问题:在 IE 进行紧耦合解算时,以下几种常见的对齐失败报错,一般是 IMR 记录出现 GAP 以及 Time Reversal 问题、起飞降落阶段受到干扰或者文件使用错误导致。

▶ 现象 1: 预处理检查提示"IMR Time Reversals"以及"IMR Large Gaps",紧耦 合处理过程中会提示类似"276411.0 Alignment successful-R:-1.035 P: 19.211 Yaw: 175.599 Est.ECEF misalignments (deg):-0.722 1.446 0.968"的报错;

IMR Time Reversals 1 IMR Time Reversals detected in raw IMU data. MR Large Gaps 1 IMR Large Gaps detected in raw IMU data. Data Rate Master data rate (in the file: "2021-12-01_12-04-55_base.gpb") is lower than remote's tota information	is 11MR Time Reversals detected in raw IMU data. 11MR Large Gaps detected in raw IMU data. Master data rate (in the file: "2021-12-01_12-04-56_base.gpb") is lower than remote's	re-processing Check	Description		
MR Large Gaps 1 IMR Large Gaps detected in raw IMU data. Data Rate Master data rate (in the file: "2021-12-01_12-04-56_base.gpb") is lower than remote's	1 IMR Large Gaps detected in raw IMU data. Master data rate (in the file: "2021-12-01_12-04-56_base.gpb") is lower than remote's	IMR Time Reversals	1 IMR Time Reversals detected in raw IMU data.		
Data Rate Master data rate (in the file: "2021-12-01_12-04-56_base.gpb") is lower than remote's	Master data rate (in the file: "2021-12-01_12-04-56_base.gpb") is lower than remote's	IMR Large Gaps	1 IMR Large Gaps detected in raw IMU data.		
ica information		Data Rate	Master data rate (in the file: "2021-12-01_12-04-56_base.gpb"	") is lower than remote's	
lora information					
Internation					
		tere information			
		lore information			

图 预处理检查报错

Processing Error	×
276411.0 Alignment successful - R: -1.035 P: 19.211 Yaw: 175.599 Est. ECEF misalignments (deg): -0.722 1.446 0.968	
确定	

图 紧耦合处理报错

▶ 現象 2: 预处理检查提示 "IMR Time Reversals"、"IMR Small Gaps"以及 "IMR Large Gaps", 紧耦合处理过程中会提示类似 "22395.0 Fatal error : IMU data gap of 128 epochs Avoid by changing IMU start or end processing time range,or usage of INS user command:" INS\_DATAGAP\_TOL=128""的报错;

Pre-processing Check	Description
IMR Time Reversals	1 IMR Time Reversals detected in raw IMU data.
IMR Small Gaps	15 IMR Small Gaps detected in raw IMU data.
🚹 IMR Large Gaps	15 IMR Large Gaps detected in raw IMU data.
🛕 Data Rate	Master data rate (in the file: "2021-12-26_13-49-49_base.gpb") is lower than remote's
fore information	
fore information	
lore information	
More information	

图 预处理检查报错



图 紧耦合处理报错

▶ 现象 3: 预处理检查正常,紧耦合解算时提示【FATAL ERROR: Alignment unsuccessful->GNSS failed during auto alignment /Suggestions: Try a different IMU process time range/Change Alignment Options or Processing Profile】或者

[FATAL ERROR: RE-Alignment failed: GNSS failed during re-alignment End-

of-file Reached Suggestions: Try a different IMU process time range/Change

Alignment Options or Processing Profile ].

