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Combustion spring 2011

For Prof Lu

Combustion Project – Unsteady PSR

Step 1: read the notes on stirred reactors posted online. Derive the equations for unsteady PSR for given residence time and initial conditions. Ignore the terms related to surface reactions and heat loss.

Therefore my assumptions are:

Ignore the terms related to surface reactions and heat loss.

Also in class ignoring plasma and charge was mentioned.

***Mass conservation (continuity equation):***

\* = in

Define terms:

is the outlet mass flow rate

is the inlet mass flow rate

is mass density

V is reactor volume

is gas temperature

***Simplified Species equation (surface reactor term dropped):***

Substitute continuity

Expand terms

Cancel terms

Which simplifies to

Where

For can use matlab function ckrhoy with input (P, T, )

***Energy Equation:***

\* = in

Substitute continuity

Expand terms

Cancel terms

Substitute species equation

Expand terms

Cancel terms

Substitute

Results:

1. Starting from fuel-air mixture at Tin = Tout= 1200K, p=1 atm, and phi=0.5 solve the temperature and species concentrations for different resident times, tau= 1 millionth of a second, 1 millisecond and 1 second. Make sure you get a solution on the upper branch for the long residence time.

For tau = 1 second

Temperature



Mass fractions of H2, CO, CH4







For tau = 1 millisecond and 1 millionth of a second did not receive any ignition.

1. Use the solution on the upper branch as the initial condition, solve the temperature and species profiles for tau = 1 millionth of a second, make sure extinction occurs.

Temperature



Mass fractions of H2, CO, CH4





