ISTANBUL KULTUR UNIVERSITYINTEGRATING MOBILE MAPPING,GPS AND GIS TECHNOLOGIES

by

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ABSTRACT

A detailed definition of Global Positioning System (GPS) as given by *Wooden* 1985] reads: "The Navstar Global Positioning System (GPS) is an all weather, space based navigation system under development by the U.S. Department of Defense (DoD) to satisfy requirements for the military forces to accurately determine their position, velocity, and in a common reference system, anywhere on or near the earth on a continuous basis".

Despite the main military goal of GPS, it has attracted a broad spectrum of users. Moreover, it has become an essential component of various applications ranging from surveying and mapping as well as precise time determination, vessel navigations and oceanography to international air traffic management [*Parkinson et al.,* 1994].

Basically, GPS is comprised of three main segments: the space segment, the control segment and the user segment. The purpose of these segments is to provide continuous reliable positioning and timing services for GPS users. The space segment consists of 24 satellites orbiting around the earth at an altitude of about 20200 km and with a period of Approximately 12 hours as illustrated in Figure 2.1 [*Hoffmann-Wellenhof et al*., 1994].

Each satellite transmits a signal that includes the navigation messages based on periodically uploaded data from the control segment. The control segment is a set of monitor stations, ground control stations, and a master control station (that is the central control node for GPS operations) and backup master control station. The user segment consists of GPS receivers from wide varieties of manufacturers. These receivers process The received GPS signals and compute the user position.

The GPS reference coordinate system is the World Geodetic System 1984 (WGS-84) [*Decker,* 1986]. The user's coordinates are determined in this frame and can then be transformed to other systems. Timing is the heart of GPS; GPS time uses an atomic time scale. GPS time is defined as the number of seconds elapsed from Saturday midnight of the present week. The GPS time was coincident with Universal Time Coordinated (UTC is maintained by the U.S. Naval Observatory USNO) at the GPS standard epoch of January 6, 1980.

GPS time is synchronized with UTC at the microsecond level, within an integer number of seconds. The integer offset between GPS time and UTC arises because of the leap seconds periodically inserted for UTC [*Hoffmann-Wellenhof et al*., 1994].

Fundamentals of GPS signal structure, observations and error sources, as well as a brief history of the Global Positioning System, Segments of the GPS, A primer on how the GPS works, Problems with the GPS, Advancements in the GPS are presented in the following sections. These fundamentals are directly relevant to the research presented in this thesis.

Mobile mapping has been the subject of significant research and development by several Research teams over the past decade. A mobile mapping system consists mainly of a moving platform, navigation sensors, and mapping sensors. The mobile platform may be a land vehicle, a vessel, or an aircraft. Generally, the navigation sensors, such as GPS (Global Positioning System) receivers, vehicle wheel sensors, and INS (Inertial Navigation System), provide both the track of the vehicle and positional and orientational information of the mapping sensors. Objects to be surveyed are sensed directly by mapping sensors, for instance CCD (Charge Coupled Device) cameras, laser rangers, and radar sensors. Since the orientation parameters of the mapping sensors are estimated directly by the navigation sensors, complicated computations such as photogrammetric triangulation are greatly simplified or avoided. Spatial information of the objects is extracted directly from the georeferenced mapping sensor data by integrating navigation sensor data. Mobile mapping technology has evolved to a stage which allows mapping

and GIS industries to apply it in order to obtain high flexibility in data acquisition, more information with less time and effort, and high productivity. In addition, a successful Extension of this technology to helicopter - borne and airborne systems will provide a powerful tool for large scale and medium scale spatial data acquisition and database updating. This thesis provides a systematic introduction to the use of mobile mapping technology for spatial data acquisition. Issues related to the basic principle, data processing, automation, achievable accuracies and a break down of errors are given. Application considerations and application examples of the technology in highway and utility mapping are described. Finally, the perspective of the mobile mapping technology is discussed.