**TABLE 5.7.1** MODIFIED NEWTON–RAPHSON ITERATION

1.0 *Initialize data.*

$$u_{i+1}^{(0)} = u_i \qquad f_S^{(0)} = (f_S)_i \qquad \Delta R^{(1)} = \Delta \hat{p}_i \qquad \hat{k}_T = \hat{k}_i$$

2.0 *Calculations for each iteration,* $j = 1, 2, 3, \ldots$

2.1 Solve: $\hat{k}_T \, \Delta u^{(j)} = \Delta R^{(j)} \Rightarrow \Delta u^{(j)}$.

2.2 $u_{i+1}^{(j)} = u_{i+1}^{(j-1)} + \Delta u^{(j)}$.

2.3 $\Delta f^{(j)} = f_S^{(j)} - f_S^{(j-1)} + (\hat{k}_T - k_T)\, \Delta u^{(j)}$.

2.4 $\Delta R^{(j+1)} = \Delta R^{(j)} - \Delta f^{(j)}$.

3.0 *Repetition for next iteration.* Replace $j$ by $j + 1$ and repeat calculation steps 2.1 to 2.4.

The iterative process is terminated after $\ell$ iterations when the incremental displacement $\Delta u^{(\ell)}$ becomes small enough compared to the current estimate of $\Delta u = \sum_{j=1}^{\ell} \Delta u^{(j)}$; that is,

$$\frac{\Delta u^{(\ell)}}{\Delta u} < \epsilon$$

Then the displacement increment over the time step $i$ to $i + 1$ is given by

$$\Delta u_i = \sum_{j=1}^{\ell} \Delta u^{(j)} \tag{5.7.11}$$