



INTERSENSE

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Technical Overview PCTracker

Brief Introduction & Synopsis of the Operation of the PCTracker

The cost effective PCTracker is a new IS-900 configuration designed specifically to take advantage of fast, Windows-based computers running with modern graphics engines for the budget conscious user.

The system is a 6 degree of freedom (6-DOF) motion tracking system based on a hybrid technology of inertial and ultrasonic tracking. The position and orientation of the tracking stations are determined by the output of the accelerometers and gyros. Drift correction is accomplished in our advanced Kalman filter by fusing the output of the inertial sensors with range measurements obtained from the ultrasonic components. The result is full 6-DOF data that is very smooth, precise, and free from jitter.

Advantages of the PCTracker technology include:

- ◆ Low cost system utilizes IS-900 technology for small area tracking
- ◆ Immune to metallic, acoustic, and optical interference
- ◆ Sensor design eliminates acoustic transmitter “line of sight” blockage
- ◆ Consistent accuracy over entire tracking volume
- ◆ Factory calibration for accurate position mapping of acoustic transmitters
- ◆ Superior motion prediction algorithms
- ◆ Integration of tracking devices into OEM applications

PCTracker Configuration

The PCTracker eliminates the need for an IS-900 processor. InterSense’s SensorFusion code for calculating the full 6-DOF tracking solution is performed by the standard InterSense Windows dynamic link library (isense.dll) running through InterSense’s IServer Windows Application Tray Software. The MiniTrax tracking devices and SoniStrips plug into the PCTracker Hub, which interfaces directly to the computer via its RS-232 serial port(s). The PCTracker Hub will support a maximum of two MiniTrax devices (2 serial ports required) and 3 SoniStrips (9 SoniDisc ultrasonic emitters).

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The standard PCTracker System (shown in Figures 1 & 2) includes one PCTracker Hub; one wired MiniTrax Head tracker; a fixed SoniFrame assembly made up of two 4 foot SoniStrips, and one 2 foot SoniStrip; and, the Windows IServer Software. The deliverable configuration is flexible allowing substitution of the SoniFrame with a SoniWing, and substitution of the MiniTrax Head Tracker with either a MiniTrax Hand Tracker or MiniTrax Wand.

PCTracker Components

The fixed frame SoniFrame assembly provides a 2 x 2 x 3 meter tracking volume with no special sighting or calibration of the SoniStrips. The three SoniStrips easily mount to the SoniFrame assembly to produce a repeatable rigid structure that is portable and convenient to use.

The PCTracker System supports all Windows PC platforms and is powered by an external power supply included with the PCTracker Hub. Cables provided with the system include three Hub to SoniStrip cables, one Hub to Tracker cable and one straight through RS-232 serial cable to connect the Hub to the Windows Host PC. The PCTracker ships with an auto installer CD which provides the necessary InterSense library (isense.dll), IServer software, a full software development kit (SDK) with programming examples, and interface code needed to help developers interface to their application program.

Application programs running on Windows operating systems that currently adhere to InterSense's API are plug compatible with the PCTracker. The IS-900 Wireless Modules are not compatible with the PC Tracker.



Figure 1 - PCTracker Components

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SoniFrame or SoniWing™ Constellation acoustic pulse transmitters

The SoniFrame and SoniWing are a fixed constellation of ultrasonic SoniDiscs. Both fixed constellations do not require special measurement or calibration. The exact locations of the SoniDiscs are factory calibrated by InterSense and included in the ISDEMO Constellation Configuration Utility Program provided with the system.

The SoniFrame (left) and SoniWing (right), shown in Figure 2, have ultrasonic SoniDisc transmitters that first receive addressed signals from the PC Tracker Hub and then transmit ultrasonic pulses in response. The acoustic transmission beam width for each SoniDisc provides wide-angle coverage (approx. 70-degree cone angle) to maximize the tracking area.

