Space Propulsion

ASSIGNMENT of flipped class on SRM internal ballistics

What you need to do

In class we have already analyze the pressure traces of the 27 rocket motors (9 batches, 3 motors each) to obtain the ballistics of the propellant and their uncertainties. Remember that the 27 motors belong to the same population (they are the same propellant) so they MUST be analyzed altogether with a unique fitting.

The ideal C* is obtained from thermochemical data (see the companion document CEA-DATA.pdf)

Now you need to do the following:

1. Develop a ballistic code that performs a quasi-steady simulation of the BARIA combustion. Check class video, if you have doubts.
2. Set up a Monte Carlo analysis using the uncertainty of “a” and “n”. Remember, they are derived from experimentation so they are of aleatory type and follow a normal distribution.
3. Select a number of samples and generate the populations
4. Combine the population in couples $(a, n)_i$ to have a complete statistical coverage and randomly SHUFFLE THEM (very important for convergence monitoring).
5. Feed the BARIA code, running multiple instances, one per each couple. Each motor will burn for a different time, as $(a, n)_i$ differ. Collect the burning times in a vector.
6. Map the code convergence by computing a “cumulative” mean and standard deviation of the burning time.
7. Report the final burning time mean and standard deviation (or comment if you have not reached convergence).

What you need to place in the report

The report is intended as an INTERNAL TECHNICAL REPORT written by the technician in charge of a standard set of tests to inform the supervisor about the results.

The report shall include:

- Brief presentation of the motor and of the pressure curves.
- Brief presentation of the analysis method for ballistics, with a recap of ballistic data with uncertainty.

- Report a brief description of the Monte Carlo settlement (input distribution types, population size, criterion for convergence identification) and MC results (mean burning time and standard deviation).
- The conclusion of the report shall contain the answer to this aspect: **does the RELATIVE uncertainty on “a” and “n” amplify or smooth** when you compute the uncertainty on the burning time?

Report format

The following constraints apply to the report:

- A4 paper format
- minimum font size is 10 for the text
- margins: at least 2 cm from each side
- figures and tables should be understandable and supplied with a caption
- maximum length: 3 pages (excluding front, page if present)

Delivery

Upload on this FORM.

SHARP Deadline is May 31st 2022, 23:59 (CEST).

Other forms of delivery are not accepted.