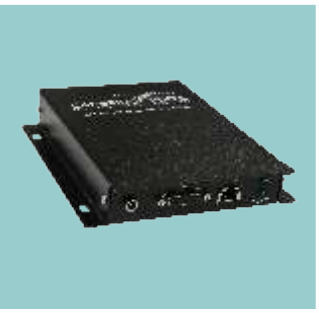
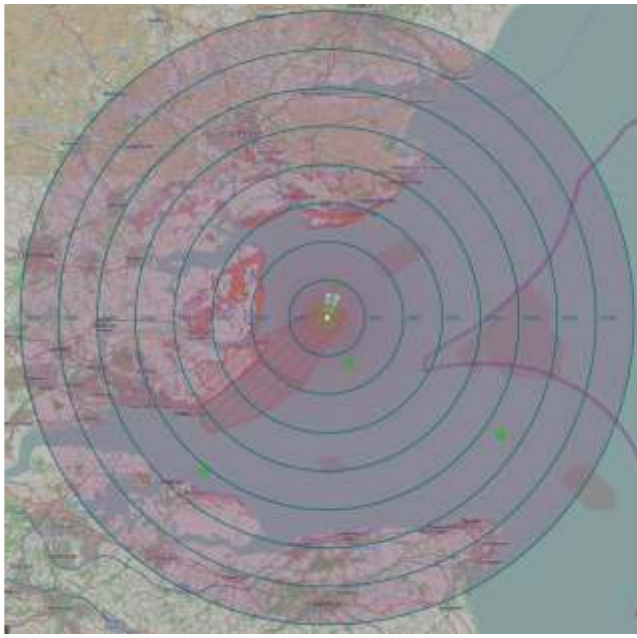
USV Sensor Processing

Sensor Processing, Distribution and Display for Unmanned Surface Vessels (USVs)





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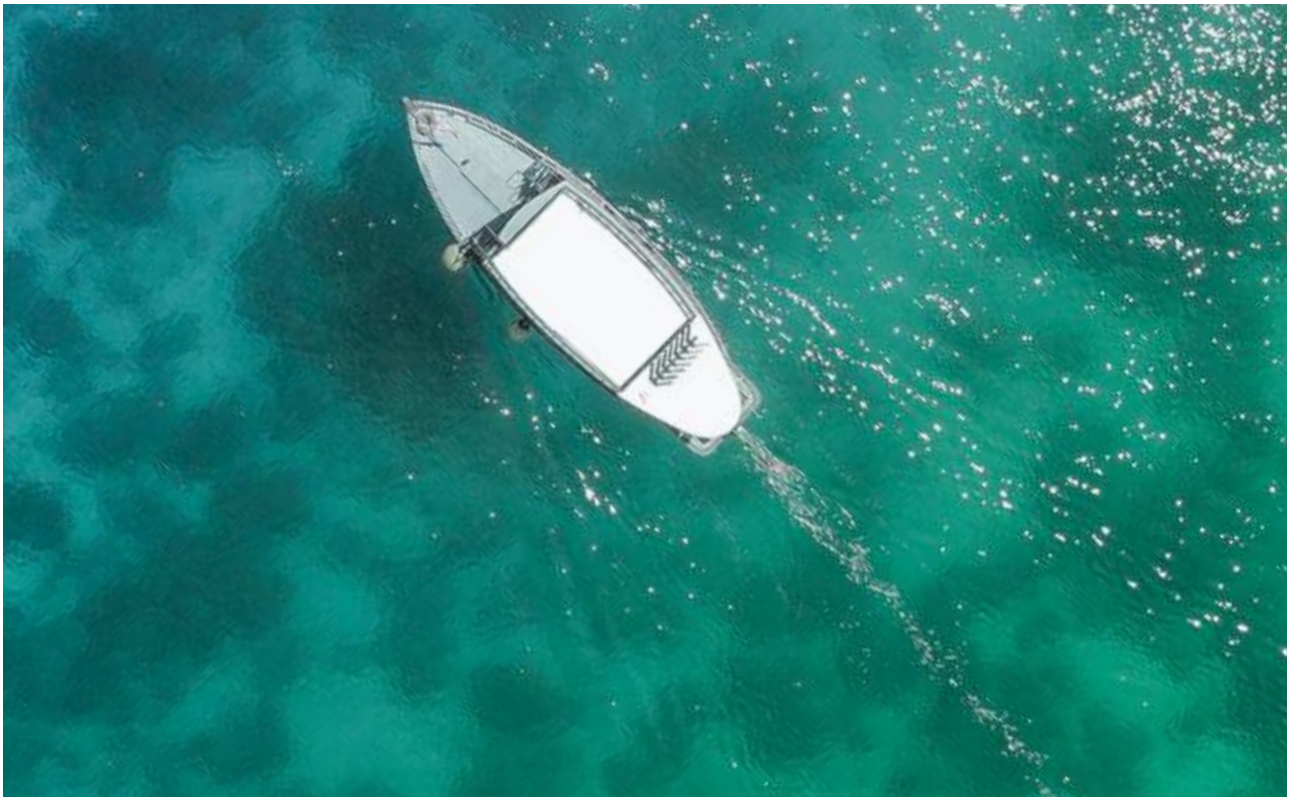
USV Sensor Processing

