World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:13, No:03, 2019

Dido: An Automatic Code Generation and Optimization Framework for Stencil Computations on Distributed Memory Architectures

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Abstract : We present Dido, a source-to-source auto-generation and optimization framework for multi-dimensional stencil computations. It enables a large programmer community to easily and safely implement stencil codes on distributed-memory parallel architectures with Ordered Read-Write Locks (ORWL) as an execution and communication back-end. ORWL provides inter-task synchronization for data-oriented parallel and distributed computations. It has been proven to guarantee equity, liveness, and efficiency for a wide range of applications, particularly for iterative computations. Dido consists mainly of an implicitly parallel domain-specific language (DSL) implemented as a source-level transformer. It captures domain semantics at a high level of abstraction and generates parallel stencil code that leverages all ORWL features. The generated code is well-structured and lends itself to different possible optimizations. In this paper, we enhance Dido to handle both Jacobi and Gauss-Seidel grid traversals. We integrate temporal blocking to the Dido code generator in order to reduce the communication overhead and minimize data transfers. To increase data locality and improve intra-node data reuse, we coupled the code generation technique with the polyhedral parallelizer Pluto. The accuracy and portability of the generated code are guaranteed thanks to a parametrized solution. The combination of ORWL features, the code generation pattern and the suggested optimizations, make of Dido a powerful code generation framework for stencil computations in general, and for distributed-memory architectures in particular. We present a wide range of experiments over a number of stencil benchmarks.

Keywords : stencil computations, ordered read-write locks, domain-specific language, polyhedral model, experiments
Conference Title : ICPP 2019 : International Conference on Parallel Processing
Conference Location : Paris, France
Conference Dates : March 28-29, 2019