SPACEPOINT™ CR
CONTROLLER MOTION–TRACKING SYSTEM

SpacePoint CR Demo Module

Quick Guide

PNI
SENSOR CORPORATION

Introduction

The purpose of the SpacePoint CR Demo Module is to demonstrate the intuitive and precise control of the SpacePoint Motion Coprocessor's 9-axis sensor fusion technology. SpacePoint CR is a custom integrated circuit that makes it easy for designers and engineers to quickly incorporate, optimize, and operate multiple orientation sensors on mobile devices. SpacePoint CR employs and manages a consumer-grade 3-axis magnetometer, 3–axis accelerometer, and 3–axis gyroscope to provide reliable motion tracking, and accurate heading and orientation data. SpacePoint CR gathers data from the sensors then integrates and fuses this data using PNI's proprietary Kalman filtering and heuristic algorithms.

Set-Up

Note: *The SpacePoint CR Demo Program is built on a Unity platform and has been demonstrated to run on Windows XP, Windows Vista, and Windows 7 computers. However, no guarantees are made regarding the ability of the SpacePoint CR Demo Program to operate on any or all computer configurations.*

Note: *SpacePoint CR includes a coprocessor called SENtral, so you will see references to SENtral throughout this document.*

Before starting:

Install the SpacePoint CR Demo Program on your computer. "Extract" all the files from the SpacePoint CR Demo Program zip file. This will put "controllerDemo _.exe" and the folder "controllerDemo_Data" into the same directory as the zip file. These two items must remain located within the same directory on your computer's hard drive.

Ensure an FTDI virtual COM port (VCP) driver is installed on your computer. If you are not sure, plug the SpacePoint CR Demo Module into your computer then go to your PC's Windows Device Manager. Under "Ports" in the Device Manager you should see a device labeled "USB Serial Port" along with the port address. Right click on this and select "Properties". This will open a new window. Click the "Driver" tab and confirm "Driver Provider" is FTDI.

If an FTDI VCP driver is not installed, download “CDM 2.08.30 WHQL Certified.zip” at: http://www.ftdichip.com/Drivers/VCP.htm. This is appropriate for all Windows systems supported by the SpacePoint CR Demo Program. Use a zip utility to extract the contents, which include: “CDM **v**2.08.30 WHQL Certified.zip” (note the “v” prior to the revision number, which is not in the host zip file name), “CDM v2.08.30 WHQL Certified.exe”, and “CDM 2 08 30 Release Info.rtf”. Double-click on “CDM v2.08.30 WHQL Certified.exe” to install the VCP driver. This should complete the FTDI driver installation process. Plug in the SpacePoint CR Demo Module and check under “Ports” in the Device Manager. You should see “USB Serial Port” along with the port address. If not, reinstall the driver, and next reboot your computer.

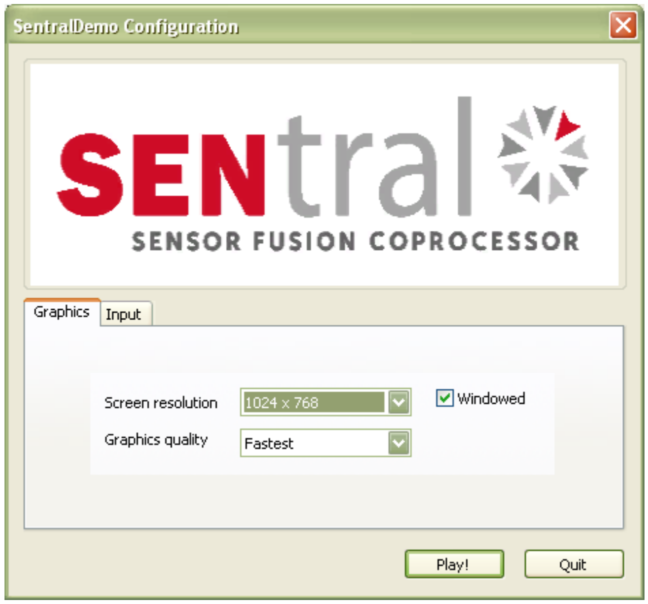
Running the SpacePoint CR Demo Program

To use the SpacePoint CR Demo Module:

