Overture Demo Introduction

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Overture is a toolkit for solving partial differential equations on structured, overlapping and hybrid grids.

Key features:

• provides a high level C++ interface for rapid prototyping of PDE solvers.
• built upon optimized C and Fortran kernels.
• provides a library of finite-difference operators: conservative and non-conservative, 2nd, 4th, 6th and 8th order accurate approximations.
• support for moving grids.
• support for block structured adaptive mesh refinement (AMR).
• extensive grid generation capabilities.
• CAD fixup tools (for CAD from IGES files).
• interactive graphics and data base support (HDF).
• PDE solvers built upon Overture include:
  • cgins: incompressible Navier-Stokes with heat transfer.
  • cgcnsl: compressible Navier-Stokes, reactive Euler equations.
  • cgmp: multi-physics solver.
  • cgmx: time domain Maxwell’s equations solver.
  • cgsm: solid mechanics (*new in version 24*)
The Overture Framework supports Physics Codes

- Physics Solvers
  - Fluid Flow
  - Electromagnetics
- Fast Elliptic Solvers
- Grid Generation
- Differential Operators
- Adaptive Mesh Refinement
- Grids
  - Data structures
- GridFunctions
  - (fields)
- Graphics
  - (high-level)
- Geometry
- CAD fixup
- Array Classes
- Graphics
  - (low-level)
- Linear Solvers
  - (external)
- Database
  - (external)
Sample 2D overlapping grids

Solutions coupled by interpolation
Sample 3D overlapping grids
Sample hybrid grids
Components of an Overlapping Grid

\[ \Omega \]

\[ \partial \Omega \]

physical boundary

\[ i_1 = 0 \quad i_1 = N_1 \]

\[ i_2 = 0 \quad i_2 = N_2 \]

bc(1,1) bc(1,2) bc(2,1)

bc(2,2)
Overture supports a high-level C++ interface (but is built mainly upon Fortran kernels):

Solve $u_t + au_x + bu_y = \nu(u_{xx} + u_{yy})$

```cpp
CompositeGrid cg; // create a composite grid
getFromADataBaseFile(cg,"myGrid.hdf");
floatCompositeGridFunction u(cg); // create a grid function
u=1.;
CompositeGridOperators op(cg); // operators
u.setOperators(op);
float t=0, dt=.005, a=1., b=1., nu=.1;
for( int step=0; step<100; step++ )
{
    u+=dt*(-a*u.x()-b*u.y()+nu*(u.xx()+u.yy())); // forward Euler
    t+=dt;
    u.interpolate();
    u.applyBoundaryCondition(0,dirichlet,allBoundaries,0.);
    u.finishBoundaryConditions();
}
```
CAD to Mesh to Solution with Overture

Cad fixup

Global triangulation

Overlapping grid

Incompressible flow.