



PLANET · SmartPNT
多源融合智能导航

Data00_20240706_100C_CAR_complex Data Description

School of Geodesy and Geomatics, Wuhan University

July 2024

Directory

1	Overview	3
2	Collection Devices	3
2.1	Devices Overview	3
2.2	Devices Lists	4
2.3	Introduction to the Main Devices.....	5
2.3.1	Novatel SPAN-ISA-100C	5
2.3.2	HGuide I300	5
2.3.3	Novatel PwrPak7	6
2.3.4	Septentrio mosaic-X5	6
2.4	Devices Connections Relationship.....	8
2.5	Devices Installation Relationship	8
2.5.1	Coordinate System Definition	8
2.5.2	Lever Arm Relationship.....	8
3	Data Collection Trajectory.....	9
4	Data Inventory.....	10
5	Data Overview	11
6	True Value Processing.....	12
6.1	Processing Methods	12
6.2	Computation Results	13
6.2.1	Ambiguity Fixed Situation	13
6.2.2	IMU flag	13
6.2.3	Forward/Backward Position Discrepancy	14
6.2.4	Forward/Backward Attitude Discrepancy.....	14

1 Overview

Data Packet Name: Data00_20240706_100C_CAR_complex

Collection Date: 2024.07.06

Collection Location: Wuhan City, Hubei Province, China

Collection Scene: Open Sky; Urban Area; Street Trees

Collection Method: Through the remote control four-wheeled cart for acquisition

2 Collection Devices

2.1 Devices Overview

The data packet was acquired by SmartPNT-mini, a multi-source navigation sensor platform (integrating multiple sensors such as a vision camera, LIDAR, inertial navigation unit, and GNSS receiver), a Novatel SPAN-ISA-100C inertial measurement unit, and a GNSS receiver. All the equipment are carried by a remote-controlled four-wheeled cart. The schematic diagram of the acquisition vehicle and equipment is shown in Figure 2-1 (see Table 2-1 for details of the specific models of equipment corresponding to the equipment abbreviations in the figure).

