Change in the Flow Rate Through a Deformed Valve

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Abstract

Introduction:
Optimization is one of the greatest challenges in engineering science. To make a design optimized to the best is very useful in order to manufacture perfected devices. In this work, an optimization problem is solved for a pipe. By choosing the right geometry we were able to make the ratio of the flow in one direction to the opposite direction maximum as possible.

Use of COMSOL Multiphysics®:
We have used the turbulent flow interface in COMSOL Multiphysics® to solve the problem. By using COMSOL Multiphysics® we calculated the flow velocity in the central area of the pipe and utilized COMSOL Multiphysics® to show the distribution of the velocity magnitude along the pipe. It is also possible to attach pipes with different geometric shapes and solve a more complex problem.

Results:
We used different connection angles 30, 45, 60, 75 (in degrees) in the geometry to solve the problem and got the following results. When the angle size increases the velocity in the y direction increases and for big angles (60 and 75) the increment is faster than for smaller angles, see Figure 1, velocity as a function of y for different angles, blue for 30, green for 45, red for 60, cyan for 75 (See also Figure 2, the surface 2D plot). Because the increment for 75 was faster we did another calculation for 75. However, this time we changed only the flow direction, first, from left to right (see Figure 3, velocity as a function of y for 75) and then from right to left (see Figure 4) and saw that for the first case the velocity was 20m/s higher than the second case which is very interesting.

Conclusion:
These results could be useful for diverse types of applications, for example, to design pipes that can be used in complex structures, such as nuclear reactors, where there is the need to transfer the coolant with a big efficiency without loses. Or it can be used in compressors where pressure fluctuations may decrease the flow rate which is undesirable.

Figures used in the abstract

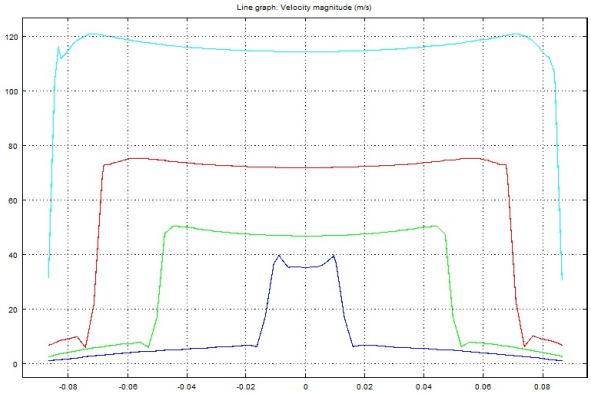

Figure 1

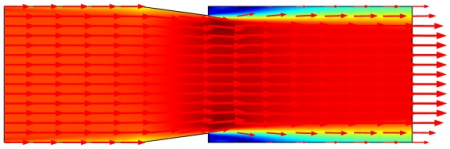

Figure 2

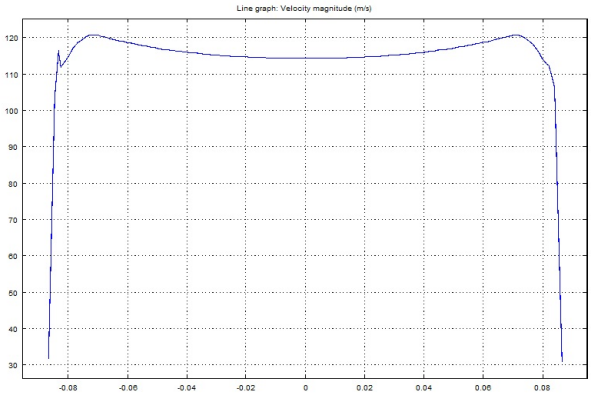

Figure 3

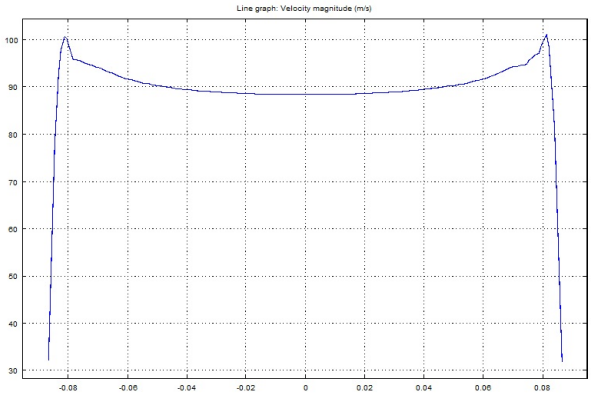

Figure 4