sample and hold amplifier, where offset and gain can be adjusted, before AD conversion takes place. Finally we have a simple AD converter, connected to an 8 bit microcontroller. This controller sends the gun ID, and both x and y coordinates through a serial link to a Windows NT computer. At the computer, we made an OCX, which takes care of communication with the Sitek PSD sensing device. It also converts the analogue measured values to screen coordinates (through a calibration table) and then generates an event for the multimedia part, which is playing the animation. The multimedia part was developed by another company, called Archivision. Finally it matches

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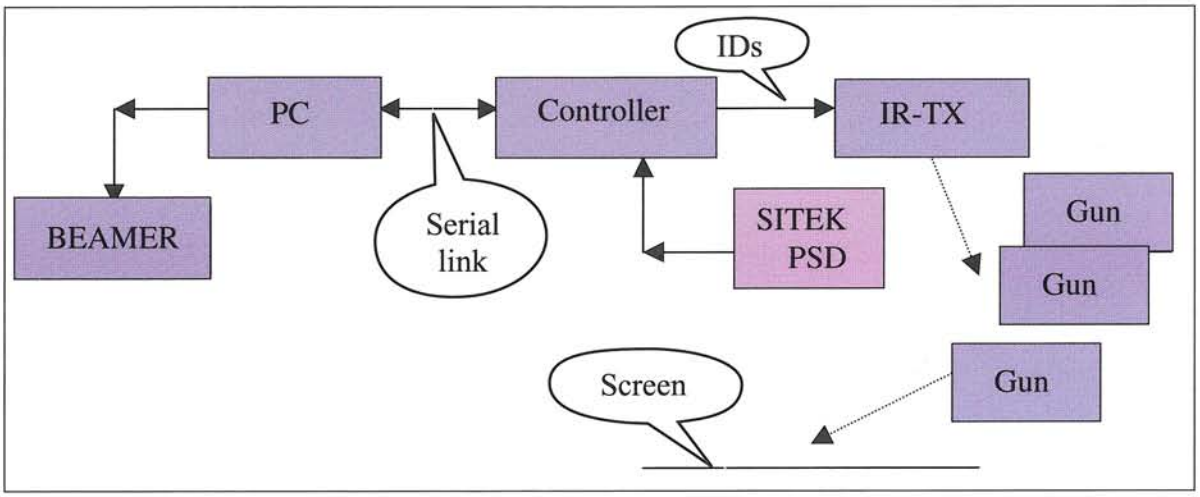
the incoming coordinates with the actual "hot area" from their creatures and has the thing exploded or not, complete with corresponding sound effects.

The whole system is integrated in a large indoor entertainment centre, where 24 of these systems are placed. They are all connected via a network, with dynamic tracing of the groups (with RF tags), so we can send new player ID s as soon as a group gets near to the adventure shooting area. Before entering the arena, each group is entered into a database where gun-ids, RF tags and other equipment (wireless information system), are coupled to the players. This part was developed by Media Bytes, and takes care of information distribution to all different systems in the arena.
A stand alone version has been developed for use in Cafés, which is simple to install and provides a lot of fun in a minimum space!



SiTek is growing again

My Name is Aida Abazagic. I'm 33 years old and come from Bosnia. I moved to Sweden in the spring of 1992 with my family. I had been studying technical subjects for 4 years in Bosnia and continued studying Cad Construction, Multimedia and 3D Design with Modulating and Simulation here in Sweden.
Today I am working at SiTek Electro Optics as a Production Engineer, constructing Position Sensing Detectors. I spend most of my free time with my husband and two children who are 8 and 10 years old. I also spend a great deal of time with friends and enjoy travelling and seeing other parts of the world. I enjoy working at SiTek very much and get on well with my collegues.
I enjoy the work here which is both challenging and interesting.

My name is Anders Lundgren and I'm another of the recent members of the SiTek team, even though it's almost a year since I joined the team.
I am responsible for the silicon chip and its properties. This means everything from development and improvement of the chip manufacturing process, testing of the device as well as development of new components and improvements of the electro optical properties of our current devices.
After I finished my Master in Engineering Physics I have worked seven years in the semiconductor IC industry with both process and device development. At the age of 34 it's now with great pleasure I've joined SiTek and I see a great challenge in developing the next generation of PSDs which will ensure that SiTek will remain the world leader in PSD technology also in the future.
If you meet me in my spare time you will most probably find me driving around on my scooter, listening to strange, unknown pop music or playing floorball. Or maybe we'll bump into each other a café over a cup of coffee.

Custom designed processing for improved PSD performance, part I

The PSDs within SiTek's standard product range are well known for their excellent performance with high linearity, great resolution and high speed. However, like all standard devices, these PSDs have been developed to fit a wide range of applications, something that necessarily leads to compromises when it comes to parameter optimisation. By optimising the manufacturing process for a specific application, the PSD performance can be enhanced further, giving a higher value product for the customer.

