

ASEN 5107 Nonlinear Finite Element Methods
Homework 2: Residual Equations (Chapters 3-4 of Notes)

Due Thursday February 1, 2007

Exercises:

3.1

3.2

3.4 or 3.5 (pick one, both are short)

4.2 or 4.4 (pick one, they are similar)

Partial result for 3.2:

$$\ddot{\mathbf{r}} = \begin{bmatrix} 4 & u_3 - 1 & u_2 \\ u_3 - 1 & 6 & u_1 \\ u_2 & u_1 & 4 \end{bmatrix} \begin{Bmatrix} \ddot{u}_1 \\ \ddot{u}_2 \\ \ddot{u}_3 \end{Bmatrix} + \begin{bmatrix} 0 & \dot{u}_3 & \dot{u}_2 \\ \dot{u}_3 & 0 & \dot{u}_1 \\ \dot{u}_2 & \dot{u}_1 & 0 \end{bmatrix} \begin{Bmatrix} \dot{u}_1 \\ \dot{u}_2 \\ \dot{u}_3 \end{Bmatrix} - \begin{bmatrix} 6 & 0 \\ 0 & 3 \\ 0 & 3 \end{bmatrix} \begin{Bmatrix} \ddot{\Lambda}_1 \\ \ddot{\Lambda}_2 \end{Bmatrix}.$$

Partial results (last two results) for 4.4: the hyperplane equation at a point P in the $\{u_1, u_2, \lambda\}$ space is

$$\frac{1}{6u_1 - 36u_2^2 + 1} [-30u_2(u_1 - u_{1P}) + 5(u_2 - u_{2P}) + \lambda - \lambda_P] = 0.$$

whereas the differential equation of the orthogonal flow (4.22) is

$$\frac{1}{6u_1 - 36u_2^2 + 1} [-30u_2\dot{u}_1 + 5\dot{u}_2] + \dot{\lambda} = 0.$$