### RTOrb SOFTWARE

**RTOrb** is designed to determine the orbits of artificial Earth satellites that are equipped with a GNSS receiver

**RTOrb** is user-friendly yet versatile orbit determination software.

RTOrb has been developed for real-time on-orbit processing and for ground-based post-processing.

Orbital parameters (initial conditions and dynamic parameters) may be treated either as deterministic parameters (specifying zero noise) or stochastic parameters. The resulting satellite orbit thus may vary from a purely dynamic through reduced dynamic to almost purely kinematic orbit.

**RTOrb** fast and efficiently processes the data from one satellite at a time in **PPP** mode.



#### SOFTWARE AT A GLANCE

| Feature  | Comment  |
|--|--|
| User friendly  | One-step   |
|  | processing with  |
|  | one input file   |
| <b>Position based</b>  | Includes   |
| on integration of  | gravitational and  |
| equation of  | non-   |
| motion   | gravitational  |
|  | forces   |
|  | SP3 Format   |
|  | positions,   |
| Output   | velocities,  |
|  | clocks   |
| Gravity field  | Eigen-S, Sun,  |
|  | Heen Tides   |
|  | moon, ndes   |
| Sat. Attitude  | Can be used  |
| Sat. Attitude<br>Data  | Can be used<br>Phase and   |
| Sat. Attitude<br>Data  | Can be used<br>Phase and<br>pseudorange  |
| Sat. Attitude<br>Data<br>Kinematic   | Can be used<br>Phase and<br>pseudorange<br>Possible with   |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits                                 | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites  |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits                                 | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)   |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits<br>Dynamic orbits               | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)<br>Possible with  |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits<br>Dynamic orbits               | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)<br>Possible with<br>few satellites  |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits<br>Dynamic orbits               | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)<br>Possible with<br>few satellites<br>in view (GEO)                             |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits<br>Dynamic orbits<br>Processing | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)<br>Possible with<br>few satellites<br>in view (GEO)<br>1-step PPP               |
| Sat. Attitude<br>Data<br>Kinematic<br>orbits<br>Dynamic orbits<br>Processing | Can be used<br>Phase and<br>pseudorange<br>Possible with<br>many satellites<br>in view (LEO)<br>Possible with<br>few satellites<br>in view (GEO)<br>1-step PPP<br>processing |

Additional Information: <u>www.gps-solutions.com</u> 1320 Pearl St. Suite 310 Boulder, CO 80301 Tel. 303 402 9150

# PRECISION ORBIT DETERMINATION

POD GNSS SOFTWARE



# **RTOrb**

- Accurate
- Easy to Use
- LEO to GEO
- Post-processing & Real-time

## RESULTS AND APPLICATIONS

RTOrb orbits have been compared to orbits estimated with established high accuracy software systems like the Bernese GPS software.

Comparison with high accuracy POD packages like the Bernese GPS software shows that dcm – level orbit positions and better than 0.2 mm/sec velocities can be achieved in low orbit.



#### Possible applications of RTOrb:

- Positioning from LEO orbit (10cmlevel) to GEO orbit (100 m –level)
- Remote sensing
- Radio occultation POD
- Synthetic Aperture Radar (SAR)

## SOFTWARE FLOWCHART



Initialization of the orbit, cycle slip fixing, ambiguity solution, and outlier rejection are all done in one processing step.

## USER INTERFACE

A GUI interface can be used to run RTOrb. The input requires specification of several files and processing parameters. An example input panel:

| Configure Process | ing <u>H</u> elp             |  |
|-------------------|------------------------------|--|
| INPUT:            |                              |  |
| Rinex File        | pod0bs_2007.036.005.01.01    |  |
| Precise Orbit:    | IGS\${GPSWD}                 | PRE  |
| External Clock    | SELECTED                     |  |
| Reference Orb.    | it lecorb_2007.036.005.01_00 |  |
| Attitude File     | leoAtt_2007.036.005.01_tx    |  |
| Satellite Info    | SATELLIT.                    |  |
| Phase Centers     |                              |  |
| Pole File         | C04_2007,ERP                 |  |
| Gravity File      | EIGEN2.                      | n_max 120 🛫 m_max 120 🛫  |
|                   |                              | and the second s |
| OUTPUT:           |                              |  |
| General Output    | RTORB_30                     | OUT  |
| SP3 Orbit         | RTORB_30                     | PRE Sat. Name L21  |
|                   |                              | Sat. Mass 70 kg  |
|                   |                              | Sat. Area 1.0 m <sup>2</sup>   |
|                   |                              |  |
| PROCESSING OPT    | TIONS:                       |  |
| Processed line    | ear combination:             | Min. Number of Obs.: 4   |
| Sampling:         | 30                           | (sec)  |
| Elevation Mask    | ·· -20 ±                     | (deg)  |
| A Priori Sigma    | a: Code: 3.0                 | Phase: 0.003   |
| Maximum Reside    | Jum: Code: 30.0              | Phase: 0.03  |
| Jump Detection    | ۲:<br>                       | and the second s |
| L4: 10.0          | MW: 9999 P3-L3: 10.0         | P1-L1: 9999 P2-L2: 99999   |
| Receiver:         | Name E2                      |  |
|                   | inding Li                    |  |
|                   | C001 L21 (P0D1)              |  |
|                   |                              |  |
| 1 00 Piev 1       | Next Cancent SavenAs inSave  | Ann Soutput Bertun Garab   |

The estimated parameters are:

- receiver clock corrections
- satellite clock corrections
- phase ambiguities
- initial conditions of the equation of motion (in the form of satellite position and velocity)
- dynamic orbital parameters (air drag and radiation pressure)