Coupled Fluid-Structure Solver

Weak form of one field scheme

Combined Field with Explicit Interface

$$\int_{\Omega_{\mathrm{h}}^{\mathrm{f}}(t)} \rho^{\mathrm{f}} \left(\partial_t \boldsymbol{u}^{\mathrm{f}} + \left(\boldsymbol{u}^{\mathrm{f}} - \boldsymbol{w}\right) \cdot \boldsymbol{\nabla} \boldsymbol{u}^{\mathrm{f}}\right) \cdot \boldsymbol{\phi}^{\mathrm{f}} \mathrm{d}\boldsymbol{\Omega} + \int_{\Omega^{\mathrm{f}}(t)} \boldsymbol{\sigma}^{\mathrm{f}} : \boldsymbol{\nabla} \boldsymbol{\phi}^{\mathrm{f}} \mathrm{d}\boldsymbol{\Omega}$$
$$- \int_{\Omega^{\mathrm{f}}(t)} \boldsymbol{\nabla} \cdot \boldsymbol{u}^{\mathrm{f}} q \mathrm{d}\boldsymbol{\Omega}$$
$$+ \sum_{e=1}^{n_{\mathrm{el}}} \int_{\Omega^{\mathrm{e}}} \tau_m \left(\rho^{\mathrm{f}} \left(\boldsymbol{u}^{\mathrm{f}} - \boldsymbol{w}\right) \cdot \nabla \boldsymbol{\phi}^{\mathrm{f}} + \nabla q\right) \cdot$$
$$\left(\rho^{\mathrm{f}} \boldsymbol{u_t}^{\mathrm{f}} + \rho^{\mathrm{f}} \left(\boldsymbol{u}^{\mathrm{f}} - \boldsymbol{w}\right) \cdot \boldsymbol{\nabla} \boldsymbol{u}^{\mathrm{f}} - \nabla \cdot \boldsymbol{\sigma}^{\mathrm{f}} - \boldsymbol{f}^{\mathrm{f}}(t)\right) d\Omega^{\mathrm{e}}$$
$$+ \sum_{e=1}^{n_{\mathrm{el}}} \int_{\Omega^{\mathrm{e}}} \nabla \cdot \boldsymbol{\phi}^{\mathrm{f}} \tau_c \nabla \cdot \boldsymbol{u}^{\mathrm{f}} d\Omega^{\mathrm{e}}$$
$$+ \int_{\Omega^{\mathrm{s}}} \rho^{\mathrm{s}} \partial_t \boldsymbol{u}^{\mathrm{s}} \cdot \boldsymbol{\phi}^{\mathrm{s}} \mathrm{d}\boldsymbol{\Omega} + \int_{\Omega^{\mathrm{s}}} \boldsymbol{\sigma}^{\mathrm{s}} : \boldsymbol{\nabla} \boldsymbol{\phi}^{\mathrm{s}} \mathrm{d}\boldsymbol{\Omega} =$$
$$\int_{\Omega^{\mathrm{f}}(t)} \boldsymbol{f}^{\mathrm{f}} \cdot \boldsymbol{\phi}^{\mathrm{f}} \mathrm{d}\boldsymbol{\Omega} + \int_{\Gamma_{\mathrm{n}}^{\mathrm{f}}(t)} \boldsymbol{T}^{\mathrm{f}} \cdot \boldsymbol{\phi}^{\mathrm{f}} \mathrm{d}\boldsymbol{\Gamma} + \int_{\Omega^{\mathrm{s}}} \boldsymbol{f}^{\mathrm{s}} \cdot \boldsymbol{\phi}^{\mathrm{s}} \mathrm{d}\boldsymbol{\Omega} + \int_{\Gamma_{\mathrm{n}}^{\mathrm{s}}} \boldsymbol{T}^{\mathrm{s}} \cdot \boldsymbol{\phi}^{\mathrm{s}} \mathrm{d}\boldsymbol{\Gamma}$$

where, Σ_2 and Σ_4 represent the Neumann boundaries of fluid and structural domains.