Resolution

One of the great advantages of a PSD, compared to other position sensing devices, e.g. CCD and quad detectors, is the superior resolution. The resolution in a PSD is, like in other analogue devices, determined by the signal-to-noise ratio. Hence, to get as high resolution as possible the signal should be maximised while the noise should be at a minimum level.

Responsivity

Since the signal, i.e. the photo current, is set by the responsivity one would like to have as high responsivity as possible for the wavelength used. At SiTek we have developed three different processes optimised for different wavelength regions, UV (200 nm – 500 nm), Standard (500 nm – 900 nm) and YAG (900 nm – 1100 nm). By choosing the process that fits the application best the first step towards world class resolution is taken.

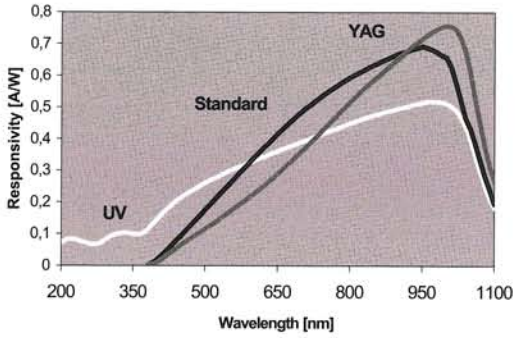


Figure 1. *Spectral responsivity for detectors manufactured in different SiTek processes.*

Next step is to tune the process for the specific wavelength used in the application. This is done by optimising the different layers building up the anti-reflection (AR) coating. By minimising the reflectivity the resopnsivity can be increased by almost 100 % for some wavelengths.

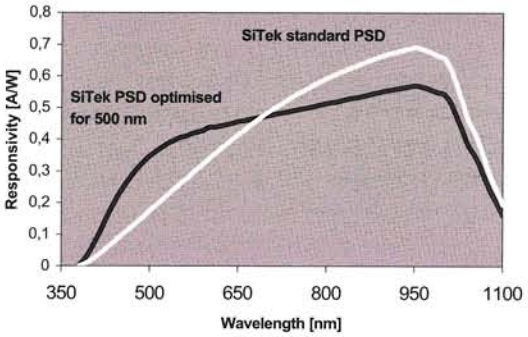


Figure 2. *Spectral responsivity for SiTek detectors manufactured with different AR coating.*

Noise

The noise in the PSD mainly consists of two parts, the so-called Johnson noise, generated by the inter electrode resistance, and the so-called shot noise, generated by the photocurrent in the PN-junction. For medium and high photocurrents the shot noise dominates, giving limited possibilities for optimisation but for low currents the contribution from the Johnson noise has a great influence on the total noise current. Hence, in applications with limited access of light, an optimisation of the inter electrode resistance will reduce the noise significantly and in that way improve the resolution.

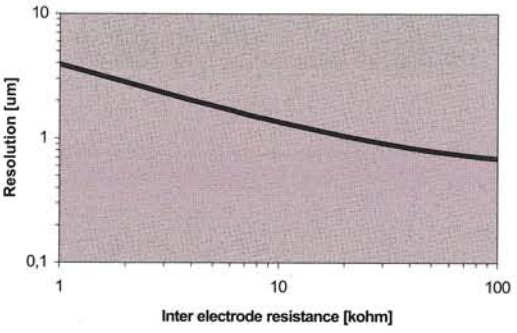


Figure 3. *Resolution on a 10 mm SiTek PSD with a photo current of 1 uA and a bandwidth of 10 kHz.*

These were a only few examples of the parameters which can be optimised to get an improved PSD performance. In the next edition of Non-contact we will give you some more examples, e.g. speed and reflectivity.

As times goes by...

It's a well-known phenomenon that times seem to rush by when you are having a good time. This was certainly the case on the SiTek 25 year's anniversary. As it felt like the 20 years one took place a month ago, we can only assume that the past five years must have been good. And that is certainly true when it comes to products, markets, premises, staff, turnover and profit.
To celebrate all this, a big party was held in a large tent just outside of the SiTek factory. Here many of those responsible for the SiTek success story - staff, management and all the reps that could come - were treated with excellent food, drinks and a variety of entertainment. For example, to help synchronize the chewing of the tender meat served, the "Göta Lejon" marching band suddenly made an appearance completely filling whatever space was left over in the huge tent with music and musicians. Later on the musical tradition was upheld by the SiTek staff who, in a more or less musical form, presented the "SiTek Evolution Story" spanning over 25 exciting years from the trembling start at Chalmers University of Technology to the world-leading position of today.
Many happy faces could be seen in the crowd as the dancing started to the enchanting music from the all-female dance-band.
The good times rolled on all night and as far as we know, have not stopped yet!

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