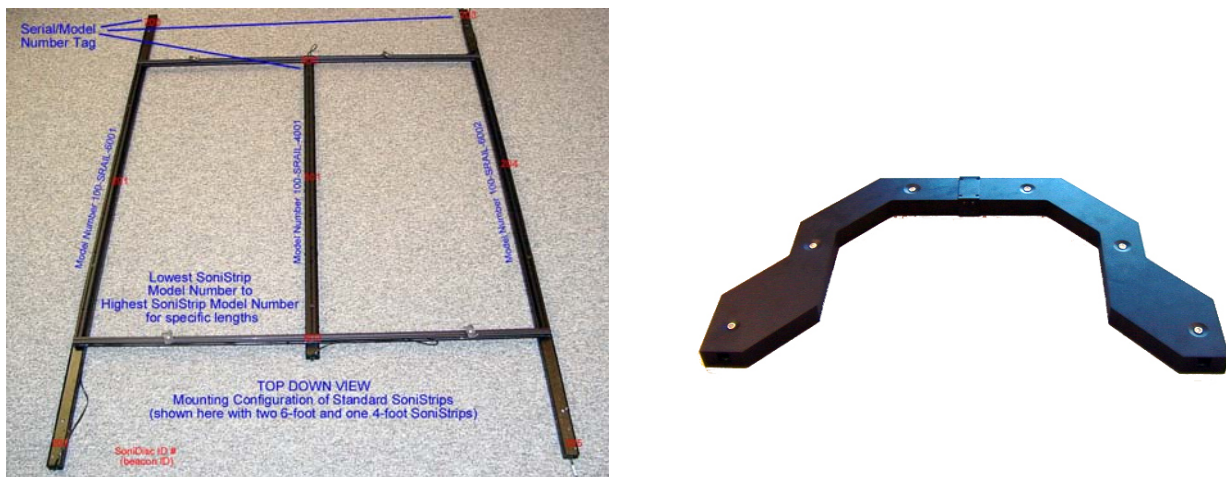


Figure 2 - PCTracker available with SoniFrame or SoniWing

SoniFrame and SoniWing Mounting and Configuration

The SoniFrame or SoniWing are typically mounted from the ceiling over the desired tracking workspace. To increase the flexibility of this system, the SoniFrame can be configured with different sized SoniStrips for mounting in a variety of small area immersive environments. The user is able to position either the SoniWing or SoniFrame SoniStrips in confined spaces as found in desktop environments, virtual workbenches, automobiles, and cockpit simulators. Once installed, the user must calibrate the SoniStrip Constellation by configuring the Cartesian x , y , z coordinates of each SoniDisc using the constellation Configuration Utility Program provided in the InterSense Program ISDEMO. ISDEMO has an easy to use INSERT function (Figure 3) that eliminates the need to measure beacon positions. Pull down menus allow the user to select the corresponding SoniStrip ID numbers, which then activates a predetermined constellation grid matched to the SoniStrip configuration assembled with the SoniFrame.

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The SoniFrame is included with the standard PCTracker system. Three SoniStrips easily mount to the SoniFrame assembly to produce a repeatable rigid structure that is portable and convenient.

