SPx ECDIS

Radar Tracking and Display Solution for ECDIS

clr 3.0

CAMBRIDGE PIXEL

SENSOR PROCESSING & DISPLAY SOLUTIONS

SPx ECDIS

SPx ECDIS brings cost-effective, high quality radar display and tracking to the ECDIS market. SPx ECDIS builds upon Cambridge Pixel's extensive experience in providing high performance, high quality radar processing and display products to the military, security, Air Traffic Control and Vessel Traffic System markets.

The SPx ECDIS Software Development Kit is a complete development package, aimed at system integrators, to build ECDIS solutions for Windows quickly and affordably.

The kit comprises three main components:

- **Radar Interface Hardware:** provides the physical interface to the radar

- **Coprocess Application:** accepts the radar data from the interface hardware and performs processing, scan conversion, ENC chart display, graphics mixing and tracking

- **Client Library:** provides the control interface to the Coprocess Application
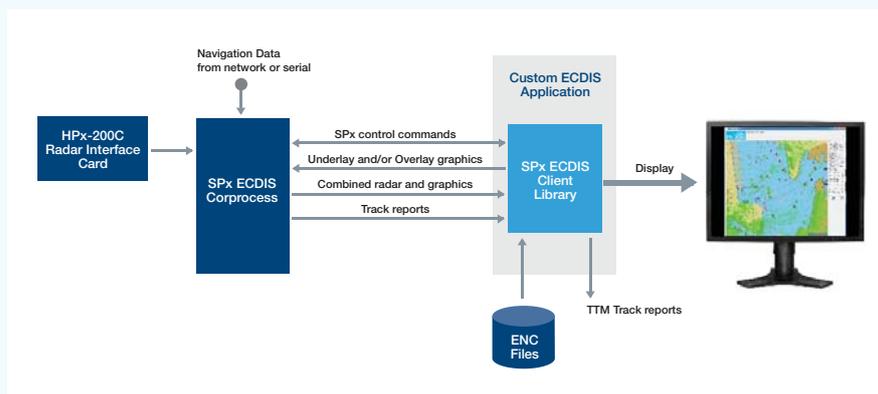
Deployed systems contain an identical radar interface card and Coprocess application, along with the custom developed application.

Ease of integration

The SPx ECDIS product has been specifically designed for ease of integration. By encapsulating processing, scan-conversion, tracking and mixing functions within the Coprocess application and presenting the application programmer with a simple API, complex display applications may be greatly simplified. The developer is free to concentrate on the graphics and user interface, considerably reducing the time and cost of developing an ECDIS application.

The client library is supplied with comprehensive sample applications (including source code), to demonstrate its use in a realistic context.

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ECDIS Coprocess

The ECDIS Coprocess application is designed to run as a separate software process, efficiently processing the radar and navigation data, while presenting the client application with a simple unified control interface. Once configured for a particular installation, the ECDIS Coprocess can run autonomously, taking its configuration from a saved file. The end-user typically does not need to perform any special configuration, beyond that exposed by the client application.

Scan Conversion

The ECDIS Coprocessor uses Cambridge Pixel's high-performance Radar Scan Converter software. The scan converter provides a high-fidelity, precise radar image that preserves all of the details in the original video.

The colour and fading of the radar video may be configured and the video can be displayed with or without history fade trails, which are retained as the view changes. Up to 255 scans of history data can be displayed and new data can be displayed in a different colour to history data for clear distinction.
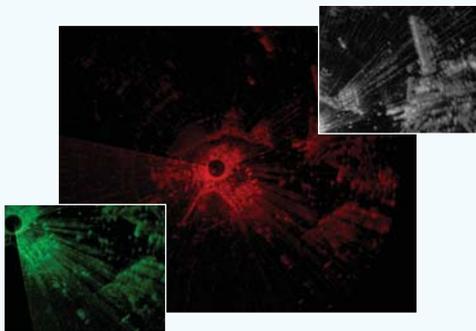
The software is designed to work with third-party graphics applications and provides a flexible set of interfacing options for the addition of radar into a multi-layer display with charts, overlays and track symbology. The ECDIS client library provides full control of the scan converter, via the Coprocess.