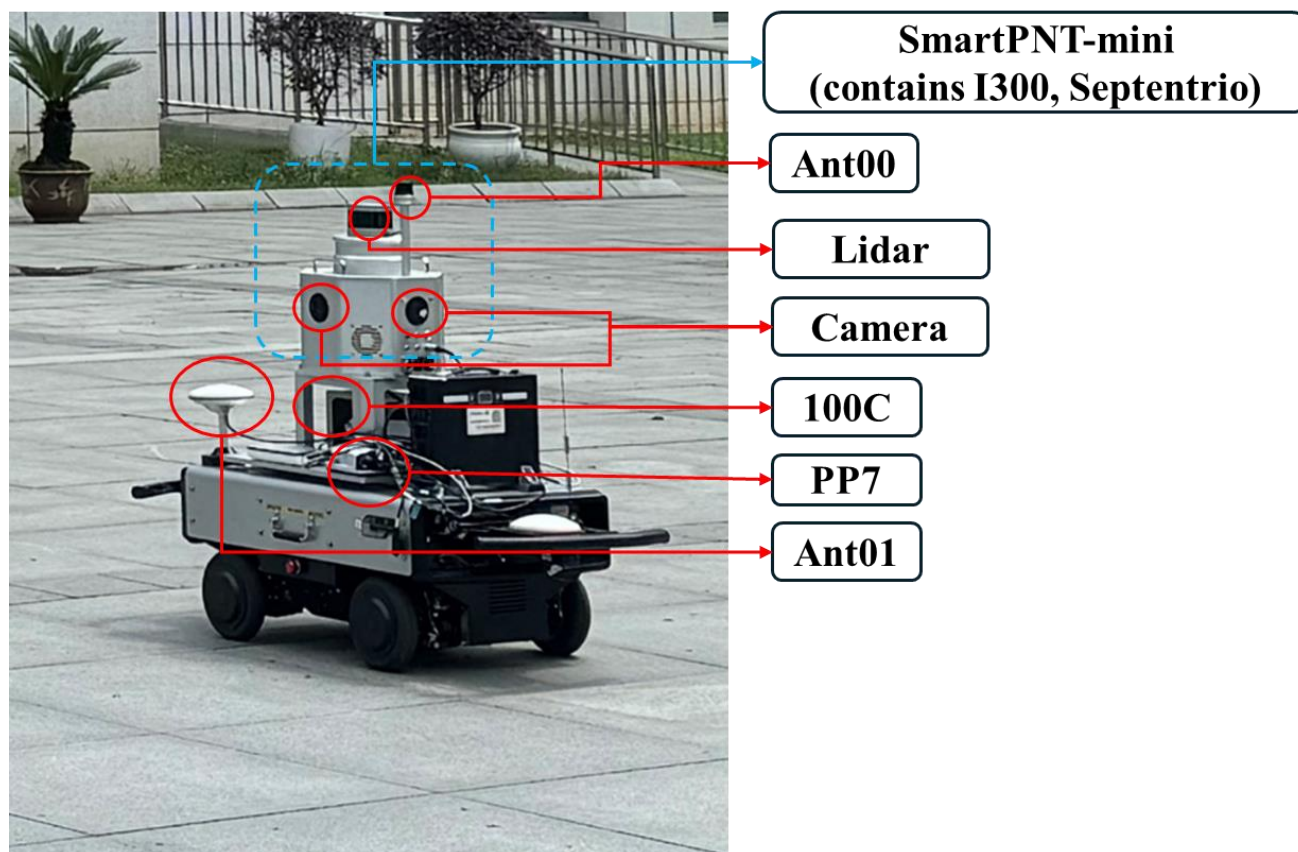


Figure2-1 Schematic diagram of acquisition equipment

2.2 Devices Lists

Table2-1 Devices Inventory List

Type	Model	Abbreviation (The devices' names in the text are all referred to by the abbreviations in this table)	Quantity
IMU	Novatel SPAN-ISA-100C	100C	1
	HGuide I300	I300	1
GNSS	Novatel PwrPak7	PP7	1
Receiver	Septentrio mosaic-X5	Septentrio	1
Antenna	Hitarget spiral antenna	Ant00	1
	bynav BY500	Ant01	1

2.3 Introduction to the Main Devices

2.3.1 Novatel SPAN-ISA-100C



Figure2-2 Novatel SPAN-ISA-100C

The SPAN-ISA-100C is a near-navigation-class inertial measurement unit that integrates a three-axis fiber optic gyroscope and a full-temperature compensated MEMS accelerometer. In this acquisition, the SPAN-ISA-100C interacts with NovAtel's PwrPak7 receiver through a high-reliability IMU interface, and the PwrPak7 receiver fuses GNSS and IMU measurement data to output high-precision 3D position, velocity, and attitude information at a frequency of 200Hz.

2.3.2 HGuide I300



Figure2-3 HGuide I300

The HGuide I300 is a tactical-grade inertial guide that can be easily integrated into a variety of architectures with its industry-standard communication interface and wide input voltage range, featuring small size, light weight, and low power consumption. The HGuide i300 includes MEMS gyroscopes and accelerometers that utilize an internal environmental isolation system to attenuate unwanted inputs commonly found in real-world applications, ensuring the HGuide i300's ruggedness. The HGuide i300 includes MEMS gyroscopes and accelerometers, and utilizes an