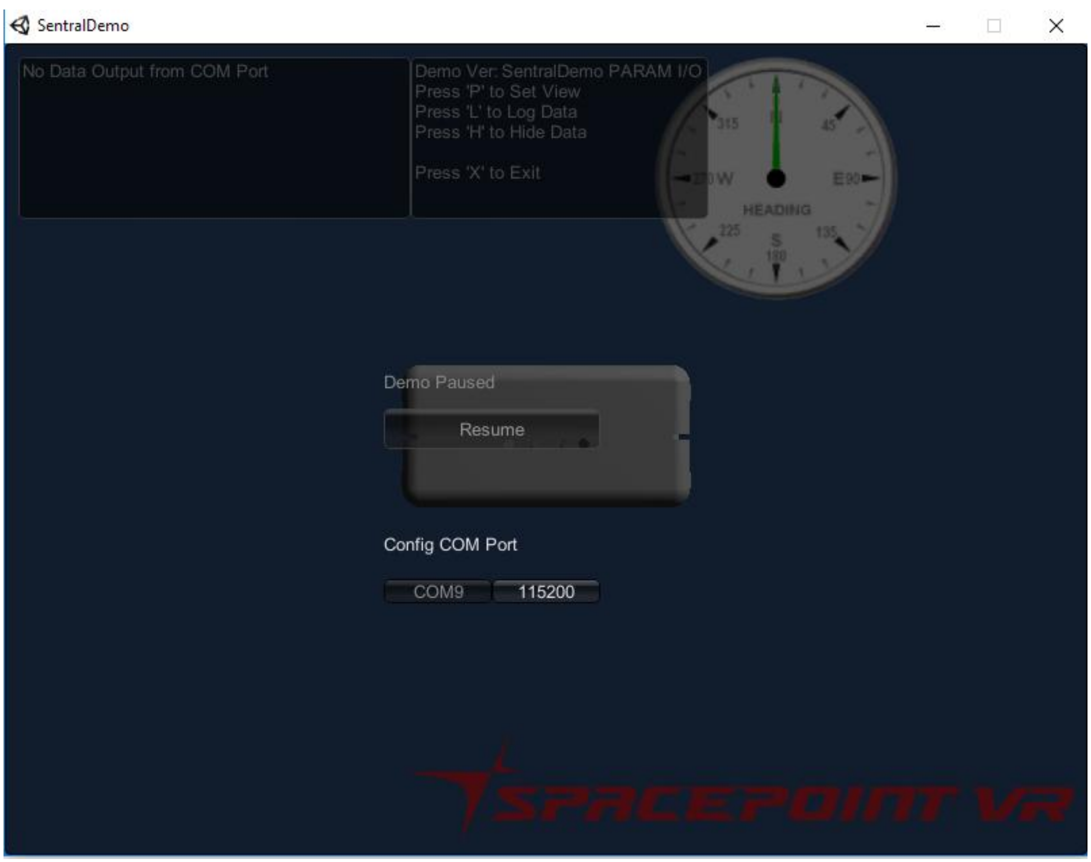
Help ensure the SpacePoint CR Demo Program runs smoothly by closing all other applications and ensuring you are running on a single-monitor computer system.

Plug the SpacePoint CR Demo Module into your computer’s USB port. Make sure the SpacePoint CR Demo Module is fully at rest for at least 6 seconds immediately after plugging it in, as the configuration file needs < 1 second to upload from the EEPROM and then the system requires ~5 seconds to learn the gyro bias. If this is the first time plugging in a specific SpacePoint CR Demo Module, Windows automatically will launch the “Found New Hardware” wizard, and then indicate it has found the module and installed the device. After this, go to the Windows Device Manager and confirm which port is assigned to the SpacePoint CR Demo Module.

Launch and Configure the SpacePoint CR Demo Program. Double-click on the SpacePoint CR Demo Program icon to launch the program. The “SpacePoint CR Demo Configuration” window will appear, as shown below. Set the desired screen resolution and graphics quality. PNI generally recommends “Fastest” graphics quality, but the user can experiment with other settings. If you want the program to run full-screen, deselect the “Windowed” box. Click the “Play!” button or press <Enter>.



Initiate Running of the Program. The main program window will now open, as shown below. Select the correct port number for the SpacePoint, and set the baud rate to 115200. Click the <Resume> button. A <Start> button will appear in the upper left quadrant. Click on this to start sending data and initiate functioning of the program.



Once the program is running: 1) the whole screen will brighten, 2) the values in the upper left-most box, referred to as the data text box, are no longer "0" and will change when the module is moved, and 3) the compass dial will start tracking heading.

The data text box displays heading, pitch, and roll, in degrees, on the top line, and on the second line the quaternion values, Qx, Qy, Qz, and Qw. The compass dial provides real-time heading data in a common graphical format. The heading given on the compass dial matches the heading value in the data window.

SpacePoint CR Calibration. SpacePoint CR's continuous background calibration starts when the demo module is plugged into the computer's USB port. Hence, we recommend that you keep the unit still for 5-10 seconds so it can first learn the gyro bias, then move the device to calibrate first for hardiron offsets and then softiron offsets. In portable use cases, this initial calibration may not be needed, since the SpacePoint will sample the sensor data during normal use cases to calibrate for the sensors and system offsets. However, for quick start up, after power on, keep the demo unit still, then move the unit around so that SpacePoint CR can measure its environment and calculate sensor scaling and offset coefficients. Movements should be such that while holding the demo module in hand, the ends of the module should trace points along the inside of a sphere.

Rendered-Image Motion-Tracking. Point the SpacePoint CR Demo Module straight at the screen and press the "P" key for the rendered SpacePoint module image to start tracking the actual SpacePoint CR Demo Module's motion. Pressing the "P" key not only initiates motion-tracking, but also (re)initializes the orientation of the rendered object on the screen, such that when the key is pushed the rendered image will point straight into the screen with no pitch or roll.

