GPS 反射訊號遙測應用於河川流速計算

Reflected GPS Signals Applied in Remote Sensing Stream Flow

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摘要

本研究將河水反射面假設為移動之表面；利用右旋 GPS 訊號相位與經過水面流動所產生的左旋 GPS 訊號相位觀測量之都卜勒頻移量（Doppler shift）與精確求解反射水面之位移量，並進行反射訊號都普卜頻率模式微分運算，進而求出河川流速之三個分量 (v_x, v_y, v_z)。本實驗所採用特殊設計之右旋及左旋圓柱形極化天線，在同一時間接收直接從衛星發射的 GPS 直接訊號與經過地表或河流水面反射之減弱的 GPS 反射訊號，並能夠穩定地被接收與分析。如此便可得同一時間之直接及反射訊號觀測量與定位資料。本研究應用 GPS 反射訊號之相位觀測量，並透過偵獲反射訊號過程加以比對直接訊號相位觀測量、訊號強度、時間修正延遲量、大氣修正延遲量之修改與設計後；求解相位觀測量整數未定值以及反射點位置與高程，並可進一步分析水流速度精確到 0.1m~5.0m/sec 之範圍內。

關鍵字：GPS 反射訊號、都卜勒頻移量、河川水面流速

Abstract

This paper is study and exploiting for three vectors of stream flow by assuming the reflected surface would be like as a moving surface and causing Doppler shift at reflected moving surface. The stream flow is developed and methodized by the three dimensional instantaneous movements of each reflected accuracy positions and the difference of Doppler shifts between the GPS reflected signals and direct signals per each satellite. In this paper, Authors designed RHCP's antenna and three LHCP's cylinder antennas for measurement at stream flow and water level. Both RHCP and LHCP antennas are employed so that direct and reflected signals can be acquired simultaneously. The study exploits the carrier phase of reflected signals and compared with that of direct signals. The high accuracy reflected position is depended by correcting the clock time delay and atmospheric delay using LAMBDA method for integer ambiguity solution, so the positions for each reflected point are accurately obtained. Analysis of the estimated velocity result, the accuracy can be in the range of 0.1m~5.0m/sec

Key words: Reflected GPS signal, Doppler shift, stream water surface velocity

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