internal environmental isolation system to attenuate unwanted inputs commonly found in real-world applications, ensuring that the HGuide i300 is rugged. The device outputs inertial data at 200 HZ for this acquisition.

2.3.3 Novatel PwrPak7



Figure2-4 Novatel PwrPak7

The PwrPak7 is a compact receiver capable of receiving expandable GNSS signals, with internal storage and INS options. It can track all current and upcoming GNSS constellations and satellite signals. It also offers optional integrated INS support for continuous position, velocity, and attitude determination during short GNSS interruptions. The PwrPak7 features a powerful GNSS engine, onboard NTRIP v1.0 and v2.0 client and server support, 16 GB of internal storage, and enhanced connectivity options (including serial, USB, CAN, and Ethernet). For this data collection, the PwrPak7 receiver was connected to the 100C and Ant01, outputting fused raw observation data from GNSS and IMU.

2.3.4 Septentrio mosaic-X5



Figure2-5 Septentrio mosaic-X5

The Septentrio mosaic-X5 is a high-precision GNSS module with full constellation and multi-frequency capabilities, designed with a low-power surface-mount package and multiple interfaces. It

is specifically designed for large-scale applications such as robotics and autonomous systems, capable of tracking all GNSS constellations and supporting both current and future signals. With its built-in AIM+ anti-jamming technology, the Septentrio provides robust support for industrial high-precision GNSS positioning applications. During this data collection, the Septentrio was placed inside the SmartPNT-mini and was primarily used to receive mobile station observation data.