Log Data. The SpacePoint CR Demo Program provides an easy way to log output data. Simply press the "L" key to initiate data logging; press it again to stop logging data. When data logging has been terminated, a .csv file will be saved in the same folder where the program resides. This file can be opened directly with Excel and contains both the quaternion outputs and heading, pitch, and roll values. The time between samples is 0.01 second (i.e., sample rate of 100 Hz).

Hide Data and Command Text Boxes. If desired, you may hide the data and command text boxes by pressing "H" on your keyboard. Pressing "H" again will toggle them back.

Exiting the Program. Press the "X" key to stop and exit the program. When you do this, a file titled "state.csv" will be saved in the same directory as the program. This file contains information that helps the SpacePoint quickly initialize itself when you restart the program. This file is not required for the SpacePoint CR Demo Program to work.

Summary of Commands:

"P" to set rendered object orientation.

"L" to start and stop logging data.

"H" to hide the data and command text boxes.

"X" to exit program.

Appendix - UART Data Format

1.1 UART Communication

The Demo Unit allows for communication with the host system via a UART interface. Through the UART, the user's system requests the output from the Demo Unit, and the module subsequently transmits this data. The outputs include quaternion and sensor data.

Table 1: UART Configuration

Parameter	Value
Baud Rate	115200
Data Bits	8
Parity	none
Stop Bits	1
Flow Control	none

1. Send Commands to the Demo Unit

	Rx Command	Description
kRequestData	0x32	Request Data Output.
kStopData	0x30	Stop Data Output

2. Receive Data Package with Frame Type

	Frame Type	Description
kRequestDataResp	0x32	Output data response to kRequestData.

kRequestData & kRequestDataResp

The command to receive data (kRequestData) is 0x32. The structure of the kRequestDataResp frame is given below in Table 1.

Table 1: Structure of UART kRequestDataResp frame

Byte	Description	Comment	Type
1	Leading Byte = 0x24, '$' in ASCII	Fixed	Byte
2	Frame ID	Incremental (0 to 255)	Byte
3	Frame Type = 0x32	Fixed	Byte
4	RES	Reserved	Float
5	RES	Reserved	
6	RES	Reserved	Float
7	RES	Reserved	
8	RES	Reserved	Float
9	RES	Reserved	
10	Quaternion X LSB	{ [LSB | (MSB << 8)] - 32768} /32768	Float
11	Quaternion X MSB		
12	Quaternion Y LSB	{ [LSB | (MSB << 8)] - 32768} /32768	Float
13	Quaternion Y MSB		
14	Quaternion Z LSB	{ [LSB | (MSB << 8)] - 32768} /32768	Float
15	Quaternion Z MSB		
16	Quaternion W LSB	{ [LSB | (MSB << 8)] - 32768} /32768	Float
17	Quaternion W MSB		
18	calScore LSB	{ [LSB | (MSB << 8)] - 32768} /32768	Float
19	calScore MSB		
20	RES	Reserved	Byte
21	calStatus	1 to 3	Byte
22	transComp	0 or 1	Byte
23	RES	Reserved	Byte
24	RES	Reserved	Byte
25	QTimeStamp LSB	LSB | (MSB << 8)	UInt16
26	QTimeStamp MSB		
27	MAG X LSB	LSB | (MSB << 8)	Int16
28	MAG X MSB		
29	MAG Y LSB	LSB | (MSB << 8)	Int16
30	MAG Y MSB		
31	MAG Z LSB	LSB | (MSB << 8)	Int16
32	MAG Z MSB		
33	MTimeStamp LSB	LSB | (MSB << 8)	UInt16

34	MTimeStamp MSB		
35	ACC X LSB	LSB | (MSB << 8)	Int16
36	ACC X MSB		
37	ACC Y LSB	LSB | (MSB << 8)	Int16
38	ACC Y MSB		
39	ACC Z LSB	LSB | (MSB << 8)	Int16
40	ACC Z MSB		
41	ATimeStamp LSB	LSB | (MSB << 8)	UInt16
42	ATimeStamp MSB		
43	GYRO X LSB	LSB | (MSB << 8)	Int16
44	GYRO X MSB		
45	GYRO Y LSB	LSB | (MSB << 8)	Int16
46	GYRO Y MSB		
47	GYRO Z LSB	LSB | (MSB << 8)	Int16
48	GYRO Z MSB		
49	GTimeStamp LSB	LSB | (MSB << 8)	UInt16
50	GTimeStamp MSB		
51	Upper Trailing Byte = 0x0D	ASCII CR	Byte
52	Lower Trailing Byte = 0x0A	ASCII LF	Byte

Copyright & Warranty Information

Revised September 2016: for the most recent version visit our website at www.pnicorp.com

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Revision Control Block

Revision	Description of Change	Effective Date	Approval
01	Initial Release	September 30, 2016	B. Thomlinson