

Calculation methods used

➤ Weighted Refsys of each receiver

Sum of the weighted REFSYS values of all satellites available, with respect to their elevation angles

$$weighted\ Refsys_1 = \sum_{SAT(i=1)}^n \frac{Refsys_i * \sin^2(ELV_i)}{\sum_{i=1}^n \sin^2(ELV_i)}$$

$$weighted\ Refsys_2 = \sum_{SAT(j=1)}^n \frac{Refsys_j * \sin^2(ELV_j)}{\sum_{j=1}^n \sin^2(ELV_j)}$$

➤ Common – View method

Average of difference between Refsys values at each epoch

$$Common - View\ at\ each\ epoch = \sum_{SA(i=1)}^n \frac{(Refsys_{(1,i)} - Refsys_{(2,i)})}{n}$$

➤ All - in- View method

All-in-view at each epoch = $weighted\ Refsys_1 - weighted\ Refsys_2$

Weighted Refsys : Performance of Receiver clock - GNSS(time)

CGGTTT data snippet

SAT	MJD	STTIME	ELV	REFSYS	FRC
		hhmmss	.1dg	.1ns	
G10	60269	1400	392	-94	L1C
G10	60269	1400	392	-86	L1P
G10	60269	1400	392	247	L2C
G10	60269	1400	392	-69	L2P
G10	60269	1400	392	159	L5C
G15	60269	1400	351	-25	L1C
G15	60269	1400	351	-8	L1P
G15	60269	1400	351	308	L2C
G15	60269	1400	351	-26	L2P
G18	60269	1400	697	-17	L1C
G18	60269	1400	697	1	L1P
G18	60269	1400	697	339	L2C
G18	60269	1400	697	4	L2P

At each epoch

Sum of the weighted REFSYS values of all satellites available, with respect to their elevation angles

$$\text{sum of weighted Refsys} = \sum_{i=1}^n \frac{\text{Refsys}_i * \sin^2(\text{ELV}_i)}{\sum_{i=1}^n \sin^2(\text{ELV}_i)}$$

$$\text{sum of weighted Refsys} = \frac{-8.6 * \sin^2(39.2) - 0.8 * \sin^2(35.1) + 0.1 * \sin^2(69.7)}{\sin^2(39.2) + \sin^2(35.1) + \sin^2(69.7)}$$

$$= -2.24 \text{ ns}$$

Example for calculation: Common-view Performance at each epoch

GPS Receiver 1 data
(CGGTTT V2E)

SAT	MJD	STTIME	ELV	REFSYS	FRC
		hhmmss	.1dg	.1ns	
G10	60269	1400	392	-94	L1C
G10	60269	1400	392	-86	L1P
G10	60269	1400	392	247	L2C
G10	60269	1400	392	-69	L2P
G10	60269	1400	392	159	L5C
G15	60269	1400	351	-25	L1C
G15	60269	1400	351	-8	L1P
G15	60269	1400	351	308	L2C
G15	60269	1400	351	-26	L2P
G18	60269	1400	697	-17	L1C
G18	60269	1400	697	1	L1P
G18	60269	1400	697	339	L2C
G18	60269	1400	697	4	L2P

GPS Receiver 2 data
(CGGTTT V2)

SAT	MJD	STTIME	ELV	REFSYS	FRC
		hhmmss	.1dg	.1ns	
8	60269	1400	188	-80	L1C
32	60269	1400	289	-63	L1C
27	60269	1400	595	-47	L1C
16	60269	1400	451	-23	L1C
23	60269	1400	458	-70	L1P
18	60269	1400	267	-85	L1P
10	60269	1400	835	-122	L1P
26	60269	1400	291	-40	L1P
8	60269	1400	188	-104	L2P
32	60269	1400	289	-88	L2P
27	60269	1400	595	-68	L2P
27	60269	1400	595	-23	L3P
16	60269	1400	451	-4	L3P

- Choice of signal Frequency (L1P)
- Common Satellites
- Refsys values for CV (units: 0.1 ns)

$$\text{CommonView difference} = \sum_{\substack{\text{SAT } (i=1), \\ \text{frequency } (f) \\ \text{Receiver } (1,2)}}^n \frac{(Refsys_{(1,i,f)} - Refsys_{(2,i,f)})}{n} = \frac{[(-8.6) - (-12.2)] + [0.1 - (-85)]}{2} = 6.1 \text{ ns}$$

Example for calculating: All-in-view Performance at an epoch

GPS Receiver 1 data
(CGGTTs V2E)

At each epoch

GPS Receiver 2 data
(CGGTTs V2)

SAT	MJD	STTIME	ELV	REFSYS	FRC
		hhmmss	.1dg	.1ns	
G10	60269	1400	392	-94	L1C
G10	60269	1400	392	-86	L1P
G10	60269	1400	392	247	L2C
G10	60269	1400	392	-69	L2P
G10	60269	1400	392	159	L5C
G15	60269	1400	351	-25	L1C
G15	60269	1400	351	8	L1P
G15	60269	1400	351	308	L2C
G15	60269	1400	351	-26	L2P
G18	60269	1400	697	-17	L1C
G18	60269	1400	697	1	L1P
G18	60269	1400	697	339	L2C
G18	60269	1400	697	4	L2P

SAT	MJD	STTIME	ELV	REFSYS	FRC
		hhmmss	.1dg	.1ns	
8	60269	1400	188	-80	L1C
32	60269	1400	289	-63	L1C
27	60269	1400	595	-47	L1C
16	60269	1400	451	-23	L1C
23	60269	1400	458	-70	L1P
18	60269	1400	267	-85	L1P
10	60269	1400	835	-122	L1P
26	60269	1400	291	-40	L1P
8	60269	1400	188	-104	L2P
32	60269	1400	289	-88	L2P
27	60269	1400	595	-68	L2P
27	60269	1400	595	-23	L3P
16	60269	1400	451	-4	L3P

- Choice of signal Frequency (L1P)
- Elevation Angle (unit 0.1 degrees)
- All available Satellites
- Refsys values for AV (units: 0.1 ns)

$$\text{sum of weighted Refsys for receiver 1} = \frac{-8.6 * \sin^2(39.2) - 0.8 * \sin^2(35.1) + 0.1 * \sin^2(69.7)}{\sin^2(39.2) + \sin^2(35.1) + \sin^2(69.7)} = -2.24 \text{ ns}$$

$$\text{sum of weighted Refsys for receiver 2} = \frac{-7.0 * \sin^2(45.8) - 8.5 * \sin^2(26.7) - 12.2 * \sin^2(83.5) - 4.0 * \sin^2(29.1)}{\sin^2(45.8) + \sin^2(26.7) + \sin^2(83.5) + \sin^2(29.1)} = -9.43 \text{ ns}$$

$$\text{All-in-view performance} = (-2.24) - (-9.43) = 7.19 \text{ ns}$$

Recommendations for Data to be processed:

- Please note that the name of the CGGTTS files should be as per the CGGTTS format. The application considers the first alphabet as the GNSS constellation as per the format.
- It is preferable that two receivers' data should be of same CGGTTS data version i.e., V1, V2 or V2E. The application works for all versions of GPS files.
- Common View or All-in-View can be performed only when the two sets of data files belong to same GNSS constellation