Layering

SPx ECDIS provides the ability to insert radar between underlay (for example electronic navigation charts) and overlay graphics (for example range rings and target tracks). The complexities of this task are contained entirely within the Coprocess. The application simply needs to provide underlay and/or overlay graphics and then select an appropriate mixing method
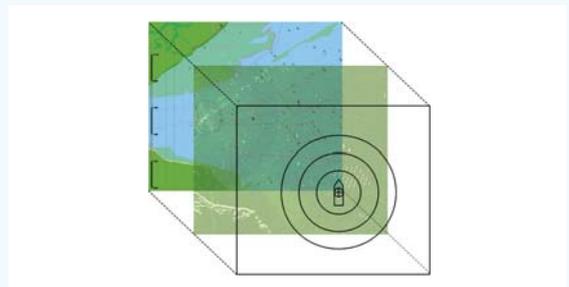
The Coprocess may mix the radar layer with graphics using standard Windows compositing techniques or, alternatively, it can provide a bitmap output of the scan-converted radar to the display application.

Other ECDIS radar systems only support underlays to the radar and do not mix the radar video with the graphics. This results in displays where the underlay graphics may be completely obscured by the radar display. In contrast, using the SPx ECDIS Coprocess the underlay may be alpha-blended and then overlays drawn opaquely on top to give a true multi-layer display.

Tracking

Based on Cambridge Pixel's established tracker technology, the SPx ECDIS software includes a full-featured automatic target tracker (ATT). Capable of tracking up to 100 targets in the standard version and 250 in the enhanced version, tracks may be initiated automatically or manually (through an API). The area of acquisition may be programmed or may be defined automatically using a built-in map database to automatically limit video processing to sea areas. Track messages may optionally be output on the network as standard NMEA "TTM" sentences.

Radar video is received from the HPx-200C card and then processed using a CFAR adaptive thresholder to identify video of interest. The desired sensitivity and size of targets may be configured. Candidate targets are considered for a number of scans (as low as 2) before creating a track, allowing track acquisition time to be balanced against false alarm rate. Once a track is created, updates are made automatically, on each subsequent detection. Statistical association algorithms are used to allow new data to be associated with the best track.

The tracker can output track reports into the application software for display by the ECDIS application, or else the tracker can automatically create a display of tracks which is then displayed as an overlay to the ECDIS chart.
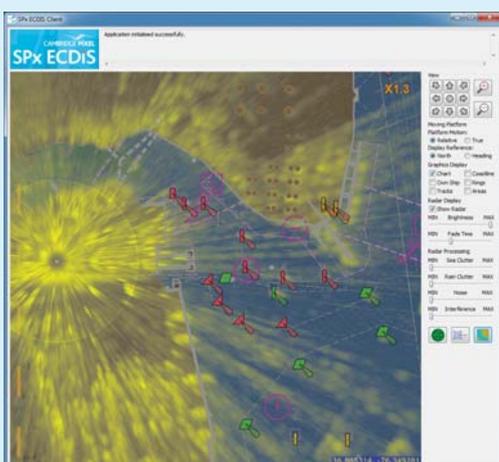

Electronic Navigation Chart Support

The Chart version of SPx ECDIS is compatible with electronic navigation charts (ENC) in S-57 format. The chart renderer used within SPx ECDIS supports the selection of individual layers within the chart as overlays, such that they are drawn above the radar video. This means that important markers are not obscured by the radar video.

The SPx ECDIS library may be used to interact with the electronic chart. It is possible to extract the water depth information for any currently visible point on the chart. This makes it possible, for example, for an application built using SPx ECDIS to raise alarms if a target enters shallow water.

The application shown opposite is a sample application supplied with the ECDIS client library demonstrating ENC support.