Unmanned Surface Vessels (USVs) are a rapidly expanding area of interest for navies and commercial enterprises around the world. Cambridge Pixel is a provider of key technology components for USV development, and has partnered with some of the key USV developers and manufacturers across the US, Europe and Asia.

A USV may incorporate a number of sensing technologies to assist with navigation, collision avoidance and target recognition. Cambridge Pixel's expertise and products for radar processing provides a core set of capabilities for USV developers, including:

- Interface options to a wide range of maritime and specialist radars
- A highly configurable target tracker
- Fusion of tracks from multiple radars and auxiliary data such as AIS and ADS-B
- Camera control from radar, slew-to-cue and video-based tracking
- Mission recording of radar video, tracks, AIS, video and navigation data
- Display applications for remote monitoring
- Simulation and training



Radar Interfacing

Various radar sensing options are available for USVs, depending on the size of the craft and the nature of the mission. Maritime radars, such as those from Navico, Furuno and Raymarine, provide a situational awareness capability with target detection out to 5NM or more. Larger craft may be fitted with larger radars to provide enhanced detection range or resolution. Cambridge Pixel's products support most commercially available radars, either as a standard network interface (ASTERIX CAT 240) or one of the proprietary standards from Navico, Furuno or Raymarine, or using a hardware capture product, such as HPx-346, to input radar signals.

Cambridge Pixel's combination of software modules and HPx radar interface cards handles most radar types from the smallest commercial maritime radars to high-end specialist surveillance radars from Hensoldt, Sperry Marine, Raytheon, JRC and Terma. For new radar types Cambridge Pixel is able to implement new import modules for custom interfaces.

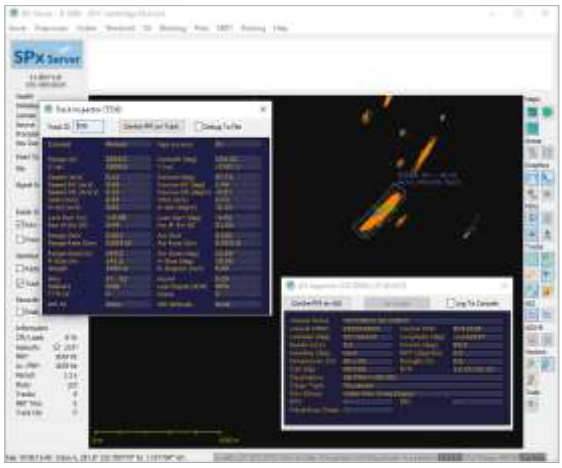
With Cambridge Pixel's modular product range it is straightforward to change radar types in a deployed solution. This permits a common software processing platform to be deployed, with different radars used for different situations.

