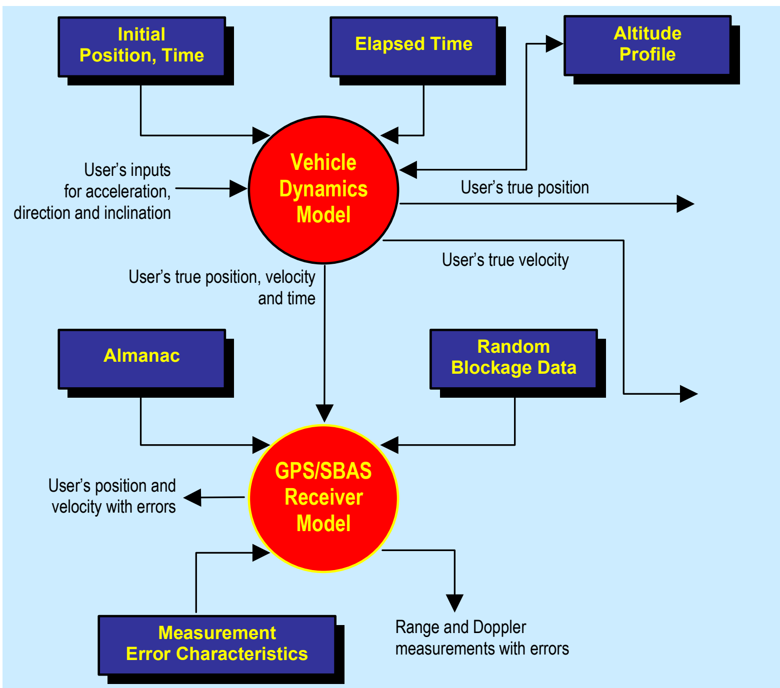
GPSLAB

Accord's GPSLAB is a PC based software simulator of vehicle dynamics and GPS/SBAS (Satellite Based Augmentation System) constellations. GPSLAB simulates the vehicle's 3D dynamics in real time and models the behavior of a GPS receiver. Simulated outputs are displayed on the screen, stored in files and also transmitted on the serial port in real time.

GPSLAB facilitates the user to configure error characteristics and behavioral idiosyncrasies of the individual error sources that effect GPS measurements and study the effects on the outputs under various conditions



Essential Model of the GPSLAB

of vehicle dynamics. The user can vary the vehicle's acceleration, direction and altitude in real time to create a dynamic scenario for analyzing the behavior of GPS/SBAS sensors with variations in their performance parameters. Scenarios can be recorded and replayed to use the software as a data generator.

GPSLAB can be a very powerful tool for software development, testing, evaluation and system integration. It can serve as a valuable aid in the performance analysis of GPS sensors.

The GPSLAB has two major functional constituents:

- Vehicle Dynamics Model
- GPS/SBAS Receiver Model

Vehicle Dynamics Model

This model simulates the 3D dynamics of the user's vehicle in real-time. It can be initialized with 3D position, heading and speed. User can vary the vehicle's acceleration and heading along the plane of the vehicle's motion as well as the inclination of the plane of motion with the locally level horizontal plane. GPS/SBAS model makes use of the vehicle's position, velocity and time outputs from this model. Outputs are displayed, saved in a file and transmitted on the serial port.

Serial output messages from the model

- 3D position (ECEF)
- 3D position (geodetic)
- 3D velocity (ECEF)
- 3D acceleration (ECEF)
- Speed and heading along the plane of motion
- Total distance traveled from the initial position
- Distance traveled during the previous second
- Angular Velocity along the plane of motion

Optional Dynamics Model

User has the option to choose the dynamic model from a predefined file. The dynamics of the vehicle (trajectory) needs to be available in ECEF (Earth Centered Earth Fixed) co-ordinate system. The co-ordinates should have an update rate of 10 Hz or 1Hz.

Leo Earth Orbit Model

GPS lab can also simulate the dynamics of a Low Earth orbit satellite. The parameters for the orbit can be configured at the start of the simulation.

GPS Receiver Model

This model simulates in real-time, the following behavioral aspects of a 12 channel GPS receiver and a 3 channel SBAS receiver:

- GPS and SBAS satellite visibility and signal blockage
- Range and Doppler measurement error characteristics
- Position and velocity computation from range and Doppler measurements
- Availability characteristics of position and velocity from the receiver
- SBAS model only simulates the pseudorange and not the SBAS messages