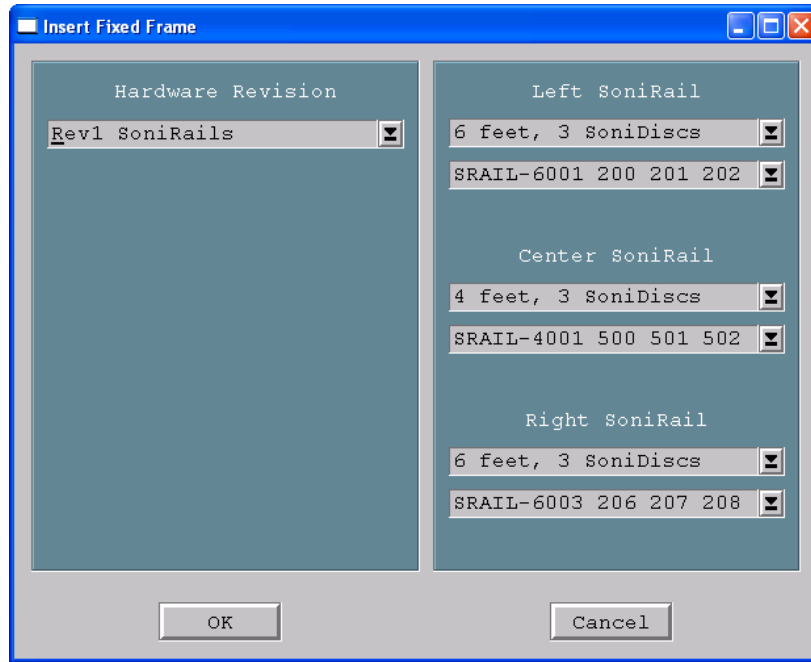


Figure 3 – ISDEMO Insert interface for installing a SoniFrame

Tracking Station Description

For InterSense motion tracking systems, a “**station**” is the tracked object or device, which in industry jargon is also called a **sensor**. An IS-900 tracks all stations in a 6-DOF mode, meaning each tracked device outputs an X, Y, Z position information along with a pitch, yaw and roll orientation information. In addition, the Wand Tracking Station outputs joystick and button information for use with the immersive environment software. Table 4 summarizes InterSense’s PCTracker Tracking Stations. A maximum of two, wired tracked stations can be used with one PCTracker System.

Tracked Station	Function
MiniTrax Head Tracking Stations	Stereo glasses and Head Mounted Display (HMD) mounted. An optional high accuracy version is available.
MiniTrax Hand Tracking Station	Right or left hand versions designed to mount on virtual reality interface gloves
MiniTrax Wand w/ Joystick Tracking Station	Five button with center push button joystick

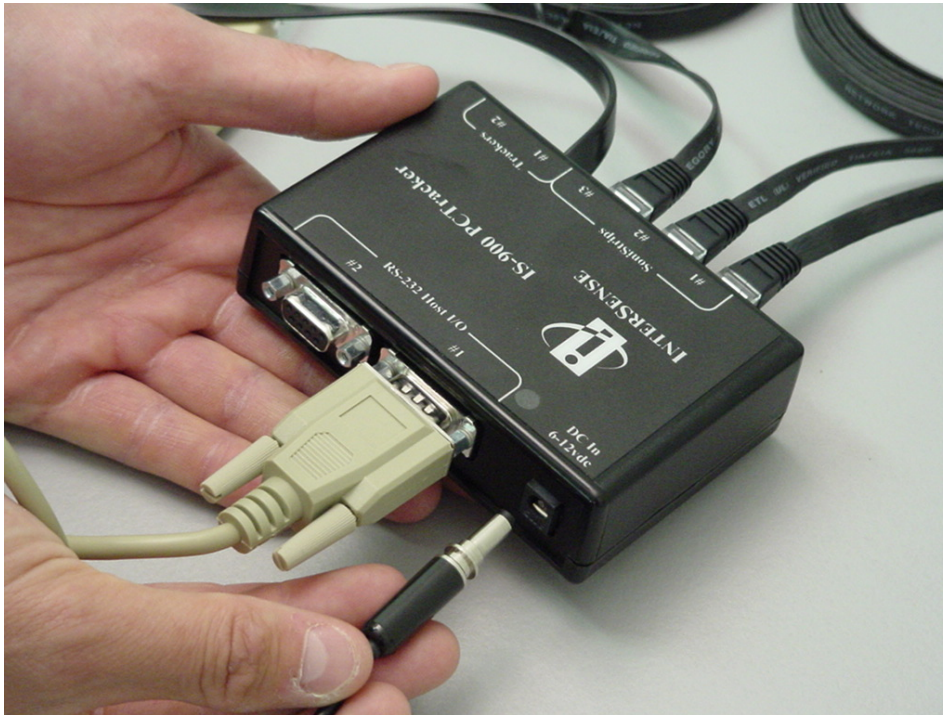
Table 4 – Choice of MiniTrax Tracked Stations for PCTracker (Maximum of two wired allowed)

Each tracked station uses InterSense’s Serial Station Protocol to combine raw data from the InertiaCube (angular & acceleration rates) with acoustic range data for transmission to the InterSense .dll via the PCTracker Hub. InterSense provides different types of tracked stations for use in immersive

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environments. All of these tracked stations use InterSense's advanced inertial MiniTrax technology combined with miniaturized digital acoustic position referencing components. The standard tracked stations include the MiniTrax 5-button wand with a center-click joystick, a MiniTrax Hand Tracker (left or right), a MiniTrax Head Tracker, and an optional High Accuracy MiniTrax Head Tracker.

