Solve equation $[K]\{X\} = [F]$

State variable $\{X\} = \{\boldsymbol{u} \quad \boldsymbol{a} \quad V\}^t$

State equations

$$\boldsymbol{S} = 1/2(\mathbf{grad} + \mathbf{grad}^t)\boldsymbol{u}$$
$$\boldsymbol{B} = \mathbf{curl}\ \boldsymbol{a}$$
$$\boldsymbol{E} = -\mathbf{grad}\ V$$

Local field $\boldsymbol{S}, \quad \boldsymbol{B}, \quad \boldsymbol{E}$

Local constitutive laws

$$\boldsymbol{T} = c\boldsymbol{S} - e^t\boldsymbol{E} - h^t\boldsymbol{B}$$
$$\boldsymbol{H} = -h\boldsymbol{S} + \nu\boldsymbol{B}$$
$$\boldsymbol{D} = -e\boldsymbol{S} + \varepsilon\boldsymbol{E}$$

Local field $\boldsymbol{T}, \quad \boldsymbol{H}, \quad \boldsymbol{D}$

Volume average

$$\begin{cases} \bar{T} & = 1/V\int \boldsymbol{T}dV \\ \bar{H} & = 1/V\int \boldsymbol{H}dV \\ \bar{D} & = 1/V\int \boldsymbol{D}dV \end{cases}$$

Material coefficients

$$\begin{bmatrix} \bar{\boldsymbol{T}} \\ \bar{\boldsymbol{H}} \\ \bar{\boldsymbol{D}} \end{bmatrix} = \begin{bmatrix} \tilde{C} & -\tilde{h}^t & -\tilde{e}^t \\ \tilde{h} & \tilde{\nu} & \tilde{\alpha}_H^t \\ \tilde{e} & \tilde{\alpha}_H & \tilde{\varepsilon} \end{bmatrix} \begin{bmatrix} \bar{\boldsymbol{S}} \\ \bar{\boldsymbol{B}} \\ \bar{\boldsymbol{E}} \end{bmatrix}$$