



CFD and OpenFOAM at Caterpillar with a Main Focus on Marine Applications

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Caterpillar manufactures construction and mining equipment, diesel and natural gas engines, marine machinery systems and propellers, as well as other machine components and systems. Several Virtual Product Development (VPD) environments are an integrated and important part of the development of these products. Simulation techniques play an important role, allowing engineers to explore potential product designs and see how a part or entire machine will operate before it's built.

Fluid dynamics simulations through Computational Fluid Dynamics (CFD) is an important and fast growing discipline at Caterpillar. CFD is used in a number of areas, such as underhood cold flow, pipe flow, tank filling and various marine applications, such as hull resistance and propeller cavitation. Within marine applications, which will be the main focus in the presentation, several challenging aspects are found such as very high Reynolds numbers, free surface flow, flow driven motion, phase transfer, large differences in time scales and more. These applications are currently being handled exclusively by OpenFOAM within Caterpillar, whereas within other fields OpenFOAM is a complement to commercial softwares, in an initialization phase to be the main solver or in some cases already well adapted for the specific applications.

Different solvers have their own individual advantages and possibilities, all complementing each other in different aspects of CFD. A major advantage for a certain code is however to have a well developed and validated methodology for the specific application. The time and efforts needed to build this methodology differs from solver to solver and OpenFOAM is well known to have a somewhat higher stepping stone as compared to other commercial softwares. When moving into a new product area, these needs to be investigated carefully. Caterpillar has built an in-house pre-processor to help resolving these difficulties and this tool will be mentioned briefly upon.