Linear Combinations of L1, L2 Observables

2005/08/26 T. Takasu

$$P_1 = \rho + c(dt - dT) + T + I_1 + \varepsilon_{P1}$$
$$P_2 = \rho + c(dt - dT) + T + I_2 + \varepsilon_{P2}$$
$$L_1 = \lambda_1 \Phi_1 = \rho + c(dt - dT) + T - I_1 + \lambda_1 N_1 + \varepsilon_{L1}$$
$$L_2 = \lambda_2 \Phi_2 = \rho + c(dt - dT) + T - I_2 + \lambda_2 N_2 + \varepsilon_{L2}$$
$$L_{WL} = \lambda_{WL}(\Phi_1 - \Phi_2) = \rho + c(dt - dT) + T - \lambda_{WL}(I_1 / \lambda_1 - I_2 / \lambda_2) + \lambda_{WL}(N_1 - N_2) + \varepsilon_{WL}$$
$$L_{NL} = \lambda_{NL}(\Phi_1 + \Phi_2) = \rho + c(dt - dT) + T - \lambda_{NL}(I_1 / \lambda_1 + I_2 / \lambda_2) + \lambda_{NL}(N_1 + N_2) + \varepsilon_{NL}$$
$$LC = C_1 L_1 - C_2 L_2 = \rho + c(dt - dT) + T + C_1 \lambda_1 N_1 - C_2 \lambda_2 N_2 + \varepsilon_{LC}$$
$$LG = L_1 - L_2 = -(I_1 - I_2) + \lambda_1 N_1 - \lambda_2 N_2 + \varepsilon_{LG}$$
$$MW = L_{WL} - \lambda_{NL}(P_1 / \lambda_1 + P_2 / \lambda_2) = \lambda_{WL}(N_1 - N_2) + \varepsilon_{MW}$$
$$MP_1 = P_1 - (2C_2 + 1)L_1 + 2C_2 L_2 = -(2C_2 + 1)\lambda_1 N_1 + 2C_2 \lambda_2 N_2 + \varepsilon_{P1}$$
$$MP_2 = P_2 - 2C_1 L_1 + (2C_1 - 1)L_2 = -2C_1 \lambda_1 N_1 + (2C_1 - 1)\lambda_2 N_2 + \varepsilon_{P2}$$

P_1, P_2 : L1, L2 pseudo range observable (m)

Φ_1, Φ_2 : L1, L2 carrier phase observable (cycle)

L_1, L_2 : L1, L2 carrier phase (m)

L_{WL}, L_{NL} : Wide-lane, Narrow-lane linear combination of phase (m)

LC : Ionosphere-free linear combination of phase (m)

LG : Geometry-free linear combination of phase (m)

MW : Melbourne-Wubbena linear combination (m)

MP_1, MP_2 : L1, L2 Multipath linear combination (m)

ρ : geometric distance (m)

dt, dT : receiver/satellite clock bias (sec)

T : tropospheric delay (m)

I_1, I_2 : L1, L2 ionospheric delay (m)

N_1, N_2 : L1, L2 carrier phase bias (cycle)

$\varepsilon_{P1}, \varepsilon_{P2}, \varepsilon_{L1}, \varepsilon_{L2}, \ldots$: $P_1, P_2, L_1, L_2, \ldots$ measurement noise + multipath (m)

c : speed of light (m/sec)

$f_1 = 1.57542\,GHz$ $f_2 = 1.2276\,GHz$: L1, L2 carrier frequency

$\lambda_1 = 19.0cm$ $\lambda_2 = 24.4cm$: L1, L2 wave length

$\lambda_{WL} = \dfrac{1}{1/\lambda_1 - 1/\lambda_2} = 86.2cm$ $\lambda_{NL} = \dfrac{1}{1/\lambda_1 + 1/\lambda_2} = 10.7cm$: Wide-lane, Narrow-lane wave length

$$C_1 = \frac{f_1^{\,2}}{f_1^{\,2} - f_2^{\,2}} = 2.546 \quad C_2 = \frac{f_2^{\,2}}{f_1^{\,2} - f_2^{\,2}} = 1.546$$