GridFOR: A Domain Specific Language for Parallel Grid-Based Applications

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Abstract To ease the programming burden and to make parallel programs more maintainable, computational scientists and engineers currently have the options to use software libraries, templates, and general purpose language extensions to compose their application programs. These existing options, unfortunately, have considerable limitations with compatibility, expressive power and delivered performance. To address these issues, we design a domain specific language, GridFOR, for computational problems defined over regular geometric grids. This language allows the programmer to first implement an algorithm on simple data structures, as commonly illustrated in textbooks or papers. The programmer then specifies transformations to extend the algorithm for complex data structures required by the target applications. We build a compiler to automatically translate a GridFOR program to a parallel Fortran version with Message Passing Interface calls. Several optimization techniques are implemented in our compiler to enhance the program speed.

1 Introduction

Many applications, such as those in the field of computational fluid dynamics, employ a structured grid model of computation. Implementing such applications can be a

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