

Microcombustor modeling using the RBF-FD method

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Microcombustors are miniature devices that convert the chemical energy in fuels to thermal heat through combustion, which may then be converted to other types of energy. There is a growing interest in microcombustors as an efficient method to power micro-devices. This is due to their inherent advantages of higher energy density and shorter recharge times compared to electrochemical batteries. As the size of the combustion chamber decreases to millimeter level, which is comparable to the laminar flame thickness, traditional combustion theory may not be able to explain and predict the details of the micro-combustion phenomena inside the combustor.

In this paper we consider a simplified model to describe combustion in small-scale rotary engines with a planar design. The model is solved using RBF-FD to approximate the spatial derivatives. We use Polyharmonic Splines (PHS) r7 with polynomial augmentation up to 4th degree on a set of scattered nodes with a location dependent inter-nodal distance. We validate the code solving flame propagation problems in a channel, and we carry out an analysis of the convergence properties of the numerical method. We present results describing the evolution with time of the combustion process from ignition to flame attachment.