

$$\mathbf{e}^{-\zeta^*/2} \mathbf{1} \mathbf{x} \overbrace{w_1 e \underline{E}} \overbrace{w_2 e \underline{E}} \mathbf{e}^{-\zeta^*/2} \boldsymbol{\gamma} = \overbrace{\bar{\zeta} - \partial w_1 \zeta^* - \dot{\partial}} \mathbf{1} \mathbf{x}_F \overbrace{\bar{\zeta} - \partial w_2 \zeta^* - \dot{\partial}} \boldsymbol{\gamma}$$

$$\begin{aligned} \text{LHS} &= \overbrace{w_1 e \underline{E}}^* \overbrace{\mathbf{e}^{-\zeta^*/2} \mathbf{1} \mathbf{x}} \overbrace{w_2 e \underline{E}} \overbrace{\mathbf{e}^{-\zeta^*/2} \boldsymbol{\gamma}} = \overbrace{w_1 e \underline{E}} \overbrace{\mathbf{e}^{-\zeta^*/2} \mathbf{1} \mathbf{x}} \overbrace{w_2 e \underline{E}} \overbrace{\mathbf{e}^{-\zeta^*/2} \boldsymbol{\gamma}} \\ &= \mathbf{e}^{-\zeta^*/2} \overbrace{\bar{\zeta} - \partial w_1 \zeta^* - \dot{\partial}} \mathbf{1} \mathbf{x} \mathbf{e}^{-\zeta^*/2} \overbrace{\bar{\zeta} - \partial w_2 \zeta^* - \dot{\partial}} \boldsymbol{\gamma} = \text{RHS} \end{aligned}$$

$$\overbrace{\bar{\zeta} - \partial w \zeta^* - \dot{\partial}} \mathbf{e}^{\zeta^*} = \overline{\zeta - \xi w} \overbrace{\zeta^* - \xi} \mathbf{e}^{\zeta^*}$$

$$\overbrace{\bar{\zeta} - \partial \dot{\alpha} \beta \zeta^* - \dot{\partial}} \mathbf{e}^{\zeta^*} = \underline{\alpha \zeta^* - \partial_\alpha} \overbrace{\beta \zeta^* - \partial_\beta} \mathbf{e}^{\zeta^*} = \underline{\alpha \zeta^* - \xi} \overbrace{\beta \zeta^* - \xi} \mathbf{e}^{\zeta^*} = \overline{\zeta - \xi w} \overbrace{\zeta^* - \xi} \mathbf{e}^{\zeta^*}$$

$$\xi \overbrace{\partial - \bar{\eta} w_2 \dot{\partial} - \bar{\eta} \zeta - \xi \dot{w}_1 \zeta^* - \xi \boldsymbol{\gamma}} = \text{tr } \dot{w}_1 w_2 + \dot{w}_1 \dot{w}_2 \xi \boldsymbol{\gamma}$$

$$w_1 = \dot{\gamma} \delta: \quad w_2 = \dot{\alpha} \beta$$

$$\begin{aligned} \overbrace{\partial - \bar{\eta} \dot{\alpha} \beta \dot{\partial} - \bar{\eta} \zeta - \xi \dot{\delta} \bar{\gamma} \zeta^* - \xi} \boldsymbol{\gamma} &= \underline{\partial_\alpha - \alpha \bar{\eta}} \underline{\partial_\beta - \beta \bar{\eta}} \underline{\zeta^* \delta^* - \xi \delta^*} \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} \\ &= \underline{\partial_\alpha - \alpha \bar{\eta}} \underline{\zeta^* \delta^* - \xi \delta^*} \underline{\partial_\beta - \beta \bar{\eta}} + \beta \delta^* \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} \\ &= \underline{\partial_\alpha - \alpha \bar{\eta}} \underline{\zeta^* \delta^* - \xi \delta^*} \underline{\partial_\beta - \beta \bar{\eta}} \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} + \beta \delta^* \underline{\partial_\alpha - \alpha \bar{\eta}} \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} \\ &= \underline{\zeta^* \delta^* - \xi \delta^*} \underline{\partial_\alpha - \alpha \bar{\eta}} + \alpha \delta^* \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} \underline{\partial_\beta - \beta \bar{\eta}} + \beta \delta^* \underline{\zeta^* \boldsymbol{\gamma} - \xi \boldsymbol{\gamma}} \underline{\partial_\alpha - \alpha \bar{\eta}} + \alpha \bar{\eta} \\ \Rightarrow \overbrace{\partial - \bar{\eta} \dot{\alpha} \beta \dot{\partial} - \bar{\eta} \zeta - \xi \dot{\delta} \bar{\gamma} \zeta^* - \xi} \boldsymbol{\gamma} &= \underline{\alpha \delta^* \beta \bar{\eta} + \beta \delta^* \alpha \bar{\eta}} \xi \boldsymbol{\gamma} = \text{tr } \dot{w}_1 w_2 + \dot{w}_1 \dot{w}_2 \xi \boldsymbol{\gamma} \end{aligned}$$

$$\overline{\zeta - \partial w_1 \zeta^* - \dot{\partial}^t} \mathbb{1}_F \overline{\zeta - \partial w_2 \zeta^* - \dot{\partial}^t} \mathbb{1} = \text{tr } \dot{w}_1 w_2 \mathbb{1}_F \mathbb{1}$$

$$\begin{aligned} & \overline{\zeta - \partial w_1 \zeta^* - \dot{\partial}^t} e^{\zeta^*} \mathbb{1}_F \overline{\zeta - \partial w_2 \zeta^* - \dot{\partial}^t} e^{\zeta^*} = \overline{\zeta - \xi w_1 \zeta^* - \xi} e^{\zeta^*} \mathbb{1}_F \overline{\zeta - \eta w_2 \zeta^* - \eta} e^{\zeta^*} \\ & = \int e^{-\zeta^*} e^{\xi \zeta^*} \zeta - \xi \dot{w}_1 \zeta - \xi \zeta - \eta w_2 \zeta^* - \eta e^{\zeta^*} = \int e^{-\zeta^*} e^{\xi \zeta^*} \zeta - \eta w_2 \zeta^* - \eta \zeta - \xi \dot{w}_1 \zeta - \xi e^{\zeta^*} \\ & = \int e^{-\zeta^*} e^{\xi \zeta^*} \partial - \bar{\eta} w_2 \dot{\partial} - \bar{\eta} \zeta - \xi \dot{w}_1 \zeta - \xi e^{\zeta^*} = \overline{\partial - \bar{\eta} w_2 \dot{\partial} - \bar{\eta} \zeta - \xi \dot{w}_1 \zeta - \xi} e^{\zeta^*} \end{aligned}$$