Simulation of flows in ducts and domains with obstacles

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Abstract:

The correct modeling and simulation of compressible fluid flows in variable cross-section ducts and in three-dimensional domains with obstacles is of major importance for EDF. In particular, the accurate prediction of the coolant fluid behaviour in pipes and in the core or the steam generators of PWR is a fundamental topic. The work that is briefly presented herein concerns such a variety of flows.

We will start with the modeling of one-dimensional flows in ducts. Two different approaches will be discussed. The first one relies on an integral approach that is applied to the Euler set of equations. One-dimensional pipes with continuous or discontinuous cross-sections are investigated. The 1D+ integral formulation is presented, and numerical results are compared with the classical Well-Balanced (WB) approach ([3,5,8]), and with the reference solution obtained with a multi-dimensional code, using a huge mesh refinement. In a second approach, we propose a new interface condition[6] to be plugged in the classical well-balanced approach. A comparison with other simulations will be discussed.

In a second part, we focus on the numerical modeling of compressible flows in domains obstructed with many tubes. The integral formulation is presented first, then explicit schemes ([7]), and implicit schemes ([2]) will be detailed. A comparison with the reference "fluid" solution will be given.

More details can be found in.[1–4,6,7]

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