SINEX Manipulation Software

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What is SINEX

- Solution (Software/technique) INdependent EXchange Format
- http://www.iers.org/SharedDocs/Publikationen/EN/IERS/Documents/ac/sinex/sinex_v202_pdf.pdf;jsessionid=50543036E4107251A625B4ACA5FCA5FC.live2?__blob=publicationFile&v=2
- Used by the IAG services (IGS, IVS, ILRS, IDS)
- Geocentric coordinates and velocities and associated variance-covariance information

Why is SINEX input

- International standard for exchanging geodetic solutions
- The International Terrestrial Reference Frame (ITRF) is provided in SINEX format
- Many geodetic tools provide SINEX e.g. AUSPOS

Software: rdsinex

- Open source tool (c code)
- Output text format SINEX
- Output text in various easy to read formats

SINEX Example 1/3

```
%=SNX 2.01 IGN 16:122:00000 IGN 79:215:00000 19:001:00000 C 00036 2 X V
*-------------------------------------------------------------------------------
+FILE/COMMENT
* File created by CATREF software (Z.Altamimi)
-FILE/COMMENT
*-------------------------------------------------------------------------------
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 PERT  A 50133M001   Perth, Australia       115 53 06.9 -31 48 07.0    12.7
 TIDB  A 50103M108   Tidbinbilla, NSW, Aust 148 58 47.9 -35 23 57.1   665.3
 YAR1  A 50107M004   Mingenew, Australia    115 20 49.1 -29 02 47.5   241.3
 CEDU  A 50138M001   CEDU 50138M001         133 48 35.3 -31 51 59.9   144.7
 HOB2  A 50116M004   Hobart/Tasmania, Austr 147 26 19.4 -42 48 16.9    41.1
-SITE/ID
*-------------------------------------------------------------------------------
```

SINEX Example 2/3

```
+SOLUTION/EPOCHS
*Code PT SOLN T Data_start__ Data_end____ Mean_epoch__
 PERT  A    1 C 94:004:00000 94:113:00000 94:058:43200
 TIDB  A    1 C 94:004:00000 96:177:86389 95:090:86394
 YAR1  A    1 C 94:004:00000 97:230:00000 95:300:00000
 PERT  A    2 C 94:117:00000 01:030:00000 97:256:00000
 CEDU  A    1 C 94:136:00000 95:277:00000 95:024:00000
 HOB2  A    1 C 94:187:00000 97:137:00000 95:345:00000
-SOLUTION/EPOCHS
*-------------------------------------------------------------------------------
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
     1 STAX   PERT  A    1 10:001:00000 m    2 -.236868757866128E+07 0.74048E-03
     2 STAY   PERT  A    1 10:001:00000 m    2 0.488131661461247E+07 0.91864E-03
     3 STAZ   PERT  A    1 10:001:00000 m    2 -.334179548710761E+07 0.84688E-03
     4 VELX   PERT  A    1 10:001:00000 m/y  2 -.472916775593191E-01 0.39163E-04
     5 VELY   PERT  A    1 10:001:00000 m/y  2 0.822689567578196E-02 0.41751E-04
     6 VELZ   PERT  A    1 10:001:00000 m/y  2 0.508006951054042E-01 0.44388E-04
```

