$$\boxed{\boldsymbol{\nu} = \mathbf{K}^{-1}\Psi}$$

$\xrightarrow{\text{AD}}$

$$\frac{\partial \boldsymbol{\nu}}{\partial \mathbf{q}} \qquad \textcolor{green}{\mathcal{O}(n^2)}$$

Substitute

$\boxed{\textbf{II}}$ $\underline{\underline{\text{mRNEAc DDP}}}$

$$\text{tmp}_1 = \text{mRNEAc}\left(\mathbf{q}, \dot{\mathbf{q}}, \ddot{\mathbf{q}}, \mathbf{a}_g, \boldsymbol{\lambda}, \boldsymbol{\mu}, \boldsymbol{\pi}\right) \qquad \mathcal{O}(n)$$

$$\text{tmp}_2 = \frac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_1\right] \qquad \mathcal{O}(n)$$

Reverse-Mode AD

$$\mathbf{T}_1 = \frac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_2\right] \qquad \textcolor{green}{\mathcal{O}(n^2)}$$

AD

$$\text{tmp}_3 = \text{mRNEAc}\left(\mathbf{q}, 0, \frac{\partial \ddot{\mathbf{q}}}{\partial \mathbf{q}}, 0, \frac{\partial \boldsymbol{\lambda}}{\partial \mathbf{q}}, \boldsymbol{\mu}, \boldsymbol{\pi}\right) \qquad \mathcal{O}(n^2)$$

$$\mathbf{T}_2 = \frac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_3\right] \qquad \textcolor{green}{\mathcal{O}(n^2)}$$

Reverse-Mode AD

$$\boldsymbol{\gamma}^\top \frac{\partial^2 \boldsymbol{\nu}}{\partial \mathbf{q}^2} = \mathbf{T}_1 + \mathbf{T}_2 + \mathbf{T}_2^\top$$