FEMTown : A GENERIC FRAMEWORK FOR PARALLEL MULTI-PHYSICS FINITE-ELEMENT SIMULATIONS

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Finite element simulations of different physics are very similar. Nevertheless, the development of general purpose software is very challenging because different physics also have significant differences. Recent implementation techniques offer the flexibility to adapt algorithms for different physics without compromising performance.
FEMTown is a parallel multi-physics finite-element framework that provides an infrastructure for a complete and integrated set of analysis tools for engineers. FEMTown provides object- oriented and generic API's to guarantee robustness and support the creation of integrated multi-physics applications. Indeed generic programming allows to reuse algorithms by e.g. only altering the physics-dependent inner loop. This way, compile-time polymorphism overcomes the performance penalty typical for object-oriented abstractions and run-time polymorphism. In addition, the use of meta-programming augments the flexibility and performance through automatic loop-fusion and supports the assembly of system-matrices directly in the external solvers data format. Finally, in combination with optimal single-node performance, FEMTown supports domain-based parallelism that is almost transparant to the developer.
The talk will be illustrated by an example from aero-acoustics.