06-720   Advanced Process Systems Engineering   Spring, 2011
.   **Homework 10   Due: 4/25/11**

1. Consider the batch reactor system in Example 8.3 in the book. Formulate this problem using 3 point Radau collocation and variable finite elements.

    (a) Solve this problem without the control bound and compare with the solution in the book.

    (b) Solve the problem with $u(t) \leq 2$. Compare the state profiles with a profile determined by a DAE solver. How many finite elements are needed to achieve a solution with less than 10^{-4} error in the states?

2. Write the KKT conditions for (10.19). Using Gauss-Legendre collocation, apply the quadrature formulation and extend the derivation in Section 10.4 to deal with algebraic variables and decision variables p.

3. Consider the singular catalyst mixing problem in Example 8.9.

    (a) Apply 3 point Gauss collocation and solve with piecewise constant controls for increasing values of N.

    (b) Apply 3 point Radau collocation and solve with piecewise constant controls for increasing values of N. Compare this solution with Gauss collocation.

    (c) Apply 3 point Radau collocation and solve with control coefficients at each collocation point for increasing values of N. Compare this solution to the ones with piecewise controls.