ARIS - Localization of a Sounding Rocket via GPS

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Interim Presentation Bachelor Thesis

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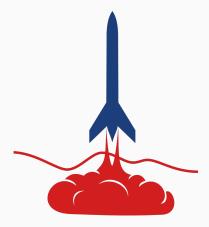
DGPS Concept for a Sounding Rocket

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

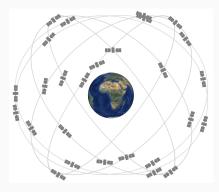
• Positioning Standard Deviation(1 σ): 1m

- Min. Update Interval: 60s
- Max. TTFF after Burnout: 2s
- Max. Uplink Datarate: 2kbit/s

GPS Concept

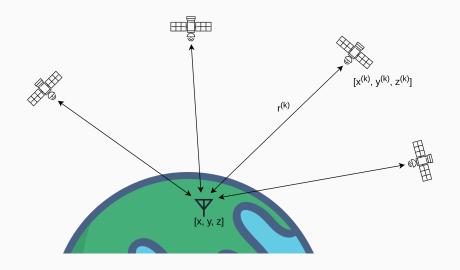
GPS Overview

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



Source: gps.gov

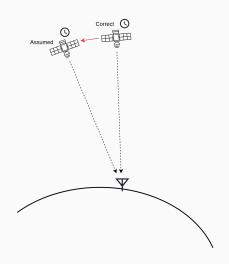
Position Estimation



Errors Sources

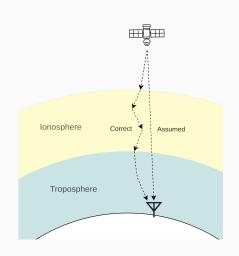
Satellite Errors

- · Clock Error
- Ephemeris Error



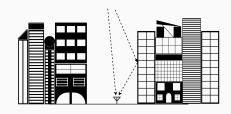
Atmospheric Errors

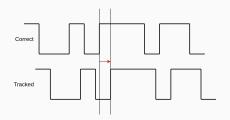
- · Ionospheric Delay
- Tropospheric Delay



Receiver Errors

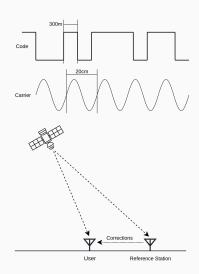
- Multipath
- · Receiver Noise





Error Mitigation

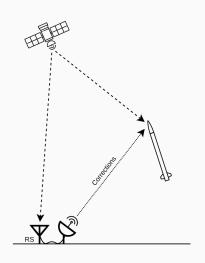
- Carrier-Phase Measurements
- · Differential GPS
- · Real Time Kinematic



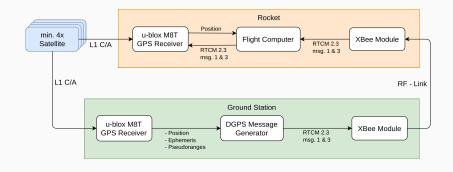
DGPS Concept for a Sounding Rocket

Concept

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



System Overview

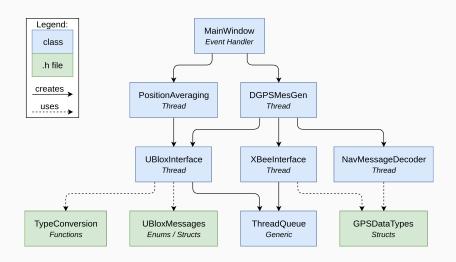


DGPS Message Generator

- Receive UBX messages
- Set reference positon
- 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