SINEX Example 3/3

```
    29 VELY   CEDU  A    1 10:001:00000 m/y  2 0.172935957701062E-02 0.38085E-04
    30 VELZ   CEDU  A    1 10:001:00000 m/y  2 0.504090658972641E-01 0.42917E-04
    31 STAX   HOB2  A    1 10:001:00000 m    2 -.395007186683046E+07 0.68502E-03
    32 STAY   HOB2  A    1 10:001:00000 m    2 0.252241528744047E+07 0.60906E-03
    33 STAZ   HOB2  A    1 10:001:00000 m    2 -.431163782526727E+07 0.78320E-03
    34 VELX   HOB2  A    1 10:001:00000 m/y  2 -.387112208023018E-01 0.40249E-04
    35 VELY   HOB2  A    1 10:001:00000 m/y  2 0.792637786129052E-02 0.37662E-04
    36 VELZ   HOB2  A    1 10:001:00000 m/y  2 0.412562272254610E-01 0.45803E-04
-SOLUTION/ESTIMATE
*-------------------------------------------------------------------------------
+SOLUTION/MATRIX_ESTIMATE L COVA
*PARA1 PARA2 ____PARA2+0_________ ____PARA2+1_________ ____PARA2+2_________
     1     1 0.548310211135644E-06
     2     1 -.255379612126912E-06 0.843901356798733E-06
     3     1 0.275659394721897E-06 -.390227388104757E-06 0.717198773827448E-06
     4     1 0.117899357365223E-07 -.141989799659082E-08 0.490066946487044E-08
     4     4 0.153376573179590E-08
     5     1 -.156538425709513E-08 0.145528459996356E-07 -.346409680913754E-08
     5     4 -.333098954124644E-09 0.174314033624727E-08
```

ITRF2014

- http://itrf.ign.fr/ITRF_solutions/2014/
- ITRF2014-IGS-TRF.SNX
- 3.9GB
- 51,751,012 lines

Using rdsinex example 1 – XYZ coordinates

```
$ rdsinex.exe REDX.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.07

PERT   1 50133M001     -2368687.5787   4881316.6146  -3341795.4871  10:001:00000
TIDB   1 50103M108     -4460996.6032   2682557.0829  -3674443.1013  10:001:00000
YAR1   1 50107M004     -2389026.1453   5043316.9745  -3078530.0634  10:001:00000
PERT   2 50133M001     -2368687.5810   4881316.6144  -3341795.4923  10:001:00000
CEDU   1 50138M001     -3753472.7778   3912741.0079  -3347960.2065  10:001:00000
HOB2   1 50116M004     -3950071.8668   2522415.2874  -4311637.8253  10:001:00000

Normal Termination
```

Using rdsinex example 2 – geographic coordinates

```
$ rdsinex.exe -g REDX.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.07

PERT   1 50133M001     115    53    6.91043   -31   -48   -7.06737     12.7042 10:001:00000
TIDB   1 50103M108     148    58   47.99723   -35   -23  -57.12782    665.3393 10:001:00000
YAR1   1 50107M004     115    20   49.12365   -29    -2  -47.58742    241.2814 10:001:00000
PERT   2 50133M001     115    53    6.91052   -31   -48   -7.06750     12.7075 10:001:00000
CEDU   1 50138M001     133    48   35.39402   -31   -51  -59.98658    144.7304 10:001:00000
HOB2   1 50116M004     147    26   19.44694   -42   -48  -16.95693     41.0544 10:001:00000

Normal Termination
```

Using rdsinex example 3 – geographic velocities

```
$ rdsinex -V REDX.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.07

PERT   1 50133M001        0.0390     0.0580    -0.0029     0.0000     0.0000     0.0001
TIDB   1 50103M108        0.0182     0.0554    -0.0009     0.0000     0.0000     0.0001
YAR1   1 50107M004        0.0388     0.0579    -0.0004     0.0000     0.0000     0.0000
PERT   2 50133M001        0.0390     0.0580    -0.0029     0.0000     0.0000     0.0001
CEDU   1 50138M001        0.0290     0.0588    -0.0010     0.0000     0.0000     0.0000
HOB2   1 50116M004        0.0142     0.0553    -0.0010     0.0000     0.0000     0.0001

Normal Termination
```