Target Tracking with SPx Server

Radar video is processed by Cambridge Pixel's SPx Server software, which provides a full chain of processing, plot extraction, auto-acquisition and target tracking. Navigation data from the craft in NMEA format is input to SPx Server to provide information on the boat's heading, course and speed. SPx Server then processes the radar video to identify targets of interest.

A multi-hypothesis tracker (MHT) is used to create and maintain tracks with the sweep of the radar. There is considerable flexibility to configure the tracker to detect and track a wide range of target types, including very small targets, provided they are visible in the radar video.

Parameters of the track processing can be used to control the speed of detection, area of interest, track dynamics and filtering. The output of the processing is track reports which may be distributed off the boat using normal communications methods, and/or used by further processing on the boat for fusion or navigation.



SPx Server is a Windows or Linux software application for radar processing and target tracking. It can be installed on standard PC hardware.

Camera Control and Slew to Cue

If it is desired to provide automatic control of a camera based on the position of a track, Cambridge Pixel's software provides a number of options. One scenario is where a target is observed on radar and the camera follows that target, for example to assist identification. The selection of a target to view may be automatic - for example it could be the only target observed on radar, or there can be a priority system which identifies the most important target. Alternatively, the target may be selected by an operator at a remote control location.

Either way, once the track has been identified, a closed-loop control process moves the camera to follow the target. This can be handled by SPx Camera Controller.

Once given a track ID, SPx Camera Controller will automatically update the camera based on track updates derived from the radar. This process is called slew-to-cue. The process can be configured to maintain the camera on a specific track, or it can automatically cycle between tracks meeting some alarm criteria.

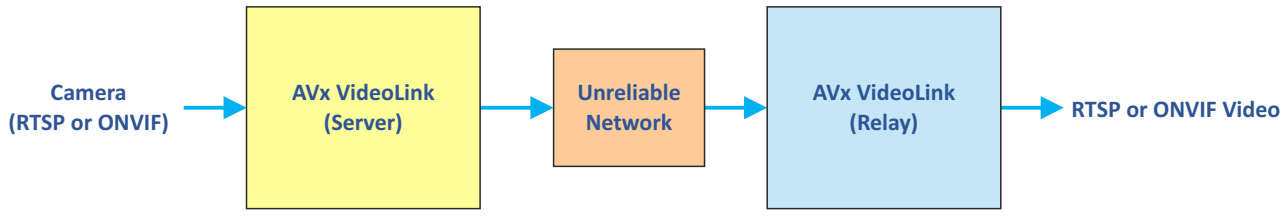
If video tracking, rather than radar tracking, is desired, the control of the camera can be passed to an external video tracker. Cambridge Pixel's software is compatible with the Vision4ce DART video tracker.

Camera Video Distribution

Video from a camera may be distributed over a radio, microwave or satellite communication link using normal network protocols. However, the presentation of camera video is sensitive to packet loss in the communication link, and unreliable datalinks can give rise to significant degradation in the quality of the video. A relatively small packet loss in the distribution can cause significant sections of video to be lost or severely corrupted on the replay side of the link.

To assist with this process, Cambridge Pixel's AVx VideoLink significantly improves the robustness of the video distribution. The input to the encoding process is standard ONVIF or RTSP video streams. These are recoded by AVx VideoLink and then sent over the unreliable data link. On the other side of the data link, the encoding is reversed to return to the original ONVIF or RTSP data stream.

The encoding process used by AVx VideoLink is much more robust with respect to occasional packet loss than is the original encoding used by the camera.



