$$\underline{\frac{\text{Dynamics}}{\boldsymbol{\nu} = \mathbf{K}^{-1} \boldsymbol{\Psi}} \qquad \underline{\underline{\mathbf{III}} \ \underline{\frac{\text{mRNEAc DDP}}{\boldsymbol{\sigma}^{2} \boldsymbol{\nu}}} = \mathsf{T}_{1} + \mathsf{T}_{2} + \mathsf{T}_{2}^{\mathsf{T}}$$

$$\frac{\mathbf{r} \, \mathbf{DDP}}{\mathbf{DDP}} \quad \partial^2 \boldsymbol{\nu}$$

$$\frac{\partial \mathcal{D}}{\partial \mathbf{r}} = \frac{\partial^2 \mathbf{\nu}}{\partial \mathbf{r}}$$
ls twice: $\frac{\partial^2 \mathbf{\nu}}{\partial \mathbf{r}}$

ols twice:
$$\frac{\partial^2 \boldsymbol{\nu}}{\partial^2 \mathbf{q}}$$
 $\mathcal{O}(n^3)$

AD tools twice:
$$\frac{\partial^2 \boldsymbol{\nu}}{\partial^2 \mathbf{q}} \quad \mathcal{O}(n^3)$$

$$\mathsf{T}_2 = \mathbf{q}$$
Tensor contraction: $\boldsymbol{\gamma}^{\top} \frac{\partial^2 \boldsymbol{\nu}}{\partial^2 \mathbf{q}} \quad \mathcal{O}(n^3)$

ols twice:
$$\frac{\partial^2 \boldsymbol{\nu}}{\partial^2 \mathbf{q}}$$
 $\mathcal{O}(n^3)$ $\nabla_2 \mathbf{q}$

$$\frac{\partial^{2}\mathbf{q}}{\partial \mathbf{q}} = \frac{\partial}{\partial \mathbf{q}} \left[\frac{\partial}{\partial \mathbf{q}} \text{ mRNEAc} \right]$$

$$\mathsf{T}_1 = \frac{\partial}{\partial \mathbf{q}} \left[\frac{\partial}{\partial \mathbf{q}} \, \text{mRNEAc} \left(\mathbf{q}, \dot{\mathbf{q}}, \ddot{\mathbf{q}}, \mathbf{a}_g, \boldsymbol{\lambda}, \boldsymbol{\mu}, \boldsymbol{\pi} \right) \right] \quad \mathcal{O}(n^2)$$

$$rac{\partial \mathbf{q}}{\partial \mathbf{q}} \left[rac{\partial}{\partial \mathbf{q}} \, \mathrm{mRNEAc} \left(\mathbf{q}, \dot{\mathbf{q}}, \ddot{\mathbf{q}}, \mathbf{a}_g, \boldsymbol{\lambda}, \boldsymbol{\mu}, \boldsymbol{\pi}
ight) \\ - \mathbf{q} \left[\begin{array}{ccc} \partial \ddot{\mathbf{q}} & \partial \ddot{\mathbf{q}} & \partial \boldsymbol{\lambda} \end{array} \right]$$

$$\mathsf{T}_{2} = \frac{\partial}{\partial \mathbf{q}} \, \text{mRNEAc} \left(\mathbf{q}, 0, \frac{\partial \ddot{\mathbf{q}}}{\partial \mathbf{q}}, 0, \frac{\partial \boldsymbol{\lambda}}{\partial \mathbf{q}}, \boldsymbol{\mu}, \boldsymbol{\pi} \right) \quad \mathcal{O}(n^{2})$$

$$rac{1}{2} \left[rac{1}{2}
ight] ext{mRNEAc} \left(\mathbf{q}, \dot{\mathbf{q}}, \dot{\mathbf{q}}, \mathbf{a}_g, oldsymbol{\lambda}, oldsymbol{\mu}
ight] \ ext{mRNEAc} \left(\mathbf{q}, 0, rac{\partial \ddot{\mathbf{q}}}{\partial \mathbf{q}}, 0, rac{\partial oldsymbol{\lambda}}{\partial \mathbf{q}}, oldsymbol{\mu}, oldsymbol{\mu}, oldsymbol{\mu}
ight]$$

$$egin{aligned} & rac{\partial}{\partial \mathbf{q}} & \mathrm{mRNEAc}\left(\mathbf{q}, \dot{\mathbf{q}}, \ddot{\mathbf{q}}, \mathbf{a}_{g}, oldsymbol{\lambda}, oldsymbol{\lambda} \end{aligned}$$

where $egin{bmatrix} oldsymbol{\mu} \ oldsymbol{\pi} \end{bmatrix} = -\mathbf{K}^{-1} oldsymbol{\gamma}$