Summary of GPS Computation

Collect All Pseudo-Ranges
(at the same Receiver time)

Calculate SV Time (t_{SV})
1. Guess transmit & *transit* time
2. Correct SV clock error (use previous receiver bias & relativity term)
3. Get new transmit & *transit* time

$$t_{SV} = (t_R - \Delta t_R) - \tau \quad (where \quad \tau = \rho / c)$$
$$\Delta t_{SV}(t_{SV}) = a_{f0} + a_{f1}(t_{SV} - t_{oc}) + a_{f2}(t_{SV} - t_{oc})^2 - t_{gd} + t_{rel}$$
$$t'_{SV} = (t_R - \Delta t_R) - \tau' \quad (where \quad \tau' = \tau + \Delta t_{SV})$$

Calculate SV Position (XYZ)
1. Compute SV position by using ephemeris data
2. Correct Earth rotation effect by using transit time
3. Update relativistic correction term for next step

$$\begin{bmatrix} X & Y & Z \end{bmatrix}_{ECEF} = Ephemeris(t')$$
$$\begin{bmatrix} X & Y & Z \end{bmatrix}'_{ECEF} = EarthCorrection(\tau')$$
$$t_{rel} = Fe\sqrt{A}\sin E_k$$

Correct Pseudo-Range (ρ)
1. Correct PR with SV clock error and ionosphere delay (Receiver clock error should not be applied)

$$c\Delta t_{ion} = \frac{f_{L2}^2}{f_{L2}^2 - f_{L1}^2}(\rho_{L1} - \rho_{L2})$$
$$\rho' = \rho + (\Delta t_{SV} + \Delta t_{ion})c$$

Least Square Solution (x)
1. Get predicted PR based on current state
2. Compute state error by pseudo-inverse
3. Update receiver state & iteration

$$\Delta\rho = \rho_{meas} - \rho_{pred}(x_0)$$
$$\Delta x = (H^T H)^{-1} H \Delta\rho$$
$$x' = x_0 + \Delta x$$

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