2.4 Devices Connections Relationship

Table2-2 Device Connection Relationships

Combinations	GNSS Receiver	IMU	Antenna
①	PP7	100C	Ant01
②	Septentrio	I300	Ant00

2.5 Devices Installation Relationship

2.5.1 Coordinate System Definition

Table2-3 Coordinate System Definition

Object	Coordinate System	Placement Angles (X, Y, Z) in the Carrier System
Carrier System	Right-Forward-Up	-
100C	Back-Left-Down	(180, 0, -90)
I300	Down-Right-Back	(0, 90, -90)

2.5.2 Lever Arm Relationship

Table2-4 Lever Arm between devices

IMU	Device	Lever Arm (X,Y,Z) (m)
100C (Right-Forward-Up)	I300	(0.124, -0.008, 0.400)
	Ant00	(0.124, -0.128, 0.518)
	Ant01	(-0.178, 0.285, 0.065)

(Note: Here, only the lever arm relationships from the 100C to other inertial navigation systems and antennas are provided. The lever arm relationships from other inertial navigation systems to each antenna can be derived from these.)

3 Data Collection Trajectory

The data collection trajectory for this set is shown in Figure 3-1.

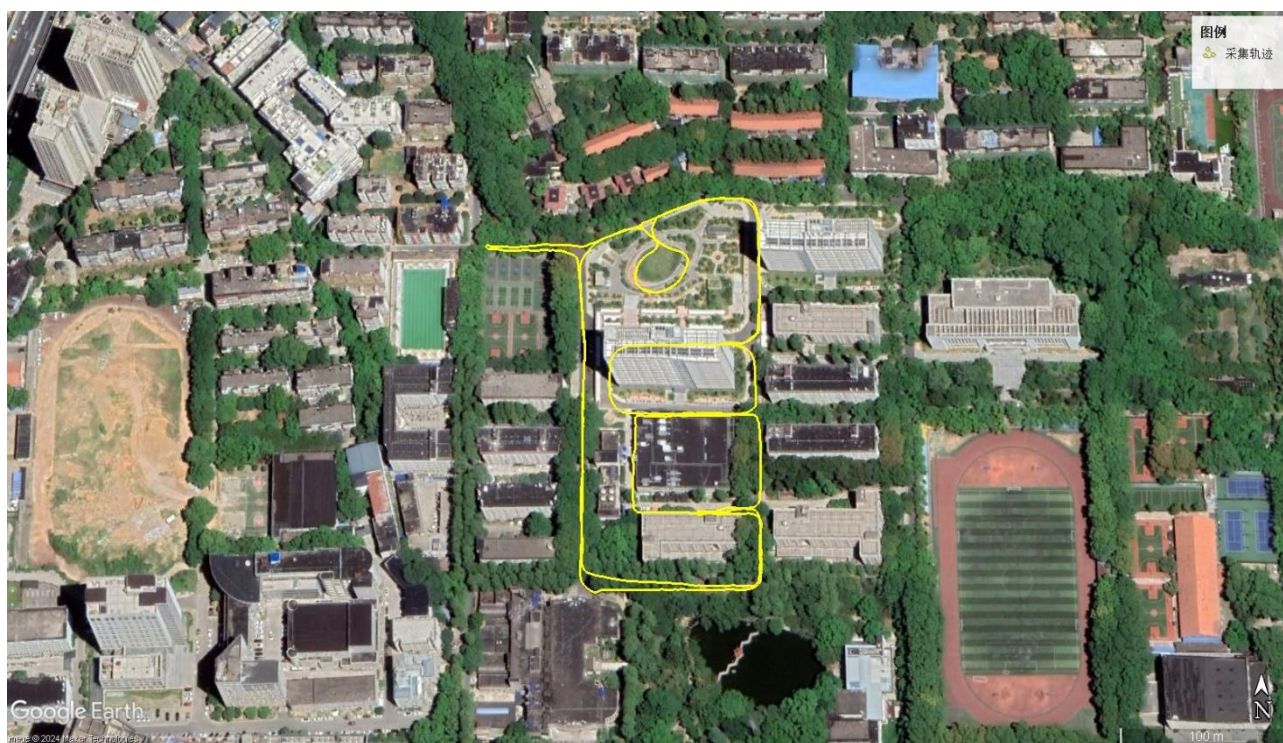


Figure3-1 Data Collection Trajectory

4 Data Inventory

Table4-1 Data Inventory

Device	Type	Whether Included	File Name
Base Station of Wuhan University	GNSS Observation Data	✓	BASE.24o
100C+PP7 +Ant01	Inertial Navigation Data	✓	100C.imr
	GNSS Observation Data	✓	ROVE_01.24o
I300+Septentrio +Ant00	Inertial Navigation Data	✓	I300.imr
	GNSS Observation Data	✓	ROVE_02.24o
Broadcast Satellite Ephemeris Data		✓	brdm1880.24p
Precise Satellite Ephemeris Data		✓	WUM0MGXFIN_20241880000_01D_05M_ORB.SP3
Satellite Clock Offset Data		✓	WUM0MGXFIN_20241880000_01D_30S_CLK.CLK

5 Data Overview

Table5-1 Data Overview

File Name	Format	Recording Time (GPST)	Output Frequency	Data Quality
BASE.24o	RINEX3.04	2024/07/05 23:00:00.000-- 2024/07/06 05:59:59.000	1HZ	Normal
ROVE_01.24o	RINEX3.04	2024/07/05 23:50:22.000-- 2024/07/06 00:53:46.000	1HZ	Normal
ROVE_02.24o	RINEX3.04	2024/07/05 23:55:03.000-- 2024/07/06 00:50:16.000	1HZ	Normal
100C.imr	IMR	2024/07/05 23:55:44.958-- 2024/07/06 00:50:16.195	200HZ	1 Large gap (1.749s)
I300.imr	IMR	2024/07/05 23:50:23.998-- 2024/07/06 00:53:46.094	200HZ	Normal

6 True Value Processing

6.1 Processing Methods

Processing Software: Inertial Explorer 8.90.8304 [64-bit]

Processing Mode: GNSS/IMU Tight Integration

Use of Precise Ephemeris: No

Use of Odometer: No

Data Used:

- **Base station data from Wuhan University's base station::** BASE.24O
- **PP7's Rover Station Data:** ROVE_01.24O
- **100C's Inertial Navigation Data:** 100C.imr

