EGSIEM

Title: SINEX and Gravity Field Parameters

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SINEX

- SINEX: Solution INdependent EXchange Format
- widely used in the (geometry-related) space geodesy
- numerous parameter types are defined, among others gravity field parameters.
- two types of representation of a solution are possible:
  1. unconstrained normal equations
  2. solutions with full covariance information

Format description of SINEX

Since version 2.10:

- CN = Normalized spherical harmonic coefficient of the Earth's gravity field (cosine term)
- SN = Normalized spherical harmonic coefficient of the Earth's gravity field (sine term)

The degree and order of the spherical harmonic coefficients is stored in the columns 'Site Code' and 'Solution ID', respectively.

Format description of SINEX

SINEX with coordinates (as widely used):

```
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
     1 STAX   GANP  A    1 10:207:43200 m    2 0.392918142065180E+07 .549572E-03
     2 STAY   GANP  A    1 10:207:43200 m    2 0.145523682233853E+07 .270852E-03
     3 STAZ   GANP  A    1 10:207:43200 m    2 0.479365395060395E+07 .654024E-03
...
```

SINEX for gravity field:

```
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
...
   101 SN      100  A  100 10:207:43200      2 0.392918142065180E+07 .549572E-03
   102 CN      100  A  100 10:207:43200      2 0.145523682233853E+07 .270852E-03
   103 SN        1  A  101 10:207:43200      2 0.479365395060395E+07 .654024E-03
...
```

Format description of SINEX

SINEX with coordinates (as widely used):

```
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
     1 STAX   GANP  A    1 10:207:43200 m    2 0.392918142065180E+07 .549572E-03
     2 STAY   GANP  A    1 10:207:43200 m    2 0.145523682233853E+07 .270852E-03
     3 STAZ   GANP  A    1 10:207:43200 m    2 0.479365395060395E+07 .654024E-03
...
```

Feature in column «S=Constraint Code» may also be applied for the gravity field determination:

- 0-fixed/tight constraints,
- 1-significant constraints,
- 2-unconstrained.

Sections in a SINEX-file:

- SOLUTION/STATISTICS
  - NUMBER OF OBSERVATIONS
  - NUMBER OF UNKNOWNS
  - SQUARE SUM OF RESIDUALS (v^TPv)
  - …
- SOLUTION/EPOCHS
  - Parameter validity intervals (same for CN and SN):

```
+SOLUTION/EPOCHS
*CODE PT SOLN T _DATA_START_ __DATA_END__ _MEAN_EPOCH_
...
  100  A  100 P 10:207:00000 10:207:86370 10:207:43185
    1  A  101 P 10:207:00000 10:207:86370 10:207:43185
...
```

Sections in a SINEX-file:

- SOLUTION/ESTIMATE
  - estimated parameters
- SOLUTION/APRIORI
  - apriori information for estimated parameters
- SOLUTION/MATRIX_APRIORI
  - apriori constraint matrix (if there are any)

Sections in a SINEX-file:

Two representations of the solution:

- SOLUTION/NORMAL_EQUATION_VECTOR: A^TPl
  SOLUTION/NORMAL_EQUATION_MATRIX: A^TPA
  (in that case the SOLUTION/ESTIMATE block is informative)

- SOLUTION/MATRIX_ESTIMATE
  - variance-covariance matrix for the unknowns of this constrained normal equation system

Limitation

- Only constant parameters can be reported.
  - No feature for periodic or piece-wise linear or what ever parameter type
  - If alternative parameter types are needed an official approval by the SINEX working group of the IERS is needed

Feedback from the Partners:

- University of Bern
- University of Luxembourg
- GeoForschungsZentrum
- Technical University of Graz
- Groupe de Recherche de Geodesie Spatiale
- Deutsches Zentrum für Luft- und Raumfahrt
- University of Hannover
- Géode & Cie