

# GPS 反射訊號應用於海面水位觀測

## GPS Reflected Signal Applied on the Sea Elevation Observations

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### 摘要

本論文敘述以雙頻接收儀利用架設於海堤並指向海面之左旋圓形偏極化天線接收以 GPS 衛星當作訊號源於海面反射之反射訊號，同時以 10 Hz 之頻率接收 5 顆以上 GPS 衛星之反射訊號，利用直接訊號與反射訊號兩者之雙頻相位觀測量與兩訊號所解算之高程差異求得海面高程，並利用都卜勒頻移估算出海面波浪起伏垂直方向的變化速率，實驗結果顯示由 GPS 衛星 PRN 11、PRN 25 與 PRN 31 海面反射訊號解算之平均海面高程為 -1.085 m，最大波高變化速率介於 -7 m/s ~ 7 m/s 之間。海面反射點高程變化經過一維穩態小波轉換濾波器濾波後，可看出海面之波浪起伏，本研究之優點為可以取得連續密集的資料並可即時解算，可應用於水位觀測。

關鍵字：GPS、反射訊號、都卜勒頻移、變化速率、水位觀測

### Abstract

This thesis narrates that utilizes a left-hand circularly polarized antenna which was located on the sea wall and pointed to the sea surface. This equipment could receive the measurements of the global positioning system (GPS) carrier phase with 10 Hz sample rate after reflection on the sea surface and estimate the altitude of sea surface, waveforms, and vertical variation velocity of tide. The results present that average sea level is -1.085 m which estimated from the reflected signal of PRN 11, PRN 25 and PRN 31. Using Doppler shifts and ocean reflection positions altitude to conduct the velocity of sea states are among -7 m/s ~ 7 m/s. Through the Stationary Wavelet Transform De-noising 1-D filter, author can obtain sea level variation. The system provides GPS reflection continuous data, and real-time geodetic solutions. Meanwhile, the future application is including water level observations.

Keyword : GPS Reflected signal, Doppler shift, variation velocity, water level observations.

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