Processing

The processing included within the ECDIS Coprocess is based on Cambridge Pixel's well established SPx radar processing toolkit. This provides a powerful set of processing and display components for capture and presentation of radar video using the capabilities of modern multi-core processors and graphics processor units (GPUs). The ECDIS Coprocess provides two independent processing chains, one for display purposes and the other for tracking.
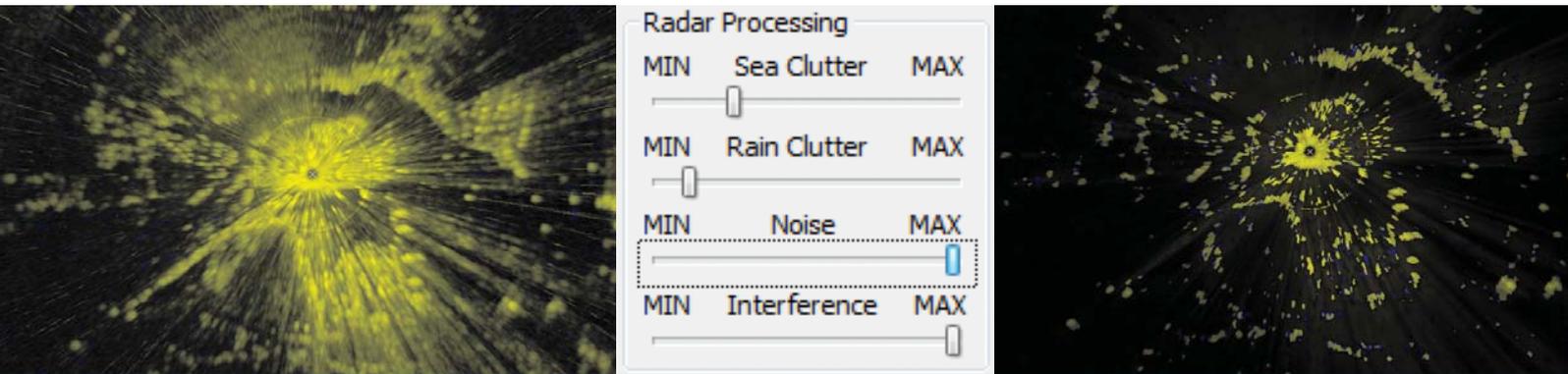

A configuration file defines the initial values of parameters that control the processing at start-up and the client library API provides the functions to control the parameters at runtime. Processing available within SPx ECDIS includes:

- **Filtering:** STC and FTC filters are available to help reduce sea clutter and weather effects.

- **Thresholding:** Video may be thresholded using a dynamic CFAR threshold, which is adaptive to the local signal average, or a fixed level threshold.

- **Clutter processing:** A clutter map is calculated based on a long-term average of correlated video. This clutter map may then be combined with the original data to produce the processed video. A simple application of this is to remove static video and display the remaining moving targets.

- **Radar to radar interference suppression:** Removes samples that are uncorrelated in time.

- **Area Processing:** Eliminating radar returns based on the World Vector Shoreline database or within a user-defined geographic region.

Benefits of the ECDIS Coprocess

- Greatly simplifies and reduces application coding overhead

- Supports multi-layered displays – the radar video may have overlays and underlays

- Provides built-in configuration file support

- Upgrades to processing, tracking and scan conversion simply by upgrading the Coprocess application

- Support during development is simplified, saving the developer time

- Written by experienced software engineers to the highest standards and highly optimised
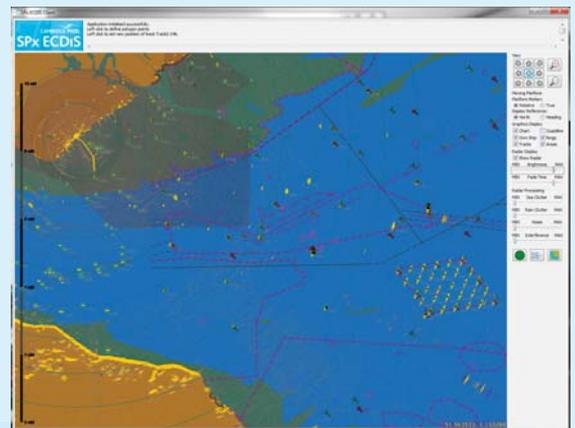
Navigation Data Input

The ECDIS Coprocess takes a NMEA navigation input in order to compensate for the platform's movement. The NMEA 0183 data may be received via a serial port or Ethernet socket. The ECDIS Coprocess automatically uses the navigation data for tracking and, if required, to switch between "true" and "relative motion" display modes. Furthermore, in either display mode, it is possible to present the information (radar video, tracks and maps) in north-up or heading-up formats. Output of navigation data to the client application is also supported.