Using rdsinex example 4 – baselines

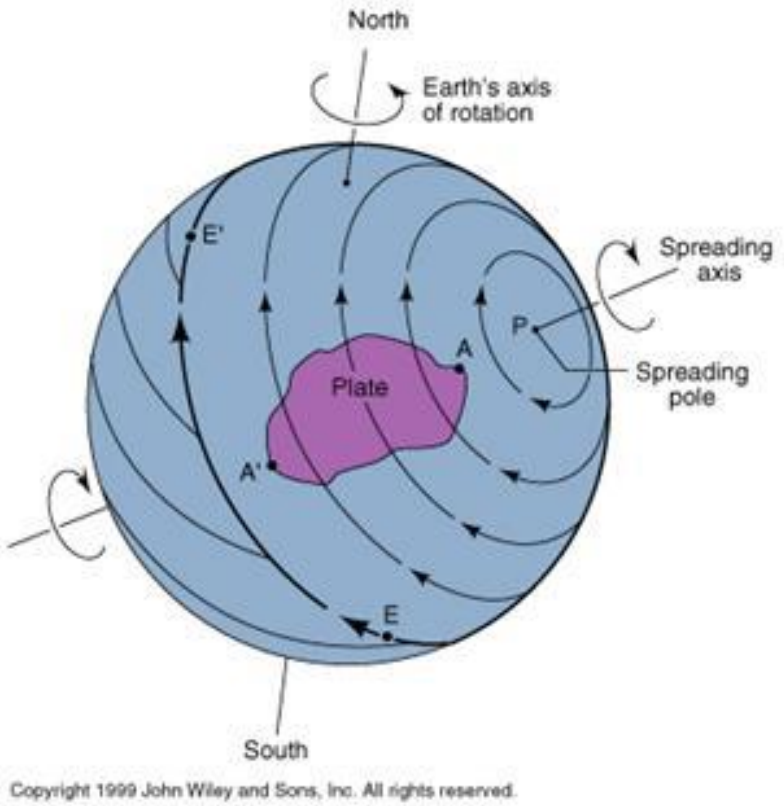
```
$ rdsinex -b REDX.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.07

# FROM STATION  TO STATION
PERT  1 50133M001    -- PERT  1 50133M001    DXYZ          0.0000          0.0000          0.0000 10:001
PERT  1 50133M001    -- TIDB  1 50103M108    DXYZ  -2092309.0246  -2198759.5317   -332647.6142 10:001
PERT  1 50133M001    -- YAR1  1 50107M004    DXYZ    -20338.5667    162000.3599    263265.4237 10:001
PERT  1 50133M001    -- PERT  2 50133M001    DXYZ         -0.0023         -0.0002         -0.0052 10:001
PERT  1 50133M001    -- CEDU  1 50138M001    DXYZ  -1384785.1991   -968575.6067    -6164.7194 10:001
PERT  1 50133M001    -- HOB2  1 50116M004    DXYZ  -1581384.2882  -2358901.3272   -969842.3382 10:001

Normal Termination
```

Using rdsinex example 4 – changing the reference epoch

```
$ rdsinex -e05:001 REDX.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.09

PERT   1 50133M001     -2368687.3422   4881316.5735  -3341795.7411   05:001:00000
TIDB   1 50103M108     -4460996.4220   2682557.0800  -3674443.3301   05:001:00000
YAR1   1 50107M004     -2389025.9103   5043316.9322  -3078530.3173   05:001:00000
PERT   2 50133M001     -2368687.3445   4881316.5732  -3341795.7463   05:001:00000
CEDU   1 50138M001     -3753472.5688   3912740.9993  -3347960.4586   05:001:00000
HOB2   1 50116M004     -3950071.6733   2522415.2478  -4311638.0315   05:001:00000

Normal Termination
```

Using rdsinex example 5 – changing the reference epoch but apply an external plate model

$$\begin{pmatrix} \dot{X} \\ \dot{Y} \\ \dot{Z} \end{pmatrix} = \begin{pmatrix} 0 & Z & -Y \\ -Z & 0 & X \\ Y & -X & 0 \end{pmatrix} \begin{pmatrix} \dot{R}_X \\ \dot{R}_Y \\ \dot{R}_Z \end{pmatrix}$$



Using rdsinex example 5 – changing the reference epoch but apply an external plate model (Altamim et al, 2012)

