Basics of Satellite Navigation – an Elementary Introduction

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OBSERVATION TECHNIQUES

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Observation techniques

- 7.1 Overview
  - Observation techniques
    - point positioning using a single receiver
    - differential positioning by transmitting corrections from reference site to rover
    - relative positioning by combining data observed simultaneously at two sites

Observation techniques

- 7.2 Point positioning
  - 7.2.1 Point positioning with code pseudoranges
    - Code pseudorange model

      $R_i^j(t) = \rho_i^j(t) + c\delta_i^j(t)$

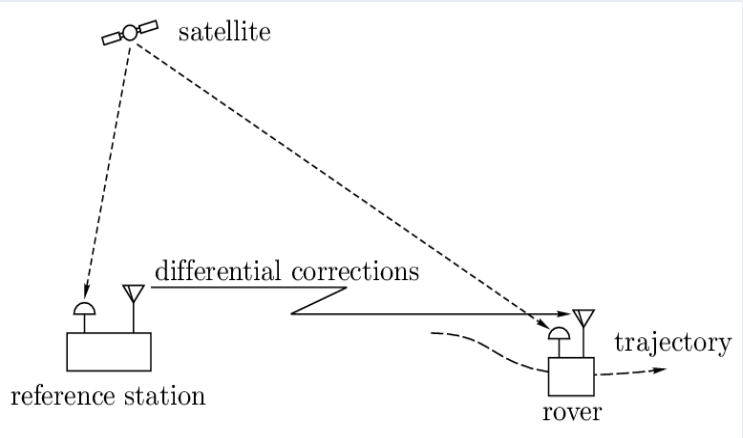
      Note that the geometric range $\rho_i^j(t)$ contains the unknown coordinates in nonlinear form. Thus, linearization is required.

Observation techniques

- 7.3 Differential positioning
  - 7.3.1 General remarks
    - Observing sites
      - Reference site A (base) with known coordinates is usually stationary.
      - Remote site B (rover) to be determined is usually moving.
    - Observables
      - Code pseudoranges (conventional approach)
      - Phase pseudoranges (precise approach)
    - Real-time (or near real-time) technique is denoted Differential GPS (DGPS).

Observation techniques

DGPS: Principle



Observation techniques

- 7.4 Relative positioning
  - 7.4.1 General remarks
    - Relative positioning is the determination of an unknown point B with respect to a known point A via the baseline vector $\underline{b}_{AB}$.
    - Baseline vector

$$\underline{X}_B = \underline{X}_A + \underline{b}_{AB}$$

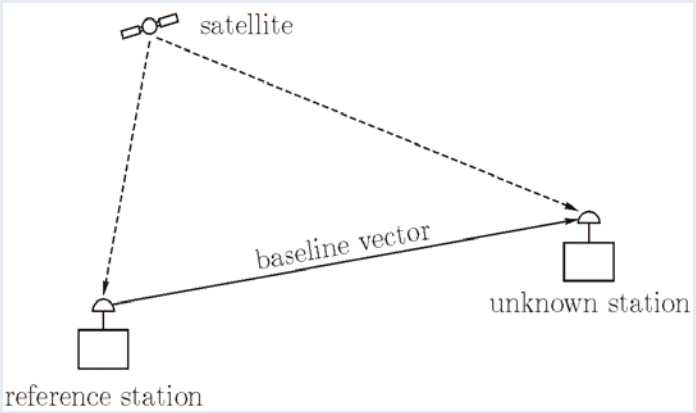
$$\underline{b}_{AB} = \begin{bmatrix} X_B - X_A \\ Y_B - Y_A \\ Z_B - Z_A \end{bmatrix} = \begin{bmatrix} \Delta X_{AB} \\ \Delta Y_{AB} \\ \Delta Z_{AB} \end{bmatrix}$$

Observation techniques

- Baseline determination
  - Simultaneous observation of identical satellites at the two endpoints of the baseline.
  - Linear combination of the observed code ranges or phase ranges.
  - Usually, only phase ranges are considered explicitly.

Observation techniques

Relative positioning: Principle



Observation techniques

- 7.5 Precise Point Positioning (PPP)
  - is a technique for highly precise positioning with only one GNSS receiver
  - 1997 for the first time used in relation with GPS
  - cm accuracy can be achieved under optimal circumstances (but not in real time)