# 1 Current methodology for TRF combination

The current methodology is based on combining simultaneously station positions and velocities using full variance-covariance information provided, in SINEX format, by the IERS analysis centers.

## 1.1 Analysis strategy

The current analysis strategy adopted for the generation of ITRF solutions consists on the following steps:

- Removing constraints from the constrained solutions and applying minimum constraints equally to all individual solutions.
- Adding minimum constraints to loose solutions.
- Leaving as they are, solutions where analysis centers already applied minimum constraints.
- Propagating, for each individual solution, station positions at epochs of minimal position variance.
- Combining all solutions together with local ties, estimating variance components and iterating as necessary.

## 1.2 Model for simultaneous combination of station positions and velocities

Assuming that for each individual solution $s$, and each point $i$, we have position $X_s^i$ at epoch $t_s^i$ and velocity $\dot{X}_s^i$, expressed in a given TRF $k$.

The combination consists on estimating:

- Positions $X_{itrf}^i$ at a given epoch $t_0$ and velocities $\dot{X}_{itrf}^i$ in ITRS
- Transformation parameters $T_k$ at an epoch $t_k$ and their rates $\dot{T}_k$, from the ITRF to each individual frame $k$

The general physical model used is given by the following equation (1):

$$\left\{ \begin{array}{lcl} X_s^i & = & X_{itrf}^i + (t_s^i - t_0)\dot{X}_{itrf}^i + T_k + D_k X_{itrf}^i + R_k X_{itrf}^i \\ & + & (t_s^i - t_k)\left[\dot{T}_k + \dot{D}_k X_{itrf}^i + \dot{R}_k X_{itrf}^i\right] \\ & & \\ \dot{X}_s^i & = & \dot{X}_{itrf}^i + \dot{T}_k + \dot{D}_k X_{itrf}^i + \dot{R}_k X_{itrf}^i \end{array} \right. \tag{1}$$

where for each individual frame $k$, $D_k$ is the scale factor, the translation vector $T_k$ and rotation matrix $R_k$ are respectively defined (following IERS conventions) by:

$$T_k = \begin{pmatrix} T1_k \\ T2_k \\ T3_k \end{pmatrix} \quad \text{and} \quad R_k = \begin{pmatrix} 0 & -R3_k & R2_k \\ R3_k & 0 & -R1_k \\ -R2_k & R1_k & 0 \end{pmatrix}$$

The dotted parameters designate their derivatives with respect to time. $T1, T2, T3$ are the 3 origin components, $R1, R2, R3$ are the three small rotations according to the 3 axes, respectively $X, Y, Z$.