Figure 5 - PCTracker Hub



In applications requiring two tracking stations, the PCTracker requires two RS-232 ports for interfacing to a Windows PC. As shown in Figure 5 of the PCTracker Hub, there are two RS-232 serial available for connection to the Windows host computer. When running with one tracking device, the single tracker is connected to Tracker Port #1 and the RS-232 Serial Port #1 is connected to the Window Host running IServer software. To add a second tracking device, the tracker is connected to Tracker Port #2 and a second serial cable is connected between RS-232 Port #2 on the PCTracker Hub and a second serial port on the same Windows Host Computer.

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Technical Information

- ◆ Serial rate: 115.2 kbaud
- ◆ Latency: 4 to 10 ms (without prediction and PC host dependent)
- ◆ Interface: RS-232 (two RS-232 required for two tracked devices)
- ◆ Protocol: InterSense API through the InterSense .dll, SDK available

Device specifications

	Wand	Hand Tracker	Head Tracker	High Accuracy Head Tracker (Optional)
Resolution (RMS)				
Position (X/Y/Z)	0.75 mm	0.75 mm	0.75 mm	0.75 mm
Angular (P/R/Y)	0.05°	0.05°	0.05°	0.05°
Static Accuracy				
Position	2.0 – 3.0 mm	2.0 – 3.0 mm	2.0 – 3.0 mm	2.0 – 3.0 mm
Angular (P/R, Y)	0.25°, 0.50°	0.25°, 0.50°	0.25°, 0.50°	0.25°, 0.25°
Size (W x L x H)	10.0 x 17.0 x 5.5 cm	10.0 x 8.0 x 4.4 cm	9.4 x 2.7 x 2.7 cm	20.5 x 3.0 x 2.7 cm
Weight	140g wired	44g	23g	38g

General specifications and cable lengths

- ◆ PCTracker Hub dimensions: 4.54 x 3.00 x 1.25 in (115.32 x 76.20 x 31.75 mm).
- ◆ Maximum cable length between the PC and PCTracker Hub is 9 ft (2.74 m).
- ◆ Maximum distance between PCTracker Hub and SoniFrame is 10 ft. (3.05 m) and SoniWing is 15 ft. (4.57 m).
- ◆ Maximum cable length between tracking device and PCTracker Hub is 14 ft. (4.27 m).
- ◆ The distance between the tracking devices and the SoniStrip array should not exceed 9 ft. (2.74 m).
- ◆ Supported with the InterSense .dll (isense.dll) on Windows 98/NT/2000/ME/XP Operating Systems.

PCTracker OEM Example Application

In addition to InterSense’s standard tracked stations, there are also new OEM devices being delivered with some IS-900 systems that integrate the IS-900 MiniTrax technology into custom 3rd party tracked stations. For example, the MiniTrax technology is successfully integrated into devices for multiple weapons systems and fire fighter training apparatus.

One specific example for the PCTracker is a welding simulator system known as the WAVE project. In the welding domain, most of the training time is spent for gesture control. This costs a lot of raw material to the training organization and is a painful step for the trainee. InterSense partner Immersion SA has developed a virtual welding workbench for WAVE project. This project is supported in the Fifth

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Framework program by the European Commission in the IST initiative and is included in the cluster of projects EUTIST-AMI (www.eutist-ami.org) regarding Agents and Middleware Technologies applied in real industrial environments. WAVE is developed in partnership by CS and AFPA WAVE will be initially deployed in all AFPA welding centers in FRANCE in 2004.

The primary goal of WAVE is to train students in mastering welding gesture. The main advantage is the reduction of raw material cost. WAVE is designed to introduce and familiarize students learning welding. It does not replace the real training, but will make up about a third of the overall training process.



**Figure 6 – WAVE Welding Simulator
using PCTracker OEM Package**

Shown in Figure 6, the WAVE welding simulator is the first commercial application of the PCTracker. The WAVE virtual workbench runs on a standard PC platform with an adjustable flat panel monitor, which is positioned to simulate different welding procedures. As shown in Figure 6, the MiniTrax components are integrated into the torch and the SoniDiscs are embedded into the bevel of the virtual workbench. Since the workbench is required to track the torch at any angle, an encoder reports angle of the workbench and the proper normal vectors for the SoniDiscs are sent to the PCTracker software for dynamic configuration of the Constellation array.

The WAVE architecture is designed for use in other networked training scenarios. Each workbench is monitored in real-time by a supervisor workstation. The supervisor workstation also acts as a central database and control manager to handle trainee information and results.