THE ITRF94 SOLUTION

The ITRF94 computation consists of the combination of station positions at two different epochs: 1988.0 and 1993.0. The combination/comparison model is given by equation (1),

\[
\begin{align*}
XS &= X + T1 + D - R3 - R2 + X \\
YS &= Y + T2 + R3 - D - R1 + Y \\
ZS &= Z + T3 - R2 - R1 - D
\end{align*}
\]

where \( X,Y,Z \) are the coordinates in the ITRF, and \( XS,YS,ZS \) are the coordinates in the individual system.

The individual SSC's are computed for these two epochs, using their respective station velocity fields. Individual covariance matrices, scaled by the \( F \) factor (see Tables 2 to 5 above), are also computed for these two epochs using the full covariance matrix between positions and velocities.

Positions of stations treated with fixed velocities are rejected when they are based on observations before 1991.0 (resp. before 1986.0 or after 1991.0) for the 1993.0 (resp. 1988.0) combination.

In the two combinations at 1988.0 and 1993.0, the local ties are introduced as observations, with appropriate variances. One or more reference points per site are selected, yielding to one or more local tie sets: A, B, C, etc (see Table T4 of the Appendix). All these sets are included in the combination provided that at least one point of each set is available in at least one space-geodesy solution.

The datum ITRF94 is defined by the following (see details in the next paragraph):

- the origin is a weighted average of a selection of SLR and GPS solutions;
- the scale is a weighted average of a selection of VLBI, SLR and GPS solutions, modified in order to take into account the fact that the solutions use TAI and not TCG as a time scale;
- the orientation is consistent with the ITRF92 (not the ITRF93) at 1988.0 epoch;
- the time evolution is consistent with the geophysical model NNR-NUVEL1A;

The ITRF94 solution is performed using the following steps:

1- A global combination at epoch 1988.0 is done, holding to zero the seven transformation parameters of the SLR solution SSC(CSR) 95 L 01 (labeled hereafter LC);

2- The same combination as in step 1 is done at epoch 1993.0;

3- A Provisional Velocity Field is derived from the difference of coordinates in the above two combinations;

4- The Provisional Velocity Field obtained in step 3 is compared to the geophysical model NNR-NUVEL1A in order to estimate the rates of the seven transformation parameters between the two, given in Table 6.

Table 6. Rate of the transformation parameters from ITRF94 Provisional Velocity Field to NNR-NUVEL1A

<table>
<thead>
<tr>
<th>(T1)</th>
<th>(T2)</th>
<th>(T3)</th>
<th>(D)</th>
<th>(R1)</th>
<th>(R2)</th>
<th>(R3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{cm})</td>
<td>(\text{cm})</td>
<td>(\text{cm})</td>
<td>(10^{-8})</td>
<td>(0.001^*)</td>
<td>(0.001^*)</td>
<td>(0.001^*)</td>
</tr>
<tr>
<td>0.10</td>
<td>-0.12</td>
<td>0.14</td>
<td>-0.053</td>
<td>-0.138</td>
<td>-0.222</td>
<td>0.032</td>
</tr>
<tr>
<td>(\pm) 0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.009</td>
<td>0.011</td>
<td>0.011</td>
<td>0.009</td>
</tr>
</tbody>
</table>
5- The seven transformation parameters of the solution obtained in step 1 relative to the ITRF92 are computed at epoch 1988.0 considering only one point per site;

6- The combination at epoch 1988.0 is repeated, holding for LC:
- the three translations and the scale factor to zero;
- the three rotations to the values determined in step 5:

\[ R_1(1988.0) = -0.15 \quad R_2(1988.0) = 1.30 \quad R_3(1988.0) = -0.87 \] (Unit: 0.001")

7- The combination at epoch 1993.0 is repeated, holding the seven transformation parameters for LC to the values obtained by propagating the values of step 6 to 1993.0 by use of the rates listed in Table 6

8- Weighted averages for the origin and the scale have been estimated based on the following solutions:
- for the origin and scale: SSC(JPL) 95 P 02, SSC(CODE) 95 P 02 and SSC(DUT) 95 C 02;
- for the scale: SSC(GSFC) 95 R 01, SSC(NOAA) 95 R 01 and SSC(USNO) 95 R 04

9- The two combinations at epochs 1988.0 and 1993.0 (steps 6 and 7) are then repeated, but correcting the translations and the scale factor fixed for LC by the values obtained in step 8. The scale factor is also corrected by \((0.7 \times 10^{-9})\) in order to be consistent with IUGG/IAU resolutions recommending that the coordinate-time of the terrestrial reference system be TCG.

10- The ITRF94 velocity field is finally estimated by differentiating the two combinations of step 9.

**STATION CLASSIFICATION**

The ITRF94 stations are classified, in order to help users for estimating the quality of station coordinates they may be use. For this analysis, we distinguish four classes: A, B, C and Z, adopting the reliability as the main criterium:

A set of points in a site have a quality number \(Q_N(t) = n\) if they are linked by local surveys and

- there are at least two different techniques in the set of points
- each point has at least one space-derived position (R, L, M, P or D) at epoch \(t\) with a maximum residual (over the three components) below \(n\) centimeters
- the local surveys for all points have also a maximum residual below \(n\) centimeters

This means that at least two independent techniques agree to better than \(n\) centimeters for these points.

Using this \(Q_N\), we define four classes:
A: points with \(Q_N(93)\) and \(Q_N(88)\) better than 2 centimeters
B: points not in A but with \(Q_N(93)\) better than 3 centimeters
C: point not included in A or B with no large residual
Z: point with large residual (blunder or poor determination)