Adaptation of finite difference numerical methods to the solution of governing equations in wall-flow diesel particulate filters

J. R. Serrano, F. J. Arnau, P. Piqueras*, O. García-Afonso

Universitat Politècnica de València, CMT-Motores Térmicos, Camino de Vera s/n, 46022 Valencia, Spain.

Abstract

Gas dynamic codes are a widespread computational tool applied to the air management modelling of internal combustion engines. The different engine systems are solved as a combination of one-dimensional (1D) and zero-dimensional (0D) elements coupled by means of quasi-steady boundary conditions. The governing equations in 1D elements are approached assuming the flow to be compressible unsteady and non-homentropic. The solution of the governing equations systems are commonly solved applying finite difference numerical methods. The inclusion of the wall-flow diesel particulate filters (DPF) as standard component of the engine exhaust line involves the inclusion of 1D elements with flow through their walls. The walls of the DPF monolith channels are made of a porous substrate to filter the particulates when the flow goes from the inlet to the outlet channels through them. Therefore, the solution of the pair of inlet and outlet channels becomes linked and dependent on the porous wall characteristics. In this study the adaptation of sock capturing methods to be applied to the coupling solution of governing equations systems of the pairs of inlet and outlet channels in DPFs is performed analyzing the influence on the model prediction capabilities.

*P. Piqueras. CMT-Motores Térmicos, Universitat Politècnica de València.
Camino de Vera s/n, 46022 Valencia, Spain. Phone: +34 963877650 Fax: +34 963877659 e-mail: pedpicab@mot.upv.es

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