A Generic Approach to Scientific Computing

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To overcome the problems of numerical solution of different areas of scientific computing an efficient and clear notation for equations and an automated means to derive linearised equation systems is of utmost importance. In addition to the aforementioned ability to formulate the equations describing the problem numerical methods also require an adequate tessellation of the simulation domain. Therefore it appears difficult, yet highly desirable, to formulate algorithms and even complete discretisation schemes independently of the used tessellation.

To realise these issues our approach is based on two different concepts of comprehensive topological traversal mechanisms and functional equation descriptions directly in a programming language. Support for several spatial dimensions is inherently included in such a way that programs can be written independently of the spatial dimension or the underlying topology without unreasonable penalties on run-time and memory consumption. Several examples, such as the drift diffusion model and the Laplace equation, have been prepared to demonstrate the applicability and high performance of our approach.