6.2 Computation Results

6.2.1 Ambiguity Fixed Situation

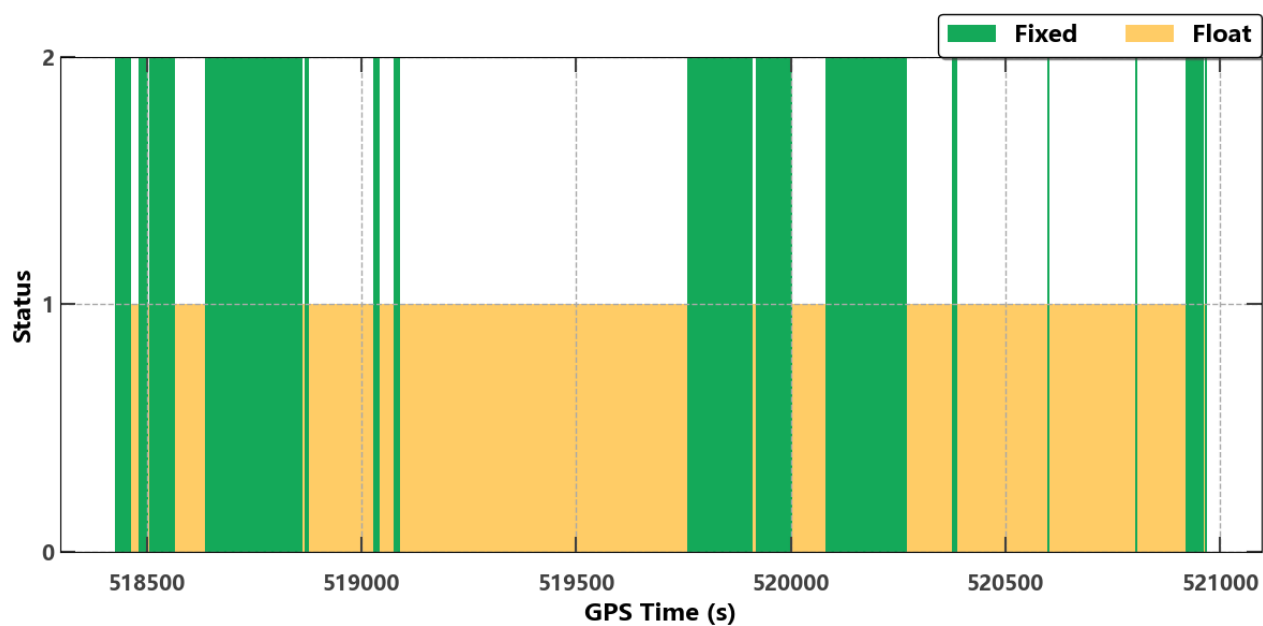


Figure6-1 Ambiguity Fixed Situation

6.2.2 IMU flag

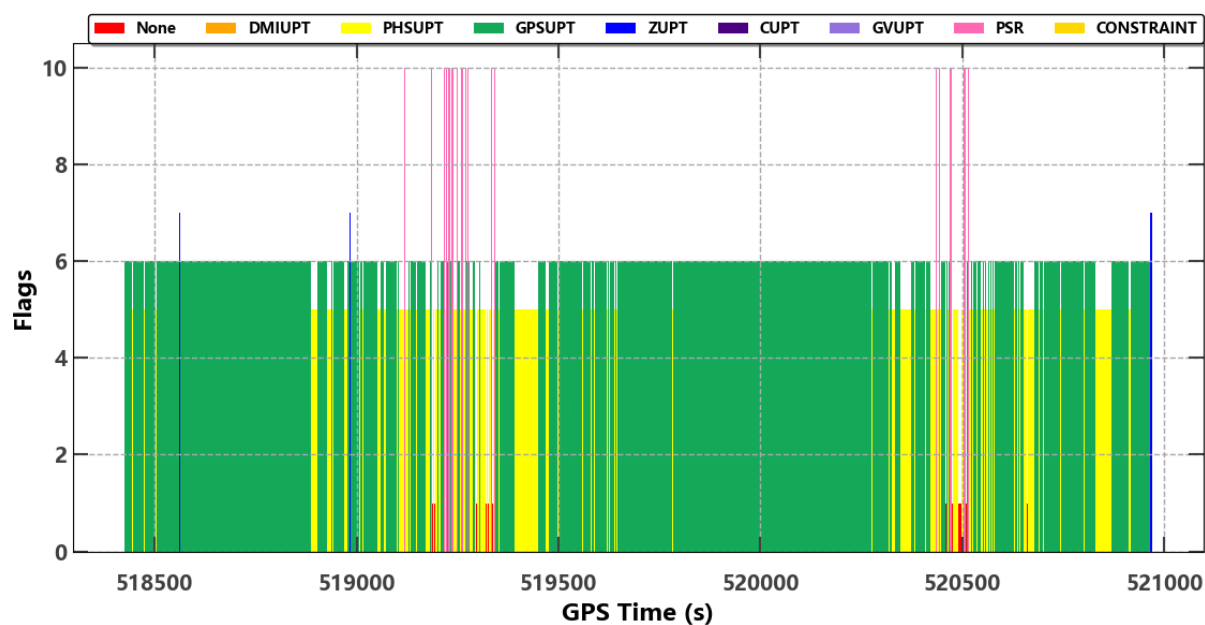


Figure6-2 IMU Flag

6.2.3 Forward/Backward Position Discrepancy

