Inserting Radar Video into an Existing Graphics Application

Summary

The use of modern CPU and GPU architectures has enabled the development of software-based radar scan conversion solutions that provide enhanced flexibility and reduced life-time costs.
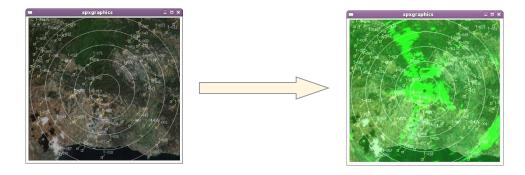
However, these benefits can only be realised if the software solution can be effectively integrated with the graphics application.

Often this graphics application already exists and the goal is to add the software-rendered radar video with minimal impact of the existing software architecture.

This application notes describes how Cambridge Pixel's "Radar Insertion" software modules supports this integration.

Software-based radar scan conversion provides flexibility, enhanced features and lower life-time costs over legacy hardware solutions. However, effective integration of the software rendering with the graphics components of the display is key to this success. In many situations, the graphics application may already exist and it may be desired to replace a legacy hardware scan converter with a more modern software equivalent. Cambridge Pixel's Radar Insertion software modules are designed to allow the graphics application and the radar scan converter to be created independently yet appear on the display as a single fused image.

Consider the screen shot shown below left. In this situation, an existing application presents map graphics and processed track data in a window. It was required to add a display of primary radar video into the window. Cambridge Pixel's *Radar Insertion* software provided a simple solution to this problem. The solution can be demonstrated in two stages:

In the first stage, scan converted radar video is inserted into the application. The significant point of this first stage is that the graphics application is completely unchanged – no code changes, no re-linking. It's exactly the same graphics application that now has radar video presented inside it. The radar video processing is done in a separate software process, which captures the video data, process it, scan converts it
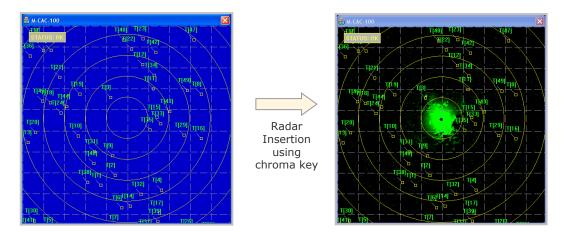
and then combines it with graphics data at the designated location. The scan converted image is updating in real-time as the radar is processed and scan converted. This all happens without the graphics application even being aware of it!

The second stage of the integration is to establish a control interface between the graphics application and the radar display program. This is necessary to allow the graphics application to change the radar presentation, for example the view, colour, fade presentation etc. The control interface can be through one of a number of methods, but the simplest is usually a socket-based interface. The graphics application can simply open a socket and send commands to the radar display program. This is typically achieved with a small number of commands, so the control interface is simple and low risk. The graphics application can be modified very easily to add this interface, noting that there are no changes to way the application handles its graphics presentation.

Radar Insertion under Windows

If you have an existing Windows graphics application, *Radar Insertion* works in one of two ways:
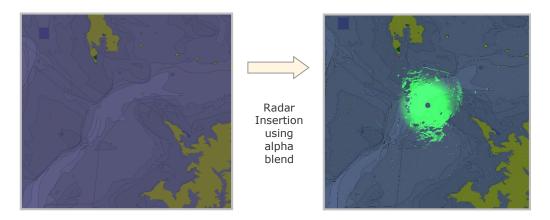
Chroma key Insertion. The application is assumed to have graphics that are to be displayed *above* the radar video as overlays. The *Radar Insertion* technique uses the background colour of the window to control the insertion of the radar video. Graphics that are drawn with a different colour appear above the radar video as a true overlay. If desired, the radar video can be transparent to allow an additional underlay layer to be displayed behind the radar.

The window above left shows the application graphics. The blue background of the window has a known RGB colour (the chroma key colour) and this is reported to the Radar Insertion software. After running *Radar Insertion*, the real-time radar video is inserted in the graphics window only where the pixel is the chroma key colour. For all other pixels (the target symbols, range rings and message) the existing colour of the graphics is preserved. The window on the right is the result of the insertion. This shows real-time scan converted video displayed with graphics data from the application. Note that at this stage no application code has been changed to implement the radar insertion.

Alpha Insertion. In this mode, the radar video is combined with the application graphics using semi-transparent blending. After the addition of the radar in this way, the existing graphics will have their colour changed according to the brightness of the radar at that location. The effect on the screen is similar to an addition of the radar and the graphics.

Radar Insertion using alpha blend

The window on the left shows the application graphics. After insertion, the radar video is combined with the graphics so that the output is a blended version of the two images. The brightness and emphasis of the radar video can be controlled in the blending process. As before, no code in the graphics application has been changed to implement the radar insertion.