Processing Error	×
FATAL ERROR: RE-Alignment failed: GNSS failed during re-alignment End-of-file Reached Suggestions: Try a different IMU processing time range Change Alignment Options or Processing Profile	
确定	]

图 紧耦合处理报错

# 处理方法如下

## 解决思路:

- ▶ 首先检查文件是否正确使用,所用数据是否为同一架次数据;
- ▶ 其次检查 IMR 文件是否存在记录问题;
- ▶ 最后选择合适的处理方法。

## 处理步骤:

1) 首先打开【Output】-【Plot Results】-【Quality Control】-【File Data

Coverage】图表,查看文件是否对应,基站、机载以及 IMU 文件时间应具有



公共部分。如果文件使用错误,选择正确的文件重新进行解算。

图 File Data Coverage 图表

注: 该图表横轴以时间绘制,纵轴代表文件类型(蓝线代表 IMU 文件、绿 线代表流动站文件、红线代表基站文件),其中基站文件时间范围大于流动站以 及 IMU 文件时间范围,流动站文件时间范围大于 IMU 文件时间范围且应基本 一致。

2) 如果文件对应没有问题,则执行 IMR 文件检查工作。在安装 IE 软件的电脑,可以直接打开 IMR 文件进行检查。

### IMR 检查步骤:

▶ 双击 IMR 文件,进入 IMR 头文件记录界面;

20220825-015001\_00010\_IMU\_DATA\_0001.imr 2022/8/26 14:17 Waypoint Raw I... 19,149 KB

图 IMR 文件

File: C:\	Users\Administrator\Desktop\Test	\20220825-01	5001 00010 IMU DATA 0001. imr
Type: Ine	rtial		
HEADER INFO	RMATION		
IMU Name:	NovAtel SPAN STIM300	Created Bv:	wconvertimu.exe
Version:	8.61	Data Rate:	300.000000 Hz
Gvro Meas:	Delta Thetas	Accel Meas:	Delta Velocities
Gvro SF:	149922641.16135576	Accel SF:	440346876. 64042050
Time Tags:	GPS, Corrected Time	Bias:	0.0000 seconds
Mapping:	0		
Lever Arm:	<n a=""></n>	Vehicle BS:	<n a=""></n>
Gimbal LA:	$\langle N/A \rangle$	Gimbal BS:	$\langle N/A \rangle$
请按任意键组	ž续		

图 IMR 头文件记录界面

▶ 在头文件记录界面,输入任意键进入检查界面;

Time	Gyro X Gyro Y Gyro Z Accel X Accel Y Accel Z
(sow)	(deg/s) (deg/s) (deg/s) (m/s? (m/s? (m/s?
352225.	135327 0.06348 0.01997-0.12321 9.42523-2.76934-0.20846
352225.	138662 0.04697-0.08685-0.12583 9.41941-2.76002-0.21865
352225.	141994 0. 10610-0. 03565-0. 11400 9. 41928-2. 74067-0. 20246
352225.	145329-0.00925-0.06286 0.03340 9.42443-2.73844-0.20834
352225.	148662-0.00896 0.01540 0.00828 9.41692-2.76427-0.20211
352225.	151994-0.02633 0.00526-0.00218 9.41908-2.77314-0.21351
352225.	155328 0.00040 0.03253-0.08167 9.42528-2.76746-0.20685
352225.	158663 0.00878-0.07911-0.23213 9.43574-2.76411-0.20238
352225.	161995-0. 10399-0. 00029-0. 10414 9. 42825-2. 75707-0. 21400
352225.	165329-0. 20558-0. 00212-0. 15165 9. 42450-2. 74365-0. 19517
352225.	168662-0. 18654 0. 06215-0. 07099 9. 41464-2. 74223-0. 18963
352225.	171994-0. 11659 0. 05471-0. 07076 9. 41858-2. 75495-0. 18495
352225.	175328-0. 15580 0. 08555-0. 12339 9. 42618-2. 76259-0. 20623
352225.	178660-0. 12381 0. 08888-0. 01742 9. 41994-2. 76181-0. 18179
352225.	181993-0. 11262 0. 04173-0. 13046 9. 43646-2. 74650-0. 17457
352225.	185327-0. 13192 0. 05374-0. 08165 9. 42641-2. 75126-0. 17500
352225.	188658-0.07489-0.07579-0.09027 9.42053-2.75426-0.16510
352225.	191992-0. 03560-0. 04681-0. 13235 9. 42306-2. 76820-0. 17070
352225.	195328 0.03940-0.04289-0.12096 9.42167-2.77130-0.17775
352225.	198659-0. 02078 0. 03105-0. 13917 9. 43026-2. 75839-0. 19181
352225.	201993-0.00308 0.11872-0.16793 9.42141-2.76209-0.16423
352225.	205326 0. 04562 0. 06803-0. 08522 9. 41096-2. 76457-0. 17151
352225.	208659 0.01659-0.01451-0.04865 9.42029-2.75733-0.17958
352225.	211993 0.05654-0.01798-0.01159 9.41656-2.75977-0.17880
352225.	215324 0.07965-0.00822-0.04706 9.41214-2.78545-0.20339
352225.	218659 0. 10194 0. 23238-0. 13616 9. 41841-2. 78316-0. 19729
352225.	221995 0.08815-0.04723 0.02685 9.41651-2.76949-0.19782
352225.	225326 0.06992 0.07207 0.02617 9.41405-2.75032-0.19094
352225.	228660 0.11695-0.09262-0.12938 9.39954-2.79407-0.20376
352225.	231991 0.08094-0.00608-0.09814 9.40998-2.78062-0.22175
352225.	235325 0.09204 0.02430-0.07010 9.41721-2.76323-0.21229
352225.	238658-0. 02181-0. 02978-0. 07829 9. 43156-2. 73415-0. 21417
main /	quit / neader / gaps / top / bottom / up / *down / find / save to file:

图 检查界面

▶ 输入G,执行检查工作并确认IMR 文件是否存在问题。

Scanning		
No problems found		
请按任意键继续		

图 检查结果1

3) 如果 IMR 文件记录没有问题,尝试"掐头去尾"操作,该操作主要是限制 解算时间范围去进行解算,一般是为了去除起飞降落阶段数据的影响。



▶ 添加完基站、流动站、IMU 数据后选择【Process】-【Process GNSS】;



▶ 按照默认设置点击【Process】开始处理,中途出现提示点击【Continue】;

Process GNSS			×
Processing Method Differential GNSS		O Precise Point Positioning	(PPP)
Processing Dir	rection		
Both	○ <u>E</u> orward	○ Reverse	O Multi-Pass
Processing Se	ttings		
Profile:	GNSS Airborne	`	Advanced
Datum:	WGS84	,	1
Processing In	formation		
Description:	Run (1)	User:	Unknown
		Process V Save Settings	Cancel

图 Process GNSS 设置

▶ 处理完成后选择【Plot Results】-【Velocity Profile】;

¥ 01 - Inertial Explorer 8.70 - [GNSS Combined - Map]	- 🗆 ×
🕱 File View Process Settings Output Tools Window Help	- 6 ×
▶ @ 🚅 🖬 🍓 🏪 🏷 嗣 🏳 🖾 寒斑 怒 🖩 🛤 🔖 🔍 🔍 📐 🔍 🐼 📷	
Plot Results 7 ×	
Select Plot X-Avia	
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图 Velocity Profile 图表

▶ 设置开始解算时间,鼠标左键点击起飞时刻区域,出现红线,然后右键

【Set GNSS Processing Time】-【Start】, 设为起点;



图 设置解算时间起点

▶ 设置结束解算时间,鼠标右键点击降落时刻区域,出现红线,然后右键



## 【Set GNSS Processing Time】-【End】, 设为终点;

图 设置解算时间终点

注:一般依据蓝线进行判断,不要求太精确,只要不多去即可。

▶ 点击【Process】-【Process Tightly Coupled】,开始正常解算。

¥ 01 - Inertial Explorer 8.70 - (GNSS Combined - Map)	- 0 ×
Rie View Process Settings Output Tools Window Help	- 6 ×
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Process Tightly Coupled X	
Processing Method	
(®) Differential GRSS OPrecise Point Positioning (PPP)	
Processing Direction	
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IMJ Instalation	
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(b) Z to Phase Centre	
Body to JPU Retarkon (priver 2, X, Y) Que to the second se	
A ( 0000 eng 11 0000 eng 21 90000 eng 0000 eng	
Processing determination Description: TC (1) [Net: Information	
Process V Bave Settings V Cancel	
20.0	

