

Infix-1 Sylphase GPS/INS evaluation kit

General Description

The Sylphase Infix-1 is a testbed for evaluation of Sylphase's GPS/INS technology. The kit consists of the Infix-1 PCB, a GNSS antenna, and associated cables. When connected to a computer running our SDGPS software, the system functions as a GPS/INS, fusing GPS observations with measurements from an accelerometer, gyroscope, magnetometer, and barometer into a optimal estimate of absolute position, relative position (odometry), orientation, velocity, and angular velocity.

Figures of merit

Mechanical PCB size 68 mm x 48 mm PCB mass 19 g PCB mounting M2.5 screws on cm grid Electrical Power 180 mA @ 5.0 V Connectors 1x micro-USB, 2x SMA Sensors 1000 Hz IMU 100 Hz magnetometer $100~\mathrm{Hz}$ barometer GNSS signals GPS L1 $100~\mathrm{mA}$ max @ 3.3 V Antenna power Performance Solution rate 1000 Hz (decimation opt.) 4 mm/s rms (typ.) Velocity noise Odometry drift after 1 s 0.5 cm rms (typ.) after 10 s 4 cm rmsafter 100 s20 cm rmsafter 1000 s60 cm rmsAbsolute position error $0.6 \text{ m} (1 \sigma)$





Applications

- Autonomous vehicles
 - Land, sea, air
- Augmented reality
- Surveying
- Vehicle performance measurement

Features

- Sylphase L1 GPS receiver IP on FPGA
 - 83 tracking channels
 - 20 correlator fingers
- IMU, magnetometer, and barometer synchronized to GPS sample clock
- USB 2.0 Hi-Speed interface for power and data
- External active antenna connected via SMA
- GPIO (SMA) port for synchronization or stamping

For pricing and ordering information, please contact sylphase@sylphase.com.

System architecture



Figure 2: System architecture. Dashed components are either off-the-shelf or user-provided.

Hardware

Figure 2 provides an overview of the system. A Spartan-6 FPGA runs our proprietary Sylphase GPS tracking engine, correlating the received RF signal with locally generated replicas of all the tracked satellites' signals. GPS correlation values and measurements from the IMU, magnetometer, and barometer are passed to the computer over USB.

Software

Our SDGPS software is a C++11 collection of modules that can be chained together to create a real-time or offline processing pipeline. The most important modules are the driver for the Infix-1 board, the GNSS signal tracking module (which converts raw correlation values to GNSS observables like pseudorange, carrier phase, and doppler shift), and the Kalman filter (which converts GNSS observables and sensor measurements to a fused solution). The final output of the normal pipeline is a pose (position, orientation) and pose rate (velocity, angular velocity) estimate in both global world and local odometry frames. That data is encoded as JSON and broadcast at 1000 Hz to any clients connected on a TCP socket.

Many other modules exist, but they are primarily to enable testing and verification of the previously mentioned modules. They include modules to record and play back the types of exchanged data, modules to simulate GPS signals and sensor inputs given a path through space, and a software correlator implementation.



Figure 3: Infix-1 PCB top



Figure 4: Infix-1 PCB bottom; Axes reference indicates origin of device coordinate frame

Typical performance (plots)

Velocity



Absolute position







Relative position (odometry)

