The goals of this research project are as follows:

1. Develop an interactive computer code for simulation of a high-intensity turbulent combustor as a "single point" inhomogeneous stirred reactor [1]. This will be developed from an existing batch processing computer code CDPSR [2].

2. Use the interactive CDPSR code as a guide for interpretation and direction of DOE-sponsored companion experiments utilizing Xenon tracer with optical laser diagnostic techniques to experimentally determine the appropriate mixing frequency, and for validation of CDPSR as a mixing-chemistry model for a laboratory jet-stirred reactor.

3. Incorporate the coalescence-dispersion model for finite rate mixing into an existing interactive code AVCO-MARK I, to enable simulation of a combustor as a modular array of stirred flow and plug flow elements, each having a prescribed finite mixing frequency, or axial distribution of mixing frequency, as appropriate.

4. Further increase the speed and reliability of the batch kinetics integrator code CREKID [3] by rewriting in vectorized form for execution on a vector or parallel processor, and by incorporating numerical techniques which enhance execution speed by permitting specification of a very low accuracy tolerance [4].

REFERENCES


Figure 1. Jet-stirred reactor with optical access (2). Details:
(a) sintered reactor wall; (b) reactant feed tube; (c) spray- 
loaded window holder; (d) exhaust ports; and (e) sapphire window

Figure 2. Measured and homogeneous PSR) predicted (DI), and  
uncorrected thermocouple temperature for combustion of DM/air at  
5 V = 19 kg/s out a/sec. (2)  
Crosses are values predicted from CDJR code with NT = 20.
Figure 3. Measured IDI normalized by D-OH equilibrium, and (homogeneous PSR) predicts IDI for combustion of CH/air at $U/V = 19$ kg/cu. ft.
Crosses are predicted values from CDIIR code with NT = 30.

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ORIGINAL PAGE IS OF POOR QUALITY

FEED 1 POPULATION = \( N_1 \)

COMBUSTOR POPULATION = \( N \)

FEED 2 POPULATION = \( N_2 \)

\[ k = K, K-1, K-2, \ldots \]

MASS FLOW RATE \( \dot{n} \)

MIXING FLOW

\[ 0 \quad L \]

\[ \alpha \quad \bar{z} \]

\[ 0 \quad I \quad L \]

\[ n=1 \]

\[ n=2 \]

\[ n=3 \]

\[ n=4 \]

GAUSSIAN DISTRIBUTION FUNCTION

LOCAL FUEL AIR EQUIVALENCE RATIO

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**MARKII**

**MARKII** is an interactive version of the MARK-II combustor model. This is a preliminary design tool, a means of gaining intuitive insight into effects of changes in fuel-air mixing or partitioning on turn-down ratio, combustion efficiency and pollutant formation rates.

An initial data set is taken from data file "MARK2.DAT" but can be altered interactively, and used in consecutive runs.

**MARKII** represents a simple kogg combustor consisting of a maximum of 9 flow elements with the addition of a single recycle element. Flow element types may include:

1. Non-reacting mixers ("mix"), in which the chemical reactions are assumed to have stopped during the mixing process;
2. Perfectly stirred reactors ("PSR"), within which intense self- or back-mixing is assumed to occur, so that there are no axial gradients;
3. Plug flow reactors ("PFR").

The user may define the model as having up to 9 elements in series with air and fuel inlet jets at each element. The recycle element may be of any of the three flow types, and must recycle from a higher numbered element to a lower. Cooling boundary layer effects and chemical reactions within the boundary layer are not considered.

--- Please wait a moment while initialization is completed.

--- initialized -- press 'return' to begin ---

### Input Data

<table>
<thead>
<tr>
<th>Flow</th>
<th>Length</th>
<th>Flow Type</th>
<th>Inlet Air</th>
<th>Inlet Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.4400 E+02</td>
<td>4.0000E-01</td>
<td>1.3500E+00</td>
<td>9.7500E-02</td>
</tr>
<tr>
<td>2</td>
<td>1.4400 E+02</td>
<td>1.0000E-01</td>
<td>4.9500E+01</td>
<td>6.0000E-01</td>
</tr>
<tr>
<td>3</td>
<td>1.4400 E+02</td>
<td>1.0000E+01</td>
<td>0.0000E-01</td>
<td>0.0000E-01</td>
</tr>
<tr>
<td>4</td>
<td>1.4500 E+00</td>
<td>2.0000E-01</td>
<td>7.9500E+00</td>
<td>0.0000E+01</td>
</tr>
<tr>
<td>Recycle</td>
<td>1.4400 E+00</td>
<td>1.0000E+00</td>
<td>4.0000E+00</td>
<td>4.0000E-02</td>
</tr>
</tbody>
</table>

**Air Temp** = 2.1000E+02 F

**Fuel Temp** = 0.0000E+01 F

**Compressor Pressure** = 2.1000E+05 PSI

**Lower Heating Value** = 1.6500E+04 BTU/PSI

Select an option by number:

- 0 - Run with this data set
- 1 - Change Air Temperature
- 2 - Change Fuel Temperature
- 3 - Change Lower Heating Value
- 4 - Change Normal Combustor Pressure
- 5 - Change Recycle Element Status
- 6 - Change Flow Elements Status
- 7 - Inspect Schematic Model Layout

--- MARKII MODEL SCHEMATIC LAYOUT ---

```
AF A A A
1 2 3 4 5
PSR--Mix-- FCM-- Mix-- Mix--
1 2 3 4 5
```

Press return to continue