I $\underline{\underline{\text{Dynamics}}}$

$$\boxed{\boldsymbol{\nu} = \mathbf{K}^{-1}\Psi} \xrightarrow{\text{AD}} \frac{\partial \boldsymbol{\nu}}{\partial \mathbf{q}} \quad \mathcal{O}(n^2)$$

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

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

$\text{tmp}_2 = \dfrac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_1\right] \quad \mathcal{O}(n)$ ← Reverse-Mode AD

$\mathbf{T}_1 = \dfrac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_2\right] \quad \mathcal{O}(n^2)$ ← AD

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

$\mathbf{T}_2 = \dfrac{\partial}{\partial \mathbf{q}}\left[\text{tmp}_3\right] \quad \mathcal{O}(n^2)$ ← Reverse-Mode AD

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

Substitute