

Rotation Matrices

Referenced to circled letter (C) in Schematic Diagram:

Geocentric Coordinate Differences to Local Geodetic Coordinate Differences (Leick, 1990, Equations 7.9 and 7.10):

$$\begin{bmatrix} \Delta e \\ \Delta n \\ \Delta u \end{bmatrix} = \begin{bmatrix} -\sin \lambda & \cos \lambda & 0 \\ -\sin \phi \cos \lambda & -\sin \phi \sin \lambda & \cos \phi \\ \cos \phi \cos \lambda & \cos \phi \sin \lambda & \sin \phi \end{bmatrix} \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} \quad (24)$$

$$\Delta e = -\Delta X \sin \lambda + \Delta Y \cos \lambda \quad (25)$$

$$\Delta n = -\Delta X \sin \phi \cos \lambda - \Delta Y \sin \phi \sin \lambda + \Delta Z \cos \phi \quad (26)$$

$$\Delta u = \Delta X \cos \phi \cos \lambda + \Delta Y \cos \phi \sin \lambda + \Delta Z \sin \phi \quad (27)$$

Local Geodetic Coordinate Differences to Geocentric Coordinate Differences, Vanicek and Krakiwsky (1986), page 38):

$$\begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} = \begin{bmatrix} -\sin \lambda & -\sin \phi \cos \lambda & \cos \phi \cos \lambda \\ \cos \lambda & -\sin \phi \sin \lambda & \cos \phi \sin \lambda \\ 0 & \cos \phi & \sin \phi \end{bmatrix} \begin{bmatrix} \Delta e \\ \Delta n \\ \Delta u \end{bmatrix} \quad (28)$$

$$\Delta X = -\Delta e \sin \lambda - \Delta n \sin \phi \cos \lambda + \Delta u \cos \phi \cos \lambda \quad (29)$$

$$\Delta Y = \Delta e \cos \lambda - \Delta n \sin \phi \sin \lambda + \Delta u \cos \phi \sin \lambda \quad (30)$$

$$\Delta Z = \Delta n \cos \phi + \Delta u \sin \phi \quad (31)$$