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Geodetic vertical control network in the KSA

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The General Directorate for Surveying and Mapping (GDSM) carries out aerial photography and produce large-scale detailed maps for about 200 cities and villages in the KSA. Thus, it has established country-wide geodetic vertical control network. While the terrain is rather smooth at many regions like central and eastern, expanded areas of western and southern regions have rough mountainous topography. The vertical control for the KSA was first established in 1960's and 1970's using classical leveling techniques. Combining the Earth Gravity Model of 1996 (EGM96) with Global Navigation Satellite Systems (GNSS) Orthometric heights became available KSA-wide with metric precision starting on late 1990's. In order to improve this, a project of GNSS/Leveling has been carried out country-wide. Out of many thousands of benchmarks established decades ago, only 460 were recovered. These recovered benchmarks do cover some regions well, while other regions (e.g. south west) are poorly covered. Thus, 1,800 km of precise digital leveling was conducted to determine the Orthometric heights of 346 newly-established benchmarks. When surface fitting algorithms were tested, boundary conditions showed significant deterioration due to extrapolation, thus 45 points were selected on Arabian Gulf, Red Sea and Mediterranean as boundary constraints, and their Geoid heights were computed from EGM96. To decide on best surface fitting algorithm, all 8 algorithms of Minimum Curvature, Kriging, Thin Plate with Collocation Matrix (TPCM), Bi-Cubic Spline, Polynomial Regression, Inverse Distance to a Power, Modified Shepard's, and Moving Average were used, tested, and analyzed. The list was shortened into the two algorithms that gave best results: Kriging and TPCM. Further tests were conducted to reveal that Kriging seemed to be fitting better surface than TPCM when EGM96 is adopted as a base.

All these tests along with comparative results will be presented in detail.