$$egin{aligned} \mathbf{v}_k' &= egin{bmatrix} \mathbf{\Gamma}^+[\mathbf{v}_k;\, \zeta_v] &\equiv \mathbf{v}_k \odot \exp\left(rac{arepsilon_k^k}{2} s_{\mathbf{v}}^k(\zeta_{\mathbf{v}_k})
ight) - rac{arepsilon_k^k}{2} igg[\partial_x S(x_k) \odot \exp\left(arepsilon_k^k q_{\mathbf{v}}^k(\zeta_{\mathbf{v}_k})
ight) + t_{\mathbf{v}}^k(\zeta_{\mathbf{v}_k}) igg] \ &= egin{bmatrix} \mathbf{v}_k' &\odot \exp\left(arepsilon_k^k s_{\mathbf{v}}^k(\zeta_{ar{\mathbf{v}}_k})
ight) + \varepsilon_{\mathbf{x}}^k igg[v_k' \odot \exp\left(arepsilon_k^k q_{\mathbf{x}}^k(\zeta_{ar{\mathbf{x}}_k})
ight) + t_{\mathbf{x}}^k(\zeta_{ar{\mathbf{x}}_k}) igg] \end{bmatrix}$$

force scaling

v scaling

translation

translation

v scaling

x scaling