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4 Performance Analysis of Real Time Kinematic GNSS Services in Taiwan

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Introduction

- eGNSS, an VRS based service (Trimble Pivot)
- Comprises of 90 CORS
- Frequent reports of no fixed solution. The current service status is to announce I95 index value for the past one hour, and advise users to avoid operation during high value hours.
- Is I95 an effective index?

I95

- Introduced in Wanninger (1999)
- The I95 index is based on the differential ionospheric residuals as computed in a network of GPS reference stations (Wanninger, 2004).

Data and Analysis

- A CORS operated by National Yang Ming Chiao Tung University (NYCU). The receiver is a Trimble NetR9. The antenna type is Zephyr Geodetic 2 RoHS.
- The sampling rate is 1 Hz. Positioning data is recorded in NMEA-0183 GPGGA sentences. For the analysis documented in this writing, 10 days observation, from Feb. 24 (DOY 055) to March 5 (DOY 064), 2023, were used.

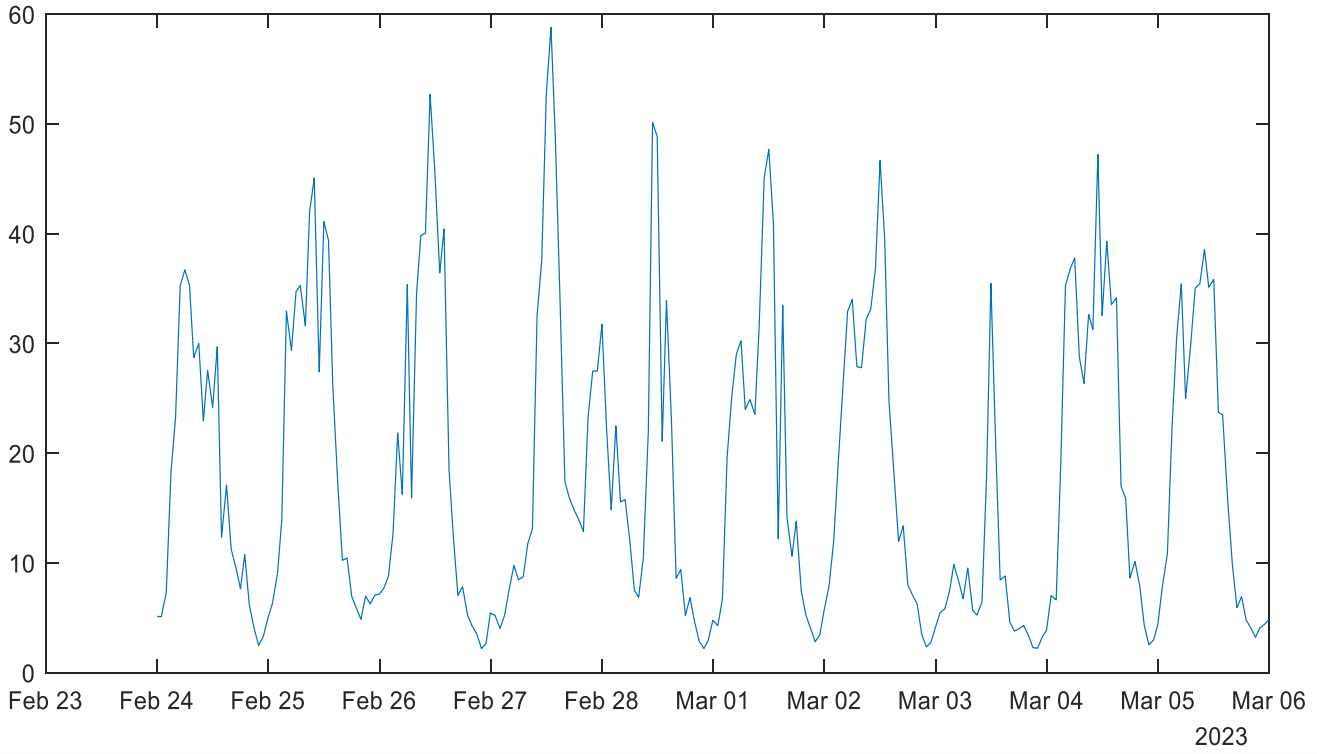
$GPGGA

- 0: Fix not valid
- 1: GPS fix
- 2: Differential GPS fix (DGNSS), SBAS, OmniSTAR VBS, Beacon, RTX in GVBS mode
- 3: Not applicable
- **4: RTK Fixed, xFill**
- 5: RTK Float, OmniSTAR XP/HP, Location RTK, RTX
- 6: INS Dead reckoning

The occurrences of quality codes

Code	Count	Percentage
1	387	0.045
2	3,007	0.35
4	847,444	98.1
5	13,162	1.523

The I95 time series



eGNSS recommendation

- The operational threshold value for I95 is 30. Higher than 30, eGNSS operation is not recommended.

The quality codes and I95

Code	>30	<30
1	84	303
2	452	2,555
4	207,458	639,986
5	5,161	8,001

Concluding Remarks

- From the preliminary assessment of the eGNSS service performance, the success rate of fixed positioning is about 98%. This rate is higher than the experiences of field surveyors and UAV operators.
- Failed cases may not be fully contributed from the ionospheric effects. At least, not the ionospheric effect measured with I95.

Concluding Remarks

- Because the NYCU CORS has a full open sky view, the high success rate may be contributed from the large number of observed satellites. 93% of the epochs observed more than 10.
- There are also 5,133 epochs with 4 to 6 satellites in total. The cause of low satellite number is currently unknown. Further investigation is needed. There are 4,338 code 5 epochs with satellites less than 10.

Analysis+

- The monitoring has been carried on after March 5. The daily fixed solution rate could be as low as ~80% on NCTU station.

Analysis+

Date	# of epochs	# of code 4	Percentage
2023/4/14	86400	84255	97.52%
2023/4/15	172800	85467	98.92%
2023/4/16	259200	84905	98.27%
2023/4/17	345600	83612	96.77%
2023/4/18	432000	70576	**81.69%**
2023/4/19	518400	82804	95.84%
2023/4/20	604800	82296	95.25%
2023/4/21	691200	84453	97.75%
2023/4/22	777600	84797	98.14%
2023/4/23	864000	85385	98.83%
			95.90%

Analysis+

- Field validation in Taoyuan, could not receive fixed solution in several hours (LMT: 19.32-24.7). But, finally received fixed solution in midnight.

Thank you all