MANE 6760 - FEM for Fluid Dyn. - Lecture 12

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FE Setup and Procedure: Multiple Dimensions

Jacobian matrix (related to mapping between x and ξ):

$$\underline{x}(\underline{\xi}) \, , \, \underline{\xi}(\underline{x}) \, , \, \frac{\partial N_a}{\partial \xi_i} = \begin{bmatrix} N_{a,\xi_1} \\ N_{a,\xi_2} \end{bmatrix} \, ; \, \text{Need } N_{a,x_i} = J^{-1} N_{a,\xi_i}$$

Local/element level operations (matrices and vectors):

$$A^e_{ab} = \int \cdots N_{a,\underline{x}} \overset{\text{dot prod}}{\underset{\bullet}{\downarrow}} \left(\kappa N_{b,\underline{x}} \right) d\Omega \quad , \quad \int \left(\underline{a} \cdot \bar{w}_{,\underline{x}} \right) \sim \left(\underline{a} \cdot \bar{\phi}_{,\underline{x}} \right)$$

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Element-level shape functions:

Element-level numerical quadrature:

FE Setup and Procedure: Multiple Dimensions

Assembly of element-level (FE) matrices and vectors:

Global level operations (including BCs):

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