USV Operation Building Blocks

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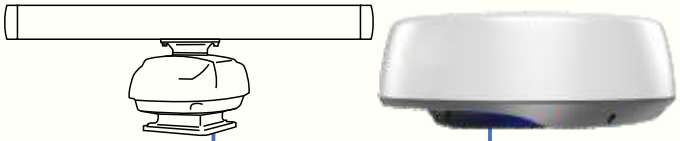


Analogue

Digital

Digital

AIS Receiver

Motion Stabilisation + Nav Data (NMEA)

Acquisition, processing and target tracking

SPx Server

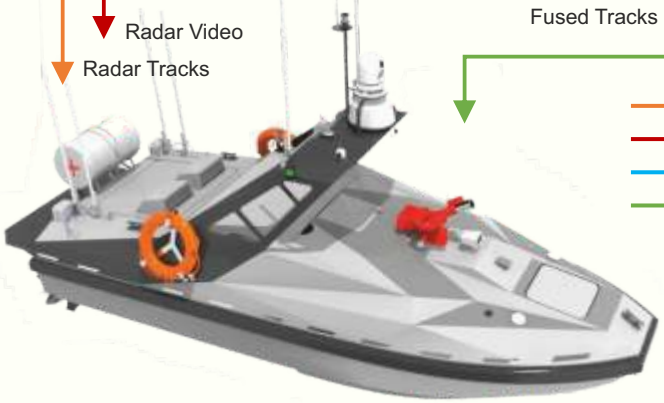
Data Fusion

SPx Fusion Server

Radar Video

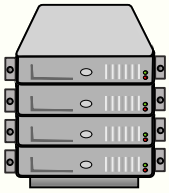
Radar Tracks

Fused Tracks



Data Recording

RDR



Video Tracking

Data Link

Slew-to-Cue (camera controlled from radar tracks)

SPx Camera Controller

Video

AVx VideoLink

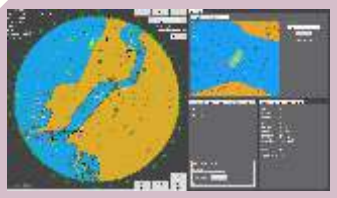
Control

Video

Cameras

Ground station or mothership

MDF



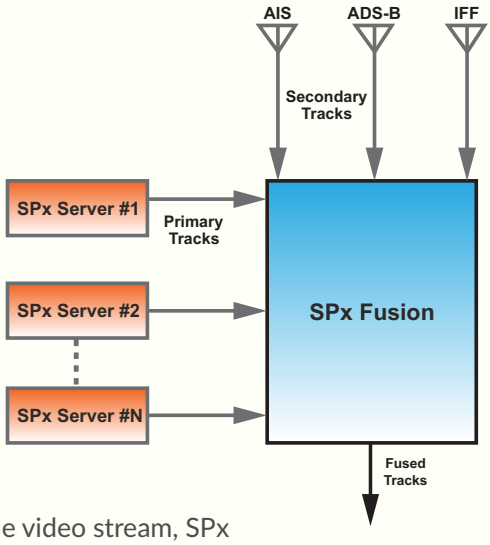
Display

USVx

Simulation

Track Correlation with SPx Fusion Server

SPx Fusion Server is able to combine radar tracks with auxiliary data such as AIS. For larger boats with two radars, SPx Fusion Server can combine the two radars into a single track stream. The fused track combines the attributes of the input tracks and may be reported to a navigation or C2 system using ASTERIX standards and/or used for local camera control (slew-to-cue).



For situations where two radars need to be combined into a single video stream, SPx Radar Video Combiner is available to merge two independent and unsynchronised radar videos.