图 重新紧耦合解算

4) 如果 IMR 记录存在 GAP 或者 Time Reversal 问题,先确认发生上述现象的 时间点是不是在起降阶段。若是,则进行"掐头去尾"操作;若不是,则执行 拆分解算轨迹操作。该操作同样是限制解算时间范围去进行轨迹解算,目的是 为了去除存在 GAP 或者 Time Reversal 的时间段数据。



注: 提示 1: "Time Reversal of -0.998564 seconds at: 268152.090452",是指在 268152.090452 时刻起,时间记录发生了 0.998564S 的回退,当前时刻实际时间应该是 268152.090452+0.998564S;

提示 2: "Large gap of 0.044500 seconds starting at 268435.083935",是指从 268435.083935 时刻开始,有 1.001644S 的时间 IMU 未记录数据。

#### 拆分步骤如下:

确认拆分段数,如存在一个时间节点的记录问题,则拆分成两段;如存在两个时间节点的记录,则拆成三段。以拆分为三段为例;

▶ 确认解算时间段,开始时间一问题节点 1-1,问题节点 1-2一问题节点 2-1,问题节点 2-2—结束时间,依次类推。按照这个原则,可以将轨迹分成三段解算;其中第1段:开始时间-268152,第2段: 268154-268435,第3段: 268437-结束时间;

注:开始结束时间可通过鼠标左键单击轨迹获取,添加完 GPB 文件就可以通过该方式进行时间的获取。在存在 GAP 或者 Time Reversal 问题的时间节点,可以前后多去除几秒的数据。



图 轨迹时间获取

▶ 点击【Process】-【Process Tightly Coupled】-【Advanced GNSS】-

【General】, 依次填写上一步设置好的时间段, 执行紧耦合处理, 每段解算 完了以后导出对应的轨迹文件;

	TO ALL Extrins	
	Process Typing Cognet Process Typing Cognet Process Typing Cognet Retro General ARTK Measurement User Cinds General ARTK Measurement User Cinds	
	House Data Tare         Out a fear of the regime           Both         Process Data Tare         Out a fear of the regime           Process Data Tare         Out a fear of the regime         Out a fear of the regime           Process Data Tare         Out a fear of the regime         Out a fear of the regime           Process Data Tare         Out a fear of the regime         Out a fear of the regime           Process Data Tare         Out a fear of the regime         Out a fear of the regime           Process Data Tare         Out a fear of the regime         Out a fear of the regime           Data         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Process Data Tare         Process Data Tare         Out a fear of the regime           Data         Process Data Tare         Process Data Tare         Process Data Tare         Process Data Tare         Process Data Tare     <	
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	1.33         n         0.007         n         1.340         m @ 2 to Mead Carlies           Mole to Distance foreir Z, V, To         200         mole to Distance foreir Z, V, To         To         Mole to Distance foreir Z, V, To         Mole to Distance f	
	Processing Information Description: TC 13 - chart: Unknown	
	Proces (* See Strings)* Cend	
	· · · · · · · · · · · · · · · · · · ·	

图 分段进行紧耦合解算

Export SBET	-	×	
Input File:	C:\Users\Administrator\Desktop\0913\01.cts	Browse	
Output File:	C:\Users\Administrator\Desktop\0913\SBET.OUT Browse		
SBET Output Options			
Append	kernel to filename 01 济	动后缀	
Output SMRMSG file			
Time System:	: 🛛 GPS 🗌 UTC 🛛 ОК Неф	Close	



5) 拆分解算以后,按多架次处理思路进行点云解算操作。