

ARIS - Localization of a Sounding Rocket via GPS

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Interim Presentation Bachelor Thesis

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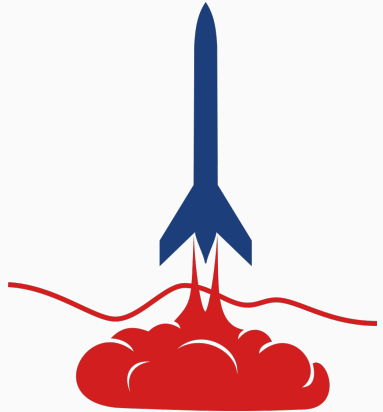
DGPS Concept for a Sounding Rocket

Definition of Task

Framework



Akademische Raumfahrt
Initiative Schweiz



Source: spaceportamericacup.com
Spaceport America Cup

Task

- Evaluate GPS positioning for a sounding rocket
- Determine external and internal disturbances
- Find error mitigation methods
- Demonstrate feasibility of one method

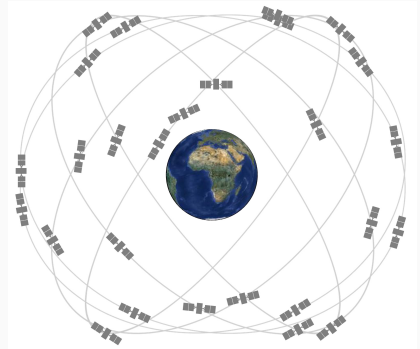
Requirements

- Positioning Standard Deviation(1σ): 1m
- Min. Update Interval: 60s
- Max. TTFF after Burnout: 2s
- Max. Uplink Datarate: 2kbit/s

GPS Concept

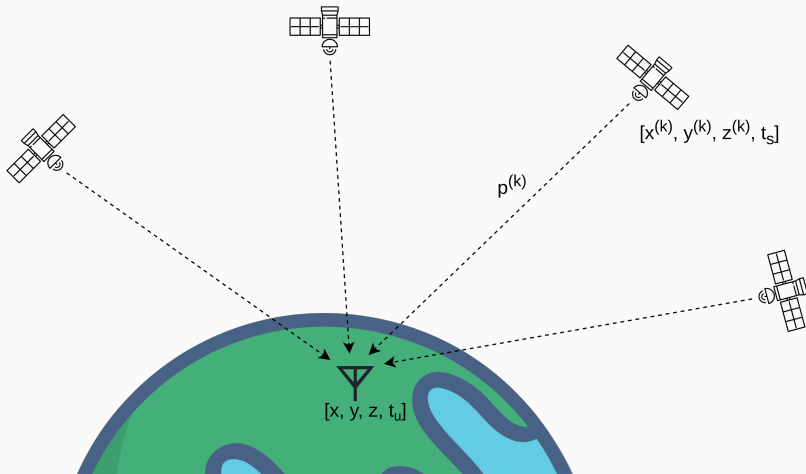
GPS Overview

- Space Segment
 - 31 Satellites (min. 24) in
Medium Earth Orbit
- Control Segment
 - Monitoring and Maintenance
Stations
- User Segment
 - Civil and Military Receivers



Source: gps.gov

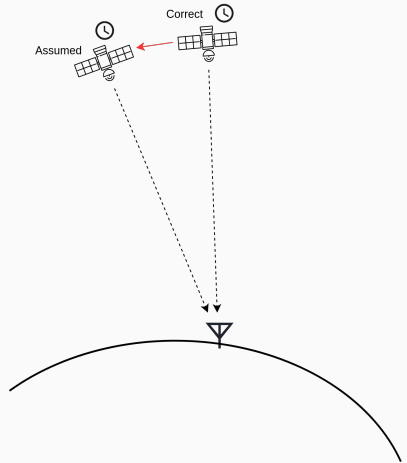
Position Estimation



Errors Sources

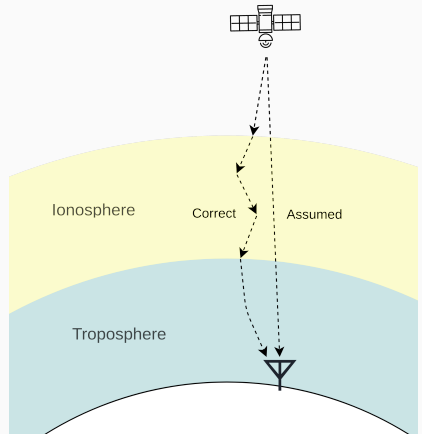
Satellite Errors

- Clock Error
- Ephemeris Error



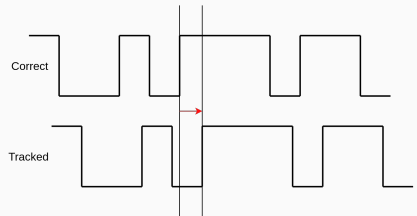
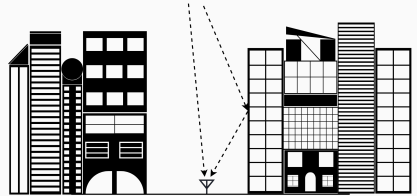
Atmospheric Errors

