NATIONAL TECHNICAL UNIVERSITY OF ATHENS
SCHOOL OF RURAL AND SURVEYING ENGINEERING
DEPARTMENT OF TOPOGRAPHY
LABORATORY OF GENERAL GEODESY

ACCURATE ORIENTATION OF THE GYROSCOPE'S CALIBRATION SYSTEM

TECHNICAL CHAMBER OF GREECE

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HELLENIC ASSOCIATION OF RURAL & SURVEYING ENGINEERS

FIG Working Week Athens, Greece
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GYROTHEODOLITE

Used for:

- The initial orientation of the 3D – geodetic networks
- Underground surveying works in caves and mines.
- Orientation of airport radar or satellite antennas.
- Ship navigation
- Orientation of army systems

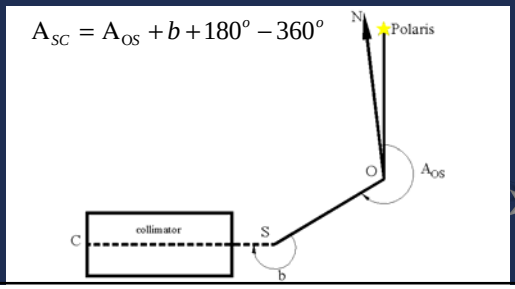
Advantages

- Determines the astronomical azimuth with high accuracy for common geodetic field works
- Its operation is independent from the sight and light conditions.
- The build-in gyroscope attachment doesn't prevent other measurements by the theodolite.

CALLIBRATION

- Check and calibration by using a collimator
- The astronomical azimuth of the collimator's line of sight must be determined

$$A_{SC} = A_{OS} + b + 180^o - 360^o$$



DETERMINATION OF THE ASTRONOMICAL AZIMUTH

Astronomical azimuth may be determined by the following methods:

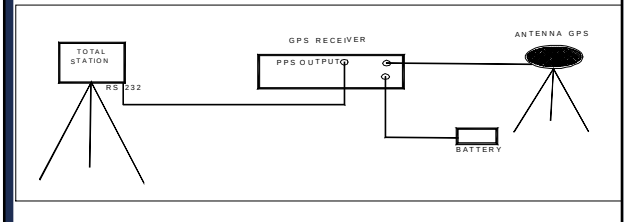
By determining the direction of the meridian of the station point

1. by equal altitudes of a star
2. by observing a circumpolar star near elongation

By measuring the angle between the vertical circle of the station point and the vertical circle of a celestial body

3. Ex-meridian observations to stars or the Sun, in which altitudes are measured
4. Observing a close circumpolar star at any hour angle

The system



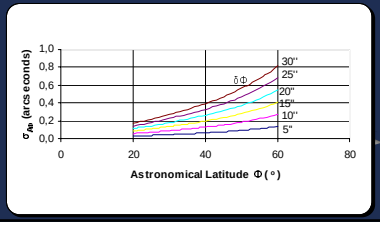
Measured

Horizontal angles ±1cc

UTC Time ±1msec

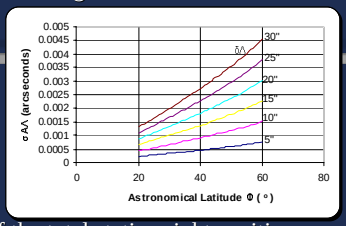
ERROR ANALYSIS (1)

- The internal uncertainty is, about ±0″.3
  - ✓ Sighting error
  - ✓ The hour angle method error
- The external uncertainty
  - ✓ The error from the celestial coordinates (α, δ) of Polaris
  - ✓ The error from the estimate value of the astronomical latitude



ERROR ANALYSIS (2)

The error from the use of an estimate value of astronomical longitude



- ✓ Errors of the total station right position
- ✓ The uncertainty of the sigthing of the initial direction
- ✓ The error in the measurement of the horizontal angle b

Total determination error ≈1″.5

APPLICATION

Laboratory

Special accessories

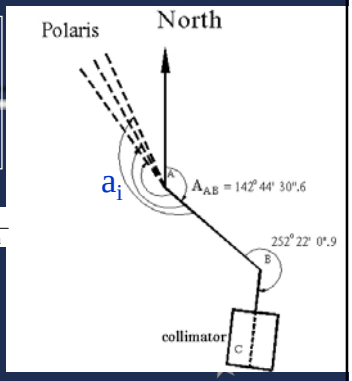
APPLICATION

- The UTC time
- The geodetic coordinates φ, λ..
- The celestial coordinates α, δ of Polaris.

$$A_p = \arctan \frac{-\sin}{\cos \Phi \cdot \tan \delta - \sin \Phi \cdot \cosh}$$

The horizontal angle a_i

A_{AB}



CONCLUSIONS

The determination of the astronomical azimuth of a collimator's axis or any other arbitrary direction may be done by an accuracy of about ±1″ by using the above described system, the total station and the GPS receiver, by the hour angle method and by sightings to Polaris.

Special attention is needed to the marking of any points, which determine the directions, and also attention is needed to the measurement of the corresponding angles.

The total duration of the application of the above methodology is about 1 hour.

This methodology appears as convenient, fast, accurate and low cost, as the accurate periodical check of the gyroscope thodolite is necessary.

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Thank you for your attention

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