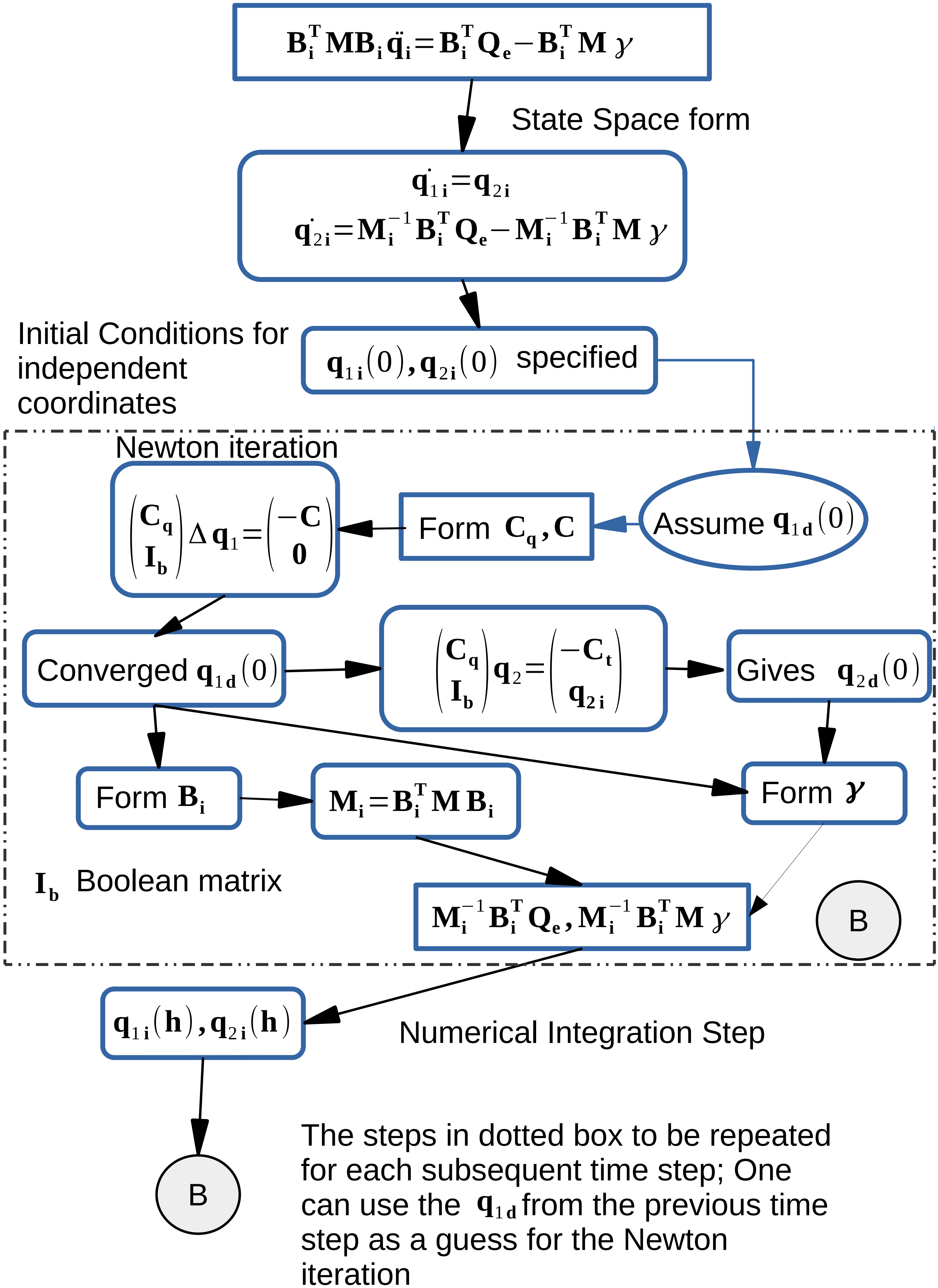

$\mathbf{B}_i^T \mathbf{M} \mathbf{B}_i \ddot{\mathbf{q}}_i = \mathbf{B}_i^T \mathbf{Q}_e - \mathbf{B}_i^T \mathbf{M} \gamma$
State Space form
$\dot{\mathbf{q}}_{1i} = \mathbf{q}_{2i}$
$\dot{\mathbf{q}}_{2i} = \mathbf{M}_i^{-1} \mathbf{B}_i^T \mathbf{Q}_e - \mathbf{M}_i^{-1} \mathbf{B}_i^T \mathbf{M} \gamma$
Initial Conditions for independent coordinates
$\mathbf{q}_{1i}(0), \mathbf{q}_{2i}(0)$ specified
Newton iteration
Assume $\mathbf{q}_{1d}(0)$
Form $\mathbf{C}_q, \mathbf{C}$
$\begin{pmatrix} \mathbf{C}_q \\ \mathbf{I}_b \end{pmatrix} \Delta \mathbf{q}_1 = \begin{pmatrix} -\mathbf{C} \\ \mathbf{0} \end{pmatrix}$
Converged $\mathbf{q}_{1d}(0)$
$\begin{pmatrix} \mathbf{C}_q \\ \mathbf{I}_b \end{pmatrix} \mathbf{q}_2 = \begin{pmatrix} -\mathbf{C}_t \\ \mathbf{q}_{2i} \end{pmatrix}$
Gives $\mathbf{q}_{2d}(0)$
Form $\mathbf{B}_i$
$\mathbf{M}_i = \mathbf{B}_i^T \mathbf{M} \mathbf{B}_i$
Form γ
$\mathbf{I}_b$ Boolean matrix
$\mathbf{M}_i^{-1} \mathbf{B}_i^T \mathbf{Q}_e, \mathbf{M}_i^{-1} \mathbf{B}_i^T \mathbf{M} \gamma$
B
$\mathbf{q}_{1i}(\mathbf{h}), \mathbf{q}_{2i}(\mathbf{h})$
Numerical Integration Step
B
The steps in dotted box to be repeated for each subsequent time step; One can use the $\mathbf{q}_{1d}$ from the previous time step as a guess for the Newton iteration