Table 3. ITRF2008 Absolute Plate Rotation Poles

Plate	NS[a]	ω_x (mas/a)	ω_y (mas/a)	ω_z (mas/a)	ω (°/Ma)
AMUR	3	−0.190 ± 0.040	−0.442 ± 0.051	0.915 ± 0.049	0.287 ± 0.008
ANTA	9	−0.252 ± 0.008	−0.302 ± 0.006	0.643 ± 0.009	0.209 ± 0.003
ARAB	4	1.202 ± 0.082	−0.054 ± 0.100	1.485 ± 0.063	0.531 ± 0.027
AUST	19	1.504 ± 0.007	1.172 ± 0.007	1.228 ± 0.007	0.630 ± 0.002
CARB	2	0.049 ± 0.201	−1.088 ± 0.417	0.664 ± 0.146	0.354 ± 0.122
EURA	69	−0.083 ± 0.008	−0.534 ± 0.007	0.750 ± 0.008	0.257 ± 0.002
INDI	4	1.232 ± 0.031	0.303 ± 0.128	1.540 ± 0.030	0.554 ± 0.017
NAZC	3	−0.330 ± 0.011	−1.551 ± 0.029	1.625 ± 0.013	0.631 ± 0.005
NOAM	44	0.035 ± 0.008	−0.662 ± 0.009	−0.100 ± 0.008	0.186 ± 0.002
NUBI	11	0.095 ± 0.009	−0.598 ± 0.007	0.723 ± 0.009	0.262 ± 0.003
PCFC	23	−0.411 ± 0.007	1.036 ± 0.007	−2.166 ± 0.009	0.677 ± 0.002
SOAM	10	−0.243 ± 0.009	−0.311 ± 0.010	−0.154 ± 0.009	0.118 ± 0.002
SOMA	3	−0.080 ± 0.028	−0.745 ± 0.030	0.897 ± 0.012	0.325 ± 0.007
SUND	2	0.047 ± 0.381	−1.000 ± 1.570	0.975 ± 0.045	0.388 ± 0.308
ITRF2008-PMM					

AUSPOS

Thank you for using AUSPOS 2.2 released on 1 June 2015.

A report of your GPS processing, job number #0721, is attached to this message. An additional copy of this report can also be found, for a short time only, at:

ftp://ftp.ga.gov.au/geodesy-outgoing/apps/ausposV2/0721/0721.pdf

A SINEX file for your solution is also available from:

ftp://ftp.ga.gov.au/geodesy-outgoing/apps/ausposV2/0721/

Using rdsinex example 5 – changing the reference epoch but apply an external plate model

```
$ rdsinex.exe -e20:001 -E-0.411:1.036:-2.166 APS050010.SNX

rdsinex: SINEX Translation Software, Geoscience Australia
         version 0.09

ASPA  1 50503S006  P  -6100260.3445   -996502.5360  -1567977.3672  20:001:00000
AUCK  1 50209M001  P  -5105681.4013    461564.7235  -3782181.1166  20:001:00000
CHAT  1 50207M001  P  -4590671.4957   -275482.0910  -4404596.2271  20:001:00000
CORM  1 50226M001  P  -5095050.9847    378667.9072  -3805557.6284  20:001:00000
FALE  1 50601S001  P  -6134112.1686   -862143.9321  -1514973.9481  20:001:00000
LAUT  1 50804M002  P  -6075194.6229    270924.8559  -1917189.0604  20:001:00000
TAH1  1 92201S011  P  -5246404.5646  -3077284.5413  -1913838.7981  20:001:00000
TIDB  1 50103M108  P  -4460996.2673   2682557.6730  -3674443.0648  20:001:00000
TOW2  1 50140M001  P  -5054582.5774   3275505.0681  -2091538.9907  20:001:00000
TUVA  1 51101M001  P  -6307543.8010     88455.3596   -939277.5989  20:001:00000
VANU  1 51402M001  P  -5950766.6054   1230704.5493  -1931444.6414  20:001:00000
```