Loctronix provides position sensing solutions for GPS challenged environments

- Offering hybrid inertial, SoOp, GNSS positioning, navigation, and timing solutions
- Experts in Signals of Opportunity (SoOp) and alternative GNSS signal processing
- Targeting embedded applications in military, aerospace, commercial markets

**Products / Solutions**

*Available Q4 2013*

- **Advanced Software Radio™ (ASR)**
  - SoOp / GNSS based navigation and simulation solutions for Military / Aerospace applications

**Core Technologies**

- **Spectral Compression Positioning™ (SCP)**
  - SoOp / GNSS Signal Processing
- **Doppler Aided Inertial Navigation™ (DAIN)**
  - RF/Inertial Sensor Fusion
- **SCP-GNSS Hybrid**
  - High Performance GNSS
Advance Software Radio™ (ASR)


Development

- **ASR-2300**, MIMO SDR Motion Sensing Module (Nov’13)
- **OPEN SOURCE Hardware**
- **ASR-2300-Device Development Kit**, Embedded Applications (Q4’13)

SDR Waveforms (2014)

- **ASR-HGR**, Hybrid GPS Receiver
- **ASR-DAIN**, SoOp Doppler Aided Inertial Navigation™ (DAIN)
- **ASR-SAID**, GPS Signal Assurance and Interference Detection Receiver™
- **ASR-SIM**, Multiband SoOp/GNSS Signal Generator / Recorder
ASR-2300 MIMO SDR / Motion Sensing Module

RF / Multi-Sensor Signal Processing
- 2 x 28 MHz Transceivers 300 MHz to 3.8 GHz Full Duplex
- 9 RF Paths: 6 RF inputs / 3 RF outputs (U.FL)
- Integrated L1 GPS and Wi-Fi Antennas
- Integrated 10 axis MEMS sensors
  (accelerometer/ gyroscope / compass / barometer)
- Expansion Port supports for MIMO / Data I/O

Electrical Interface
- SuperSpeed USB 3.0 interface at 315 MB/s sustained data transfer
- Very Large Spartan-6 FPGA: 6,822 / 58 DSP slices
- 128 MiB RAM
- 5 Volts @ 1.2 A (6 W) at full utilization.
- 1.2 mbps UART
- Li-Ion Battery external connection w/charger function

Physical Specifications
- 9.90 x 6.61 x 0.95 cm
  (3.898 x 2.60 x 0.375 in)
- Weight ~ 48 grams (1.5 oz).
Loctronix Multi-Sensor Approach

The Universal Positioning Sensor Solution Set
Orbital Navigation Using SDR

GEO
Transfer

GPS / GNSS

Neutral Density | Ionospheric Monitoring | Radio Occultation
---|---|---
Hybrid GPS Sensor | Orbital Navigation | Software Defined Radio (SDR) Platform

Generalized Broadband Orbitally Responsive Navigator (GBORN)
Combines SCP and traditional correlation technologies

Low SWaP high-performance L1/ L2 / L5, C/A / C, P(Y) channel observables
A non-linear operation on a broadband signal that enables extraction of amplitude, frequency, and phase information

**GPS example with Delay & Multiply**
- Spectral compression applies a delay and multiply operation on P(Y) ranging signals.
- Fundamental chipping rate signals are extracted using an FFT on the Spectral Compressor output.
- Each peak in the FFT (containing amplitude, frequency, and phase) represents a single GPS satellite.
- Doppler frequency shift is used to uniquely identify the specific satellite given a GPS Almanac.
- No complicated tracking loops or correlators are required.
Spectral Compression Positioning (SCP)

SWaP Advantages

1 Channel of SCP signal processing is equivalent to 16 or more correlation channels

16 Signals = 16 Channels

All-in-View = 1 SCP Channel

LEO Obs.

Loctronix

locating anything, everywhere ™
Ionosphere Free Point Positioning, Predicted Accuracy < 4 m, All satellites in view (Spirent limited to maximum of 12 satellites).
SCP C/A LEO Ionosphere Free RIC Error (Spirent Simulator)

Radial (R) Error (est - truth)

Along Track (I) Error (est - truth)

Cross Track (C) Error (est - truth)

Ionosphere Free Point Positioning Total Error < 4m (3 sigma)
- Systematic Biases Removed -
SCP GEO Hardware Simulation
(Spirent Simulator)

Observed, Computed, and Matched Doppler Observables

C/A High Sensitivity: 32 seconds coherent integration
SCP Real Time Locating Systems (RTLS)

Monitor Detected Peaks
07 Dec 2009 06:08:44.282

Rover Detected Peaks
07 Dec 2009 06:08:44.329

Estimated Rover Position (2nd Floor Woodinville HQ)
10028 17:02:00.8765440

1 m radial error
Doppler Ranging measures the apparent velocity between the signal source and sensor. By integrating, this produces a displacement vector.

Given a point of beginning (via GPS, WiFi, DTV, etc.), this technique when combined with inertial measurements produces highly accurate positioning with very low-drift error (< 2%).
SCP Doppler Observables

SCP Detected Peak (0 m/s)

Doppler Peak Broadening (1.5 m/s)

Doppler Peak Shift (1.5 m/s)
ASR-DAIN Waveform Components

Host Components
- SCP Obs
- Obs
- Data
- MEP Fusion Engine
- PNT Data

SDR Module Components
- RF Front-end
- SCP Cellular
- 3-axis Accelerometer
- 3-axis Gyroscope
- 3-axis Magnetometer
- Pressure Sensor

Application: Indoor Navigation using Signals of Opportunity
Indoor Navigation Demonstration

MEP Demo at Mobile World Congress 2012

Start/Finish

Video Demonstration (click here)
GNU Radio Conference 2013
October 1, 2013
Boston, Massachusetts

Dr. Michael B. Mathews
Loctronix, Corporation

ASR-2300 – Multichannel SDR Module for PNT and Mobile communications