The FEniCS Project

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Scientific computing permeates the physical sciences and engineering, and is increasingly impacting biomedical research. In cases where analytical and experimental approaches are either inadequate, too costly, or even impossible, scientific computing can open new avenues to discovery, insight, and prediction.

Traditionally, scientific computing has been a tool reserved for experts; expert knowledge is needed in understanding the features of the application, in designing and programming numerical algorithms, and in evaluating the veracity of the computations. The field has been marked by highly specialized software, long development cycles, and a high level of expert user intervention. The effect is a gap between state-of-the-art scientific computing and research applications.

The FEniCS Project [1] seeks to bridge this gap. Through *automated* computing, we seek to provide effective tools that facilitate and accelerate research and development in all areas of science and engineering. Our vision for automated computing is a fully automated process from the specification of a problem to its solution. We seek to build a system that allows application scientists and engineers to specify their problems with minimal effort, without compromising the complexity of the problem, and to quickly compute solutions that are guaranteed to satisfy a given quality standard. With the recent release of FEniCS 1.0, these goals have now been realized for static nonlinear partial differential equations.

In this talk, I present an overview of the FEniCS Project and its capabilities. I will also highlight a number of current FEniCS related research topics at the Center for Biomedical Computing in Oslo, including automated error control and adaptivity, and fixed background mesh techniques for fluid–structure interaction on complex geometries.

References

[1] A. Logg, K.-A. Mardal, G. N. Wells *et al.*, Automated Solution of Differential Equations by the Finite Element Method, Springer 2012.