### Reduction for nutation — rigorous formulae

Nutations in longitude ($\Delta\psi$) and in obliquity ($\Delta\epsilon$) together with the true obliquity of the ecliptic ($\epsilon$) for 2006 have been calculated using the IAU 2000A series, and are tabulated on pages B32–B39. A mean place ($\mathbf{r}_m$) may be transformed to a true place ($\mathbf{r}_t$), and vice versa, as follows:

$$\mathbf{r}_t = \mathbf{N}\,\mathbf{r}_m \qquad \mathbf{r}_m = \mathbf{N}^{-1}\,\mathbf{r}_t = \mathbf{N}'\,\mathbf{r}_t$$

$$\text{where} \qquad \mathbf{N} = \mathbf{R}_1(-\epsilon)\,\mathbf{R}_3(-\Delta\psi)\,\mathbf{R}_1(+\epsilon_A)$$

$\epsilon = \epsilon_A + \Delta\epsilon$, and $\epsilon_A$ is given at the top of page B29. The matrix for nutation is given by

$$\mathbf{N} = \begin{pmatrix} \cos\Delta\psi & -\sin\Delta\psi\cos\epsilon_A & -\sin\Delta\psi\sin\epsilon_A \\ \sin\Delta\psi\cos\epsilon & \cos\Delta\psi\cos\epsilon_A\cos\epsilon + \sin\epsilon_A\sin\epsilon & \cos\Delta\psi\sin\epsilon_A\cos\epsilon - \cos\epsilon_A\sin\epsilon \\ \sin\Delta\psi\sin\epsilon & \cos\Delta\psi\cos\epsilon_A\sin\epsilon - \sin\epsilon_A\cos\epsilon & \cos\Delta\psi\sin\epsilon_A\sin\epsilon + \cos\epsilon_A\cos\epsilon \end{pmatrix}$$