Newmark Beta Methods

1) Estimate $\ddot{u}^{*}_{n+1}$, Given u_n, $\dot{u}_n$, $\ddot{u}_n$

2) $u_{n+1} = u_n + h\dot{u}_n + (1/2-\beta)h^2\ddot{u}_n + h^2\beta\ddot{u}^{*}_{n+1}$

3) $\dot{u}_{n+1} = \dot{u}_n + (h/2)\ddot{u}_n + (h/2)\ddot{u}^{*}_{n+1}$

4) $\ddot{u}_{n+1} = f(u_{n+1}, \dot{u}_{n+1}, t_{n+1})$

5) If $\ddot{u}_{n+1} \neq \ddot{u}^{*}_{n+1}$, then $\ddot{u}^{*}_{n+1} \rightarrow \ddot{u}_{n+1}$ (Go to (1))
If $\ddot{u}_{n+1} \sim \ddot{u}^{*}_{n+1}$, then go to next step $n \rightarrow n+1$

β	Method
0	Lumped acceleration
1/8	stepped acceleration
1/6	linear acceleration
1/4	constant average acceleration (Unconditionally stable for linear systems)

For Stability $\frac{h}{T} < \frac{1}{\pi\sqrt{1-4\beta}}$

For Convergence $\frac{h}{T} < \frac{1}{2\pi\sqrt{\beta}}$