True Motion

In a true motion display, the map is held static and the own ship symbol can be seen to move across it.

Relative Motion

In a relative motion display the own ship position is centred and all world-referenced data (including the map) is shown to move relative to it.
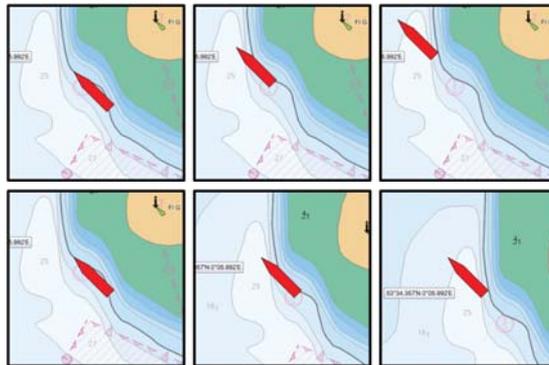
World Vector Shoreline

The SPx ECDIS software is supplied with a database of the shoreline for the whole world, at a resolution of 40m. The database may be used to provide a simple visual display of the coastline or within the processing chain to remove detections over land or a programmed distance from land. This powerful feature allows automatic track initiation to be used where previously it would have needed the operator to create an area-of-interest.
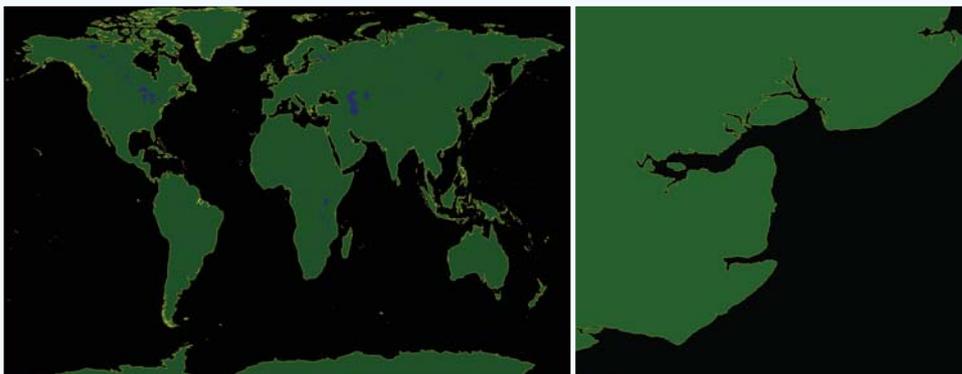
Client Library Interface

The SPx ECDIS Client Libraries provide an object-based command interface to the ECDIS Coprocess. Libraries are available for clients written using C/C++ and the .NET Framework. The libraries provide full runtime control over the operation of the Coprocess and the radar interface hardware (via the Coprocess). The libraries also provide convenient access to the track data and navigation data returned by the Coprocess. Client applications may be written with just a modest amount of code.

Comprehensive sample applications are provided in C++ (MFC /Win32 client library) and C# (.NET library). These sample applications may act as the starting point for custom display applications.

Radar Interface Hardware

The SPx ECDIS package includes radar interface hardware to connect directly to the radar's video, trigger and ACP/ARP signals.

The radar interface card is available in PCI (HPx-200C) and PCIe (HPx-200Ce) form factors and is compatible with a wide range of commercial radars, for example: Kelvin Hughes, JRC, Terma, Simrad and Furuno. Additionally, the card can support a Ship's Head Marker signal, via an independent input.

Signal	Type	Impedance	Voltage Range
Video	Single-ended	75 Ohms High-impedance	-5V to +5V -5V to +5V
Trigger/sync	Single-ended	75 Ohms High-impedance	3V to 60V 3V to 60V
	Differential (RS422)	120 Ohms	-6V to +6V
ACP	Single-ended	75 Ohms High-impedance	3V to 60V 3V to 60V
	Differential (RS422)	120 Ohms	-6V to +6V
ARP	Single-ended	75 Ohms High-impedance	3V to 60V 3V to 60V
	Differential (RS422)	120 Ohms	-6V to +6V

Please consult Cambridge Pixel for the option to input turning data from a synchro or resolver.

