

Using sensitivity entropy in experimental design for the development of combustion kinetic models

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The uncertainties of combustion kinetic model predictions can be quite large due to the inherent uncertainties in model input parameters, especially the rate coefficients of elementary reactions [1]. The well designed experimental measurements of combustion systems are usually desired to minimize the uncertainty of the kinetic model. In this work, the sensitivity entropy is proposed to guide us in designing experiments which are relatively efficient for uncertainty minimization [2,3]. Sensitivity entropy is defined as a measure of the degree of dispersion of uncertainty sources of a model output target. The smaller the sensitivity entropy is, the lower degree of dispersion of uncertainty sources will be. The experimental measurement of a target which has smaller sensitivity entropy should be more efficient for the uncertainty minimization. To illustrate the practicability of using sensitivity entropy to guide the selection of relatively efficient experimental systems for model uncertainty minimization, the methanol/oxygen/argon laminar premixed flame is investigated. Based on the analysis of sensitivity analysis entropy, experiments in which many targets have small sensitivity entropies are designed, as shown in Fig. 1. Results show that these well designed experiments can provide strong constraints on the uncertainty space of model input parameters. In the same way, a series of experiments can be designed by using the sensitivity entropy for uncertainty minimization, i.e. making a set of rate coefficients have narrower uncertainty ranges. The concept is expected to be useful for further kinetic model development.

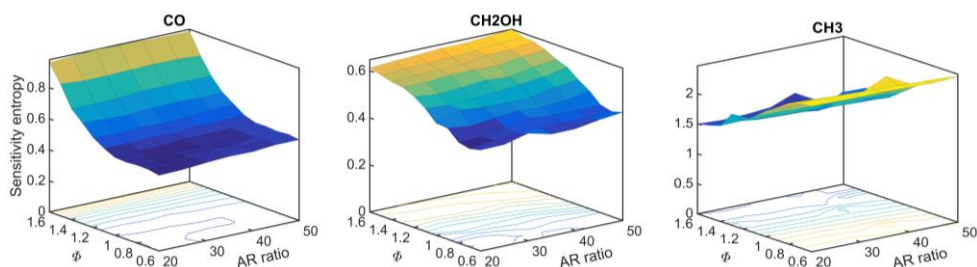


Fig. 1. Sensitivity entropies of CO, CH₂OH and CH₃ for low pressure methanol/oxygen/argon flame.

References

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