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EXAMINATION OF ACCURACY AND EFFICIENCY OF THE GPS AS A SHIPBOARD NAVIGATOR UP TO EARLY 1992 IN TAIWAN REGION

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ABSTRACT

C/A coded receivers were used to investigate accuracy and efficiency of positioning as a navigator on ships in 3D/2D GPS or DGPS measuring schemes. To date, in Taiwan offshore region 3D GPS may give over one hundred meters error of point positioning even at PDOP values lower than 5 and has an efficiency (hours positioning obtained in a day) at about 70% at satellite cutoff angle of 5°. DGPS reduces the positioning error significantly to about ±5 m with "SA" activated in the condition of both remote and reference receivers observing identical group of satellites. To enlarge efficiency of using GPS receivers without losing positioning accuracy, it is recommended to accept those low elevated satellites (lower than 5°) which are generally cut off during high precision geodetic carrier phase measurement; however, to ensure the task of DGPS efficiently accomplished, a proper site selected for reference station without any obstruction arround is most important. In addition, when doing survey in a limited area of Taiwan offshore, 2D DGPS with "height h" set at a pre-measured height (averaging 20 m) is best choice giving high efficiency and good accuracy of the positioning.

INTRODUCTION

With the advent of satellite-based navigation system known as the Global Positioning System (GPS) run by the Unite States Department of Defense, for a user with the proper receiver, an instantaneous three-dimensional positioning accurate to several meters has been possible. This capability will be extended to almost all parts of the globe when the constellation of 24 satellites is completed in the year 1993.

The space segment of GPS is a constellation of satellites in Earth orbit at an altitude of about 20,000 km equipped with highly stable rubidium or cesium clocks (with an accuracy better than a microsecond) and powerful radio frequency transmitters (with two L-band carrier frequencies at 1.57542 GHz of the L1 and 1.22760 GHz of the L2). In the L1 carrier the precision (P) code and the coarse/acquisition (C/A) code, together with a low bit rate of satellite message are modulated (the L2 is modulated without the C/A code). These codes construct like pseudorandom square wave and the code-correlating receivers can recover the carrier phase to obtain distance information. Eventually, a receiver (observer) can locate its positition by determining the distance between itself and three satellites (at least) whose orbital positions are specified by the message transmitted from the satellites (referred to as pseudorange positioning).

There are two basic measurements through the GPS positioning: pseudorange measurement and carrier phase measurement. High precision geodesy measurement, such as strain measuring for crustal deformation, for centimeters scale

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