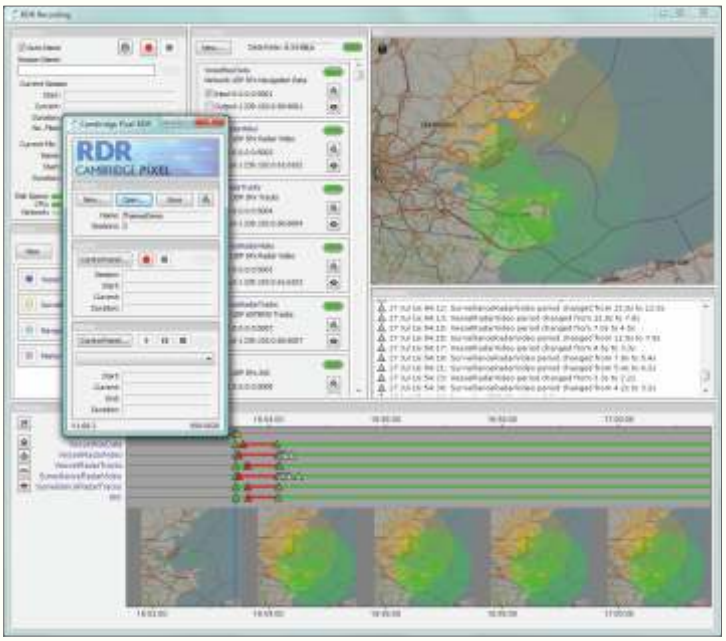
Full Mission Recording with RDR

Cambridge Pixel's RDR Data Recorder is a multi-function data recording application that is able to capture and time-synchronise a wide set of data streams, including:

- Radar video (direct from the sensor)
- Radar tracks (from SPx Server or SPx Fusion Server)
- NMEA Navigation data (direct from the GPS unit)
- AIS reports (NMEA)
- Camera video (direct from the sensor)
- Network data (any other data stream that is provided in a network format)
- Events (errors, status changes, alarms)

The software can be configured to silently and continuously record all mission data, allowing full analysis of the data off-line when the mission is complete. The duration of the recording is limited only by disk space.

The recording process can be configured to operate in the background with no intervention, or it may be incorporated into a control system to permit recording on specific events or on demand from a remote mothership.



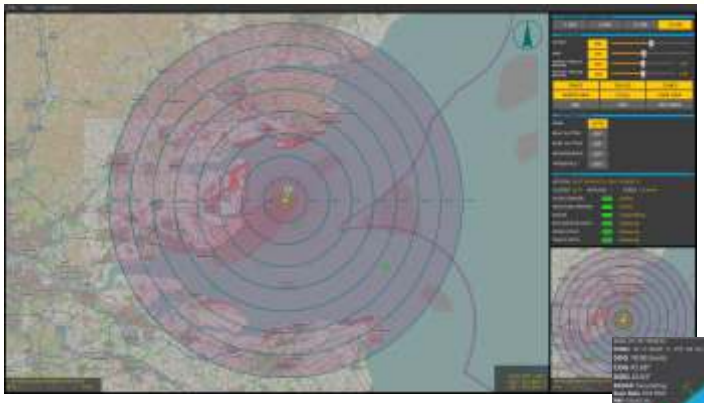
RDR is a Windows-based multi-channel, multi-format data recorder.
It can be used to capture all sensor data during trials for replay and analysis.

C2 Display

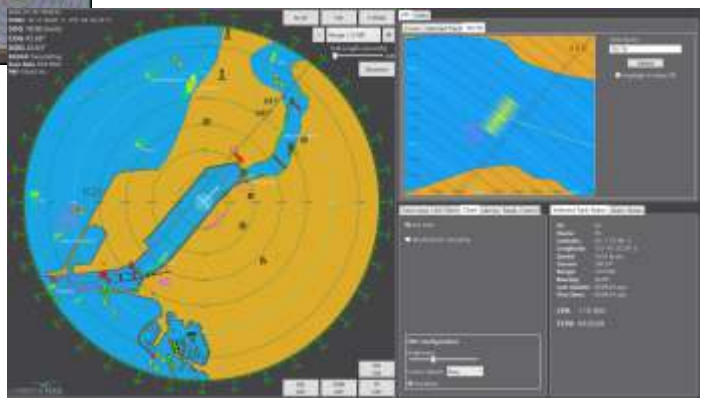
Information may be transmitted from the USV to a mothership or land station. Where it is desired to display the USV-derived data on that station, Cambridge Pixel offers a number of display application options. These range from standard applications, including USVx and MDF, which provides a display of primary radar, tracks and map, through to development packages to support customised displays. In this situation, Cambridge Pixel can provide a full toolkit of software components for radar video, tracks, AIS, map, and camera video display.

