

**GPS TOTAL ELECTRON CONTENT (TEC) AND POSITION RANGE RATE ERROR  
USING MALAYSIA DATA**



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## **PROPOSED EXECUTIVE SUMMARY**

Global Positioning System (GPS) is currently one of the most popular global satellite positioning systems due to global availability of signal as well as performance. For improving radio communication links it is essential to know the behavior of ionospheric characteristic with high temporal and spatial resolution and to know these characteristic with the best possible accuracy. The ionospheric effects in the propagation of GPS signal is one of the main sources of error in GPS precise positioning. The problem occurs in determining the GPS signal path from a particular satellite position to receiver (or vice versa) as the signals are not constant and depend on propagation medium. Among prominent factor why this study is being conducted is to obtain information about the characteristics of ionosphere in Malaysian geographical area especially on the value of total electron content (TEC). TEC is a major source of GPS positioning error, ever since the turn off of Selection Availability (SA) in year 2000. This research studied the TEC value for Malaysia regions, based on location of the receivers (latitude, longitude, height), time of the day and solar cycle . The 13 locations of GPS receiver stations across West Malaysia were chosen and their TEC values were compared. The determination of the TEC value in ionosphere is done using 'leveling' process. In the process, the error translated from code-delay to the carrier-phase is assessed to reduce carrier phase ambiguities from the data. The positioning error can be calculated as one unit of TEC introduces a range error of approximately 0.16 meters at the L1, 1.6GHz frequency of GPS. For this project, we will have a knowledge about the accuracy of GPS as we moved from one location to another and from clock time to another at different solar cycle.

## ENHANCED EXECUTIVE SUMMARY

The integral of electron density along the path, known as Total Electron Content (TEC) is a major source of GPS positioning error, ever since the turn off of Selection Availability (SA) in year 2000. Ionization process is mainly caused by solar radiation. Therefore, the density of electrons is very much dependant on location and time of the day, as well as season and sunspot cycle. This paper studied the TEC value for Malaysia regions, based on location of the receivers (latitude, longitude, height) and time of the day. The 13 locations of GPS receiver stations across West Malaysia were chosen and their TEC values were compared. The determination of the TEC value in ionosphere is done using 'leveling' process. In the process, the error translated from code-delay to the carrier-phase is assessed to reduce carrier phase ambiguities from the data. The positioning error can be calculated as one unit of TEC introduces a range error of approximately 0.16 meters at the L1 1.6GHz frequency of GPS. For this project, the calculated TEC range errors were from -3.1 meters to 7.2 meters at different receiver locations. In addition, for the 24 hours observation, the range errors varied from 1.4 meters to 6.6 meters, with the peak value at 15 hour local time and minimum at 1 hour local time