



## **Global height datum unification based on potential theory**

**A. Ardalan** and A. Safari

Department of Surveying and Geomatics Engineering, University of Tehran (ardalan@ut.ac.ir)

The problem of “global height datum unification” is tackled in the potential space based on: (1) high-resolution local gravity field modeling, (2) availability of GPS coordinates of the reference benchmark, and (3) known value of the geoid’s potential. The high-resolution local gravity field model is derived based on solution of the fixed-free two-boundary value problem of the Earth’s gravity field using observables of the type:

1. Gravity, including:
  - (a) Gravity potential (from precise leveling),
  - (b) Modulus of gravity vector (from gravimetry),
  - (c) Astronomical longitude and astronomical latitude (from geodetic astronomy and/or combination of GPS observations with total station observations, i.e., GPS/LPS observations, Grafarend and Awange, 2000).

2. Satellite altimetry

Based on the derived high-resolution local gravity field model, the gravity potential value of the zero point of the height system is computed. The zero point of the height system is located by the GPS coordinates of the reference benchmark, usually close to a reference tide gauge station, and the height of the reference benchmark according to the national height system. Then the difference between derived potential value and the known geoid’s potential value is computed. This potential difference gives the deviation of the zero point of the height system from geoid in the “potential space”, which can be transferred into “geometry space” by using a proper transformation

formula. The required transformation is derived and presented in the paper with all details. The method has been numerically tested by computing the deviation of zero point of the Iranian height system from geoid. According to the computations, the height datum of Iran is  $0.094\text{ m}$  below the geoid and as such, this value must be subtracted from all heights given in Iranian height system. Since in this method the zero point of a height datum is located with respect to geoid in potential space, where the geoid is identified by its potential value rather than its location, global height datum unification can be achieved by considering even a conventional value for the geoid's potential. Transformation of height datum from the continents to the islands could also be mentioned as the applications of the proposed method. Besides, the constructed boundary value problem has the capacity of incorporate any type of the Earth's gravity observables in a simultaneous system of equations, and as such can guarantee the maximum achievable accuracy based the available gravity observables.