Customised or semi-customised applications can be provided by Cambridge Pixel incorporating any combination of radar video, tracks, AIS, map data, camera video and other sensors.

Radar control is typically integrated into the C2 display to allow the operator to control the radar remotely, adjusting settings and selecting the appropriate operating modes.



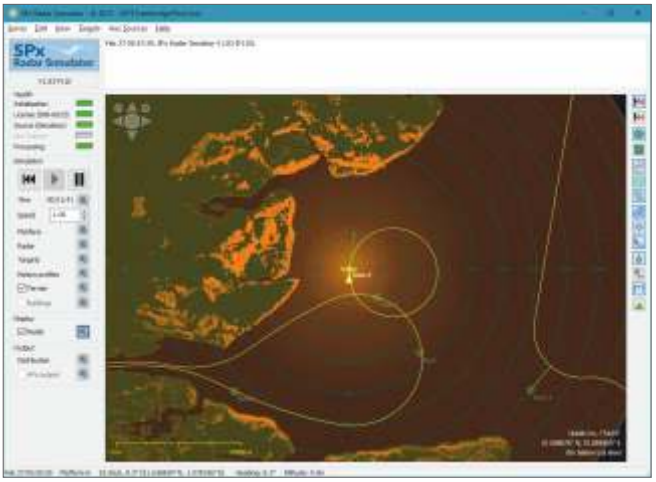
USVx is a client-side application, available as an executable or development package, which provides a remote display of radar video, tracks, AIS and radar status.



MDF is a maritime client-side application, available as an executable or development package, which provides a remote display of radar video, charts, AIS, tracks and radar status.

Simulation and Training

SPx Radar Simulator combines a scenario generator and a set of output modules to convert complex real-world scenarios into representative data streams, including ASTERIX CAT-240 video, ASTERIX CAT-48 tracks, AIS, NMEA and related data. These data streams may be input into production-ready hardware for system testing, or may be used as part of a training scenario. The Simulator is available as a Windows software application or may be provided as part of a portable PC system, optionally with an integrated radar output card.



Product Summary

Product	Description	Part Number
HPx-346	Radar signals to network converter unit.	346-110
HPx-400e	PCIe card for radar signal interfacing.	318-101
SPx Server	Radar processing, plot extraction and target tracking. Software runtime licence.	110-703 (Windows) 110-702 (Linux)
SPx Fusion Server	Fuses multiple radars and/or radar with AIS. Software runtime licence.	110-780 (2 sensors) 110-781 (4 sensors)
RDR Data Recorder	Data Recorder Application for radar, tracks, camera video, NMEA and network data. Software runtime licence.	266-500
AVx Video Link	Encoder/decoder for camera video distribution over unreliable communications link.	425-500
SPx Camera Control	Slew-to-cue control of camera from radar tracks.	356-105
USVx Display Application	A Windows-based display application available as an executable or Framework developer version.	305-500 (Runtime) 305-520 (Developer)
SPx Maritime Display Framework	A development package for creating customised user interfaces for the display of radar data, aimed at the maritime market.	438-500 (Runtime) 438-510 (Developer)
SPx Radar Simulator	Simulation of radar video, Tracks, AIS and navigation for system testing and training.	110-590
SPx Radar Video Combiner	Merges two streams of network radar video, combining them into a single, unified radar video output.	367-500

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