Peano Cookbook

www.peano-framework.org

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Chapter 1

Preamble

Peano is an open source C++ solver framework. It is based upon the fact that spacetrees, a generalisation of the classical octree concept, yield a cascade of adaptive Cartesian grids. Consequently, any spacetree traversal is equivalent to an element-wise traversal of the hierarchy of the adaptive Cartesian grids. The software Peano realises such a grid traversal and storage algorithm, and it provides hook-in points for applications performing per-element, per-vertex, and so forth operations on the grid. It also provides interfaces for dynamic load balancing, sophisticated geometry representations, and other features. Some properties are enlisted below.

Peano is currently available in its third generation. The development of the original set of Peano codes started around 2002. 2005-2009, we merged these codes into one Peano kernel (2nd generation). In 2009, I started a complete reimplementation of the kernel with special emphasis on reusability, application-independent design and the support for rapid prototyping. This third generation of the code is subject of the present cookbook.

Dependencies and prerequisites

Peano is plain C++ code and depends only on MPI and Intel's TBB or OpenMP if you want to run it with distributed or shared memory support. There are no further dependencies or libraries required. C++ 11 is used. GCC 4.2 and Intel 12 should be sufficient to follow all examples presented in this document. If you intend to use Peano, we provide a small Java tool to facilitate rapid prototyping and to get rid of writing glue code. This Peano Development Toolkit (PDT) is pure Java and uses DaStGen. While we provide the PDT's sources, there's also a jar file available that comprises all required Java libraries and runs stand alone. To be able to use DaStGen—we use this tool frequently throughout the cookbook—you need a recently new Java version.

Who should read this document

This cookbook is written similar to a tutorial in a hands-on style. Therefore, it also contains lots of source code snippets. If you read through a chapter, you should immediately be able to reprogramm the presented details in your code and use the ideas.

Therefore, this cookbook is written for people that have a decent programming background as well as scientific computing knowledge. Some background in the particular application area's algorithms for some chapters also is required. If you read about the particle handling in Peano, e.g., the text requires you to know at least some basics such as linked-cell methods. The text does not discuss mathematical, numerical or algorithmic background. It is a cookbook after all.

What is contained in this document

This book covers a variety of problems I have tackled with Peano when I wrote scientific papers. There is no overall read thread through the document. I recommend to start reading some chapters and then jump into chapters that are of particular interest. Whenever something comes to my mind that should be added, I will add it. If you feel something is urgently missing and deserves a chapter or things remain unclear, please write me an email and I'll see whether I can provide some additional text or extend the cookbook.

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Contents