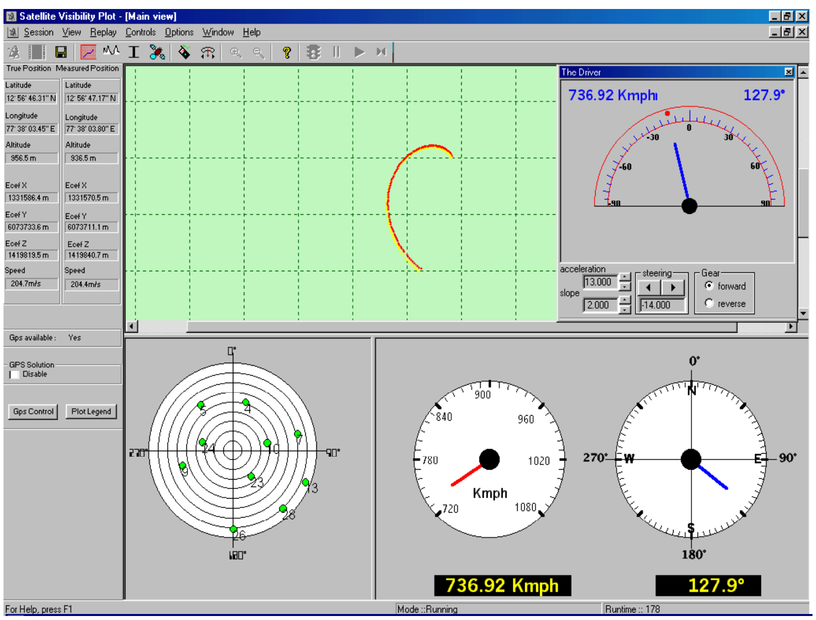
The user can configure the characteristics of various sources of error in GPS/SBAS measurements like SA, ionosphere, troposphere, receiver noise, multipath etc. User can simulate non-availability of GPS signals by varying the elevation mask angles for visibility of satellites as well as by dynamically disabling/enabling satellites. Non-availability of position and velocity information from the GPS/SBAS Receiver can also be simulated using a random blockage model. The outputs of the model are displayed, stored in a file and also transmitted on the serial port.

Serial output messages from the model

Binary	NMEA
3D position (ECEF)	$GPGSA
3D position (geodetic)	$GPGGA
3D velocity (ECEF)	$GPGLL
Ground Course and heading,	$GPZDA
True range to satellites	$GPGSV
True Doppler	$GPRMC
Range measurements (with errors)	$GPVTG
Doppler measurements (with errors)	

SA error for each of the channels being tracked can be seen on the graph in real time. This can also be logged into a file in binary format for further analysis. The user can in a way study the behavior of SA at various user dynamics.

GPSLAB can also simulate urban canyon environments

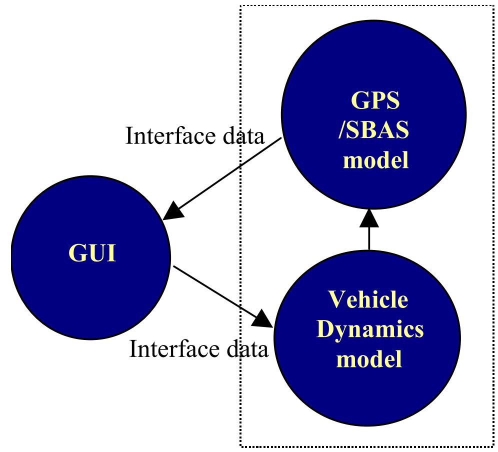


where specific satellites can be disabled and enabled from the GUI. The entire satellite constellation can also be masked for specific amount of time, whereby realistic visibility profiles for urban environment can be created. This profile can be stored in a file and replayed any number of times, which enables to simulate exactly same urban environment during each run.

GPSLAB can also simulate random blockage, where satellites are blocked in a random sequences. This is an alternate formulation of the urban canyon/foliage environment.

Programmatic Interface

The software architecture of GPSLAB is shown in the diagram below.



There are two distinct portions in the software namely the GUI and the Models. GUI accepts user input from the keyboard and generates information required for the vehicle motion. This information is transferred through a well-defined Interface data structure. The vehicle dynamics then provides the truth trajectory to the GPS/SBAS model. GPS/SBAS model also uses certain information from GUI through the interface data and simulates pseudoranges and Doppler information. This is then used in a general least squares algorithm to solve the user state vectors.

The source code contains well-documented instructions, which can be modified and compiled on Visual C++ version 6.0 and higher versions of the compiler. User has the option to modify any of the models used to simulate GPS, such as the SA model, Ionospheric model, tropospheric model.

Resource Requirements

Hardware	IBM PC with Pentium @100MHz or higher clock
Operating System	Windows 95/98/2000/NT (4.0)
RAM	16 MB recommended
Hard Disk	40MB free space recommended
Compiler	Visual C++ Version 6.0 and higher

For more information, please contact:

Accord Software & Systems Pvt. Ltd
37, K.R.Colony, Domlur Layout
Bangalore 560071, **INDIA**
Tel : +91-80-25350105/136/138
Fax : +91-80-25352723

Accord Software & Systems, Inc.
#6121, Suite 404-B, Lincolnia Road
Alexandria, Virginia VA22312, USA
Tel : +1-703-916-0623
Fax : +1-703-916-0624

Email: contactus@accord-soft.com
URL: www.accord-soft.com