Coupling of Meshfree and Finite Volume Discretizations for Flow Simulations in Pleated Filters

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ABSTRACT

The cylindrical pleated filter element is a common type of filters used in the industry for filtration of air, water, oil, etc. The computer simulations can significantly contribute to the design of improved/optimized filter elements, however the existing commercial and academic CFD software tools do not provide enough capability for performing such simulations. The CFD simulations for such type of filter elements are especially difficult due to several reasons, e.g., the complicated geometry of the pleated filtering medium, possible contacts between the filtering medium and the walls; possible deflection of pleats, etc.

This talk presents our current developments on coupling meshfree and Finite Volume Discretizations for flow simulations in pleated filters. The motivation for using such a discretization is as follows. The Finite Volume discretization on curvilinear boundary fitted grid suits very well the resolution of the porous filtering media and the accurate simulation of the flow through this porous media. Finite Volume discretization on regular grids might be beneficial for the subdomains with regular shape. Finally, the meshfree discretization is motivated by two issues: i) the complicated shape of the inter-pleat space; ii) the eventual deflection of the pleats would lead to degeneration of a grid, but can be easier handled by meshfree discretization.

First results on coupling meshfree and Finite Volume Discretizations will be presented. The first studies are done for a scalar elliptic equation. Next, the approach is tested on flow in a channel with and without filtering medium. Finally, simulations for a pleated filter geometry will be shown.