Analogue radar video is sampled at 50MHz, which provides range resolutions as low as 3m. The card can also provide indications of received PRF, turning data and triggers, allowing for monitoring of the radar status and automatic display adjustments.

Each of the inputs on the card is configurable via jumpers, providing a flexible range of inputs that may be re-configured quickly and simply. The following input options are available:

SPx ECDIS Features

Host:
Licencing: requires HPx-200C or HPx-200Ce hardware within system.
System Requirements: Modern Intel processors (Core 2 Duo or better), 2GB or more of RAM, ATI or nVidia graphics hardware recommended
OS: Windows XP/7

Processing:
Processes: clutter suppression, thresholding, sea clutter (STC), rain clutter (FTC), area processing LUT, gain and offset

Record/Replay:
Radar video may be recorded to a local hard drive whilst still being displayed. This recording may then subsequently be replayed

Tracking:
Track Initiation: manual or automatic
Maximum Number of tracks: 100 tracks (normal version), 250 tracks (extended version)
Maximum target speeds: 600kts

Radar Acquisition:
Radar Input: HPx-200C (PCI) or HPx-200Ce (PCIe)
Maximum Radar Rotation: 60rpm
Maximum Radar PRF: 8kHz
Maximum Number of Range Samples: 4096

Radar Display:
Number of PPI windows: 1 (standard version), 2 (extended version)
Scan Conversion features: programmable colour and fade, history trail retention
Display Types: true or relative motion, north or heading referenced
Graphics Support: underlay raster map or S-57 chart (Chart version only), built-in world vector shoreline map

Navigation Input:
Navigation Input: NMEA 0183 over serial or Ethernet

Client Library Support:
C/C++, Java, .NET

SPx ECDIS Product Options and Ordering Information

Standard Version: supports up to 100 tracks and provides 1 PPI window
Extended Version: supports up to 250 tracks and provides up to 2 PPI windows
Chart Version: as Extended version but adds support for S-57 charts

Item	Description	Part Number
SPx ECDIS OEM Software Development Kit for Windows	SPx ECDIS OEM Software Development Kit Printed documentation set Technical Support (12 months)	110-095
HPx-200C PCI radar interface card	Card + drivers only, no software licenses	161-104
HPx-200Ce PCI Express (x1) radar interface card	Card + drivers only, no software licenses	161-105
SPx ECDIS OEM Production Kit (Standard Version)	1 x HPx-200C card 1 x Radar Scan Conversion license 1 x Target Tracking Software license (Standard)	191-510
SPx ECDIS OEM Production Kit (Extended Version)	1 x HPx-200C 1 x Radar Scan Conversion license 1 x Target Tracking Software license (Extended)	191-520
SPx ECDIS OEM Production Kit (Chart Version)	1 x HPx-200C 1 x Radar Scan Conversion license 1 x Target Tracking Software license (Extended with ENC chart support)	191-525

Feature	SPx ECDIS Provides	System Integrator Provides	Notes
Radar Sensor		●	
Radar interface hardware (PCI or PCIe card)	●		
Radar PPI display	●		
Radar + Graphics mixing			
Chart Display and Maintenance	●*	●	SPx ECDIS provides a world vector shoreline map. *ENC charts are supported in the Chart version or may be handled by the SI
Automatic Target Tracking (ATT) (Manual and Automatic initiation)	●		
Target Display	●		Tracks from the tracker can be displayed by SPx ECDIS or reported to the client application (or both)
User Interface		●	
Alarm generation, PPC, CPA, PAD		●	
Navigation Tools and Route Planning		●	
Type Approval		●	SPx ECDIS is "designed to meet" IMO standards. Type approval can only occur at the system level
AIS Receipt and Display		●	
Radar Video Record/Replay	●		Extended version only.
Interface to GPS, GYRO etc		●	Data feed in NMEA format required
System Computer and Display		●	
Cabling to radar sensor		●	Cambridge Pixel can supply radar interface cable on request.