2. show $\frac{\partial J}{\partial \underline{F}} = J\,\underline{F}^{-T}$

**2D** $J = F_{11}F_{22} - F_{12}F_{21}$ $\quad \frac{\partial J}{\partial \underline{F}} = \begin{bmatrix} F_{22} & -F_{21} \\ -F_{12} & F_{11} \end{bmatrix}$

$$\underline{F}^{-1} = \frac{1}{J}\begin{bmatrix} F_{22} & -F_{12} \\ -F_{21} & F_{11} \end{bmatrix} \qquad J\,\underline{F}^{-T} = \begin{bmatrix} F_{22} & -F_{21} \\ -F_{12} & F_{11} \end{bmatrix} = \frac{\partial J}{\partial \underline{F}}$$

**3D** $\underline{F} = \begin{bmatrix} a & d & g \\ b & e & h \\ c & f & i \end{bmatrix}$ $\quad J = aei - ahf + dhc - dbi + gbf - gec$

$$\frac{\partial J}{\partial \underline{F}} = \begin{bmatrix} ei-hf & hc-bi & bf-ec \\ gf-di & ai-gc & dc-af \\ dh-ge & gb-ah & ae-db \end{bmatrix} = J\,\underline{F}^{-T}$$

because $\underline{F}^{-1} = \frac{1}{J}\begin{bmatrix} ei-hf & gf-di & dh-ge \\ hc-bi & ai-gc & gb-ah \\ bf-ec & dc-af & ae-db \end{bmatrix}$