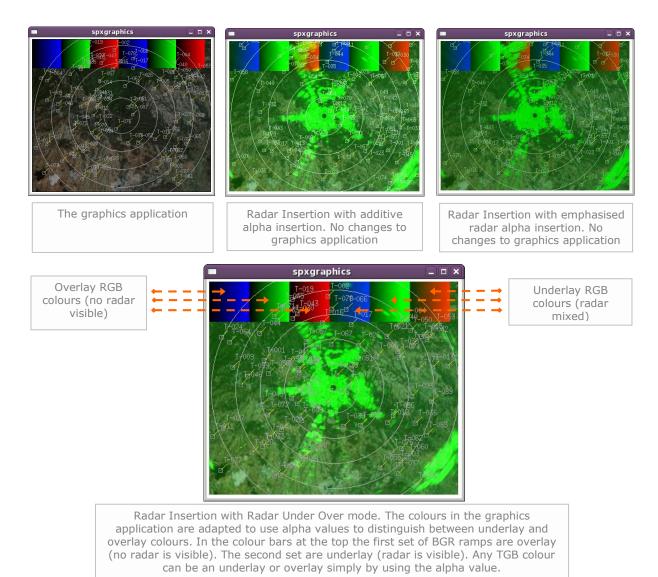## Radar Insertion under Linux with X Windows

If you have an existing X Windows application, *Radar Insertion* offers the following options

Alpha Insertion - The radar video can be combined into the existing colours of the application. The colour of each pixel on the display is derived as the combination of the existing graphics and the new radar video. This combination can be a sum of the graphics and the radar, or the radar can attenuate the graphics as part of the combination, effectively emphasizing the radar display. In addition mode, if peak intensity green radar were written over a blue area of the graphics, the result would be cyan (blue + green). In contrast, in the emphasised radar mode, for the same green+blue combination example, the bright green of the radar causes the blue of the graphic to be attenuated so the result is the green of the radar. In this mode the radar is given priority to the point where peak radar masks the colour of the graphic.

Radar Under Over - In this mode radar can appear as an underlay to some graphics components and be semi-transparently mixed with others. Some graphics of the application can be designated as underlay graphics, with the effect of mixing with the radar. Other graphics can be designated as overlays and appear on top of the radar video, such that there colour is unaffected by the radar. Unlike the other mode, this approach requires some co-operation from the graphics application. It must indicate which graphics are underlay and overlay, so that the *Radar Insertion* processing knows how to interpret them. This indication happens using the alpha value of the graphics

colour. If the graphics are drawn with 32-bit ARGB colours, then the alpha component indicates that the RGB value is to be treated as an overlay or underlay. This mode provides the greatest degree of flexibility in configuring colours of the application as either underlays or overlays, but some changes may be needed to explicitly set the colour values in the application software.
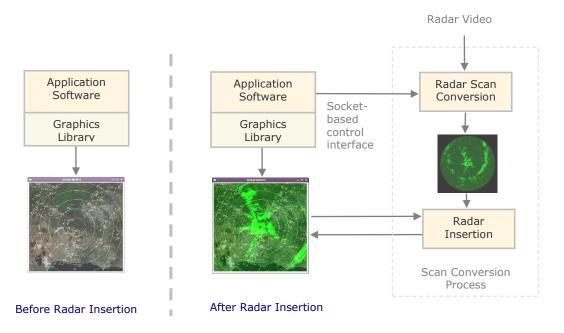

The graphics application	Radar Insertion with additive alpha insertion. No changes to graphics application	Radar Insertion with emphasised radar alpha insertion. No changes to graphics application

Overlay RGB colours (no radar visible)

Underlay RGB colours (radar mixed)

Radar Insertion with Radar Under Over mode. The colours in the graphics application are adapted to use alpha values to distinguish between underlay and overlay colours. In the colour bars at the top the first set of BGR ramps are overlay (no radar is visible). The second set are underlay (radar is visible). Any TGB colour can be an underlay or overlay simply by using the alpha value.

Radar Insertion Software Architecture

Radar Insertion is a method of incorporating radar video into an existing graphics application with minimal impact on the existing application.

The goal is to have zero impact on the display graphics and require only a simple socket-based interface between the graphics application and the radar scan converter.

This interface is then used to send control commands to ensure that the displayed radar picture matches the scale and position of the graphics application.

Before Radar Insertion   After Radar Insertion

Expanded Radar Insertion Options

Although much can be achieved in the insertion of radar video into an existing graphics application, additional capabilities are available if the graphics application can be developed or modified to support multiple layers directly.

By separating maps and overlays into distinct bitmap layers, the expanded radar insertion can ensure that radar is blended with the underlay then superimposed by the underlay.

The SPx library supports a number of different approaches for combining layers of graphics and radar video, providing flexible, scalable and high-performance software solutions.

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