- Ionospheric Delay
- Tropospheric Delay



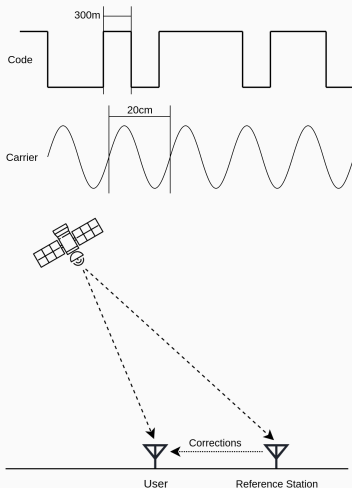
Receiver Errors

- Multipath
- Receiver Noise



Error Mitigation

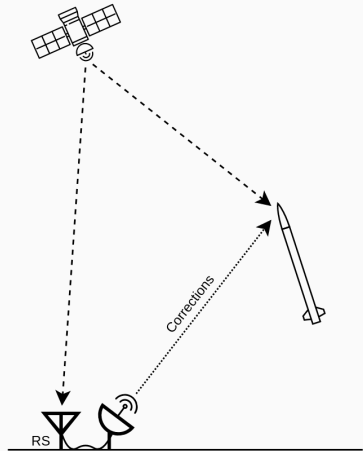
- Carrier-Phase Measurements
- Differential GPS
- Real Time Kinematic
- Dual Frequency Measurements
- SBAS



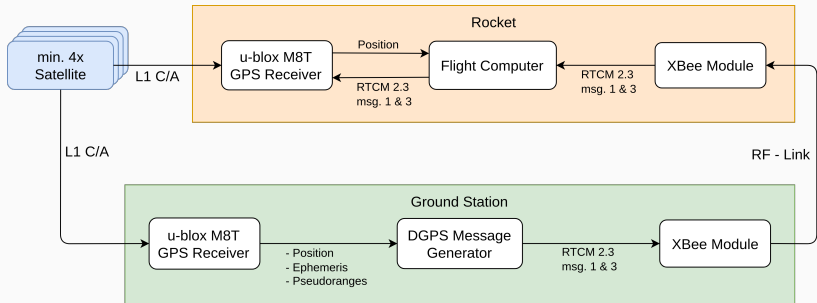
DGPS Concept for a Sounding Rocket

Concept

- Position of RS is known
- RS receives satellite ephemeris data
- Distance between RS and satellite is calculated
- Pseudorange between RS and satellite is measured
- Range error of every visible satellite is sent to rocket
- Receiver on rocket includes corrections in position estimation

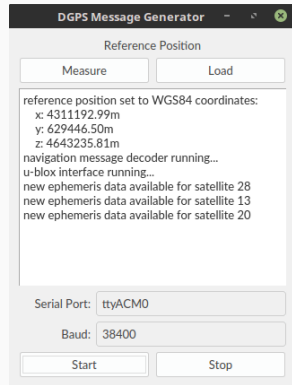


System Overview

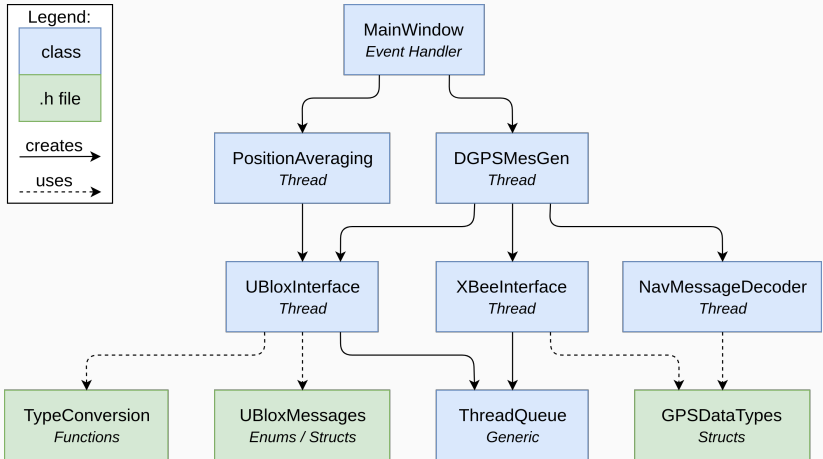


DGPS Message Generator

- Receive UBX messages
- Set reference position
- Decode ephemeris data
- Calculate satellite position
- Calculate pseudorange error
- Encode RTCM messages
- Send RTCM messages



Software Architecture



Tests

- Static Accuracy
- Mobile Accuracy
- Rover / Reference Station Distance
- Height Difference
- Antenna Rotation
- Correction Message Interruption
- Rocket Launch

Questions?