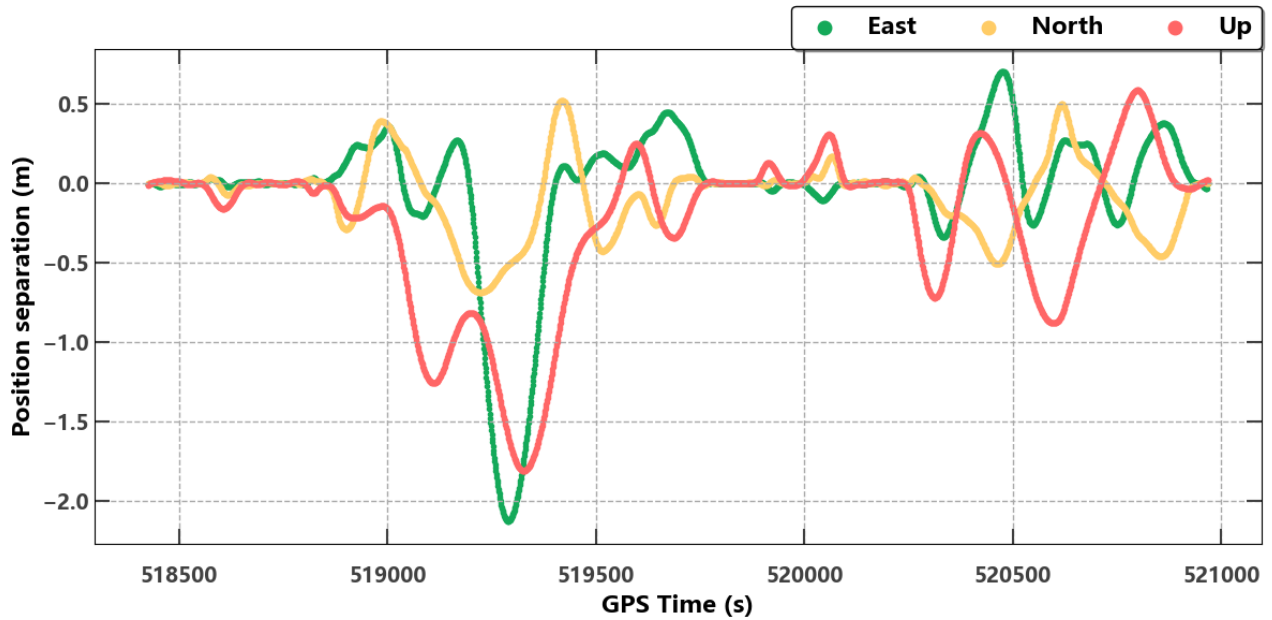


Figure6-3 Forward/Backward Position Discrepancy

6.2.4 Forward/Backward Attitude Discrepancy

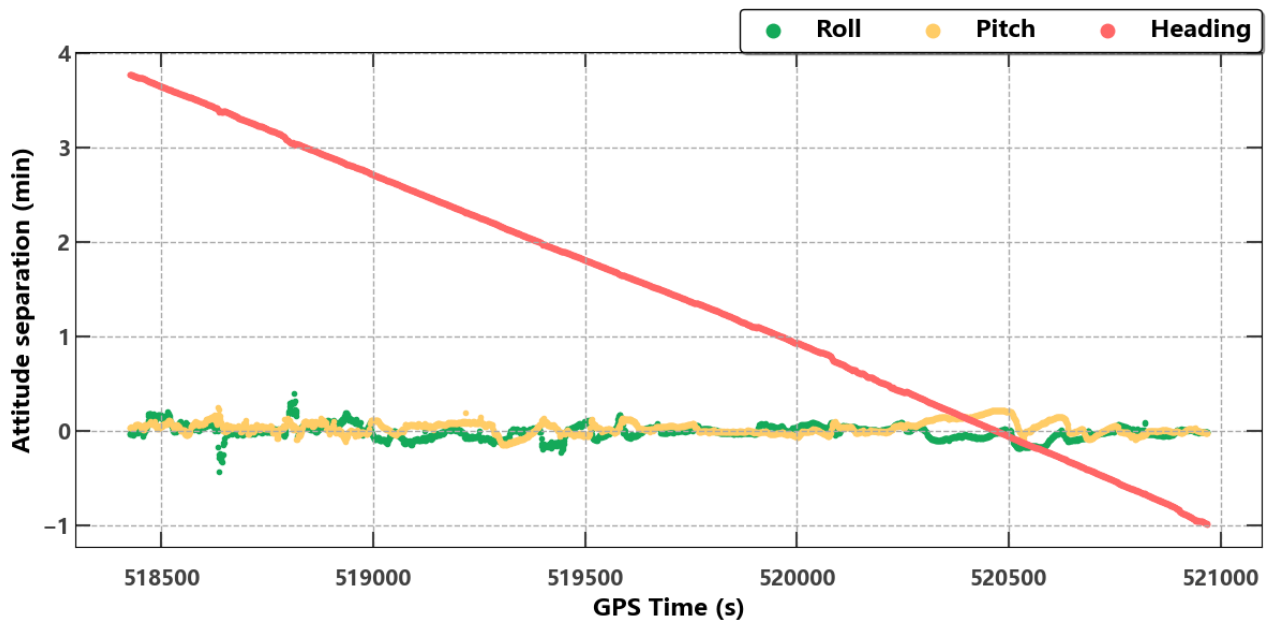


Figure6-4 Forward/Backward Attitude Discrepancy