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Astro-geodetic Measurements using Digital Zenith Camera System in Istanbul-Turkey

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The determination of earth's gravity field and its change as a function of time is a major problem in geodesy and geophysics. Recently, there have been many theoretical and applied researches, which focus on geoid determination as a main reference surface (datum). Astro-geodetic technique is one of the oldest and the most fundamental technique used for geoid determination. Restrictions in direction measurements with analog instruments, and time measurements decreased the usage of this method. However, tilt measurements, UTC synchronized time measurements, and CCD technique made significant developments in astro-geodesy, which are aimed to make improvements in measurement accuracies. Hence, astro-geodetic measurements remove the restrictions of gravity measurements in mountainous regions and coastlines. From this point of view, with its suitable topography Turkey is an ideal test area for measurements as such.

Researches on astro-geodetic geoid determination techniques using Digital Zenith cameras are published by some universities around Europe (Vienna TU, IfE Hannover, ETH Zurich, and AGH-UST in Poland) in the last decade. These various zenith camera systems equipped with CCD sensors for imaging stars near zenith and with GPS devices to obtain ellipsoidal coordinates and precise time in order to determine the direction of the plumb line. These systems are designed and tested either for insufficiency of conventional techniques or for the essential high precision astro-geodetic measurements.

In the scope of this study, a new CCD equipped telescope is designed as Zenith Camera in order to perform astro-geodetic observations in Istanbul. The system contains a CCD camera, Schmidt-Cassegrain type telescope with 14 inches aparture, two inclinometers, a dual frequency geodetic GPS receiver used for time measurements and ellipsoidal coordinates of station, and a computer control unit for data capturing and system control. This new Digital Zenith Camera system is capable of capturing stars up to approximate apparent magnitude of 18.5. Yet, the long aperture of optical component of Zenith Camera limits the image dimensions on the celestial sphere which is 14'x21'=0.81deg^2 (FOV) for 22.3 x 14.9 mm (4.7μm pixel size which is equal to an angular scale of 0.18") sensor size.

First observations are performed in Kandilli Observatory and Earthquake Research Institute and the performance of capturing stellar objects is tested. Two different kinds of CCD cameras are used in different observation epochs with different exposure times. Further studies are going to be carried out on performing photogrammetric camera calibration using stellar objects and on increasing leveling accuracy of the system with precise inclinometers.

In this presentation, the different stages of the first observations of Digital Zenith Camera System of Turkey will be evaluated. Those stages include the design, the field works, data capturing, and data processing steps. In line with the shared experiences, future studies will be questioned and discussed in order to achieve the necessary higher precision in astro-geodetic observations.