Overture Demo Introduction

Jeff Banks, Kyle Chand and Bill Henshaw

Lawrence Livermore National Laboratory,
Livermore, CA, USA 94551

`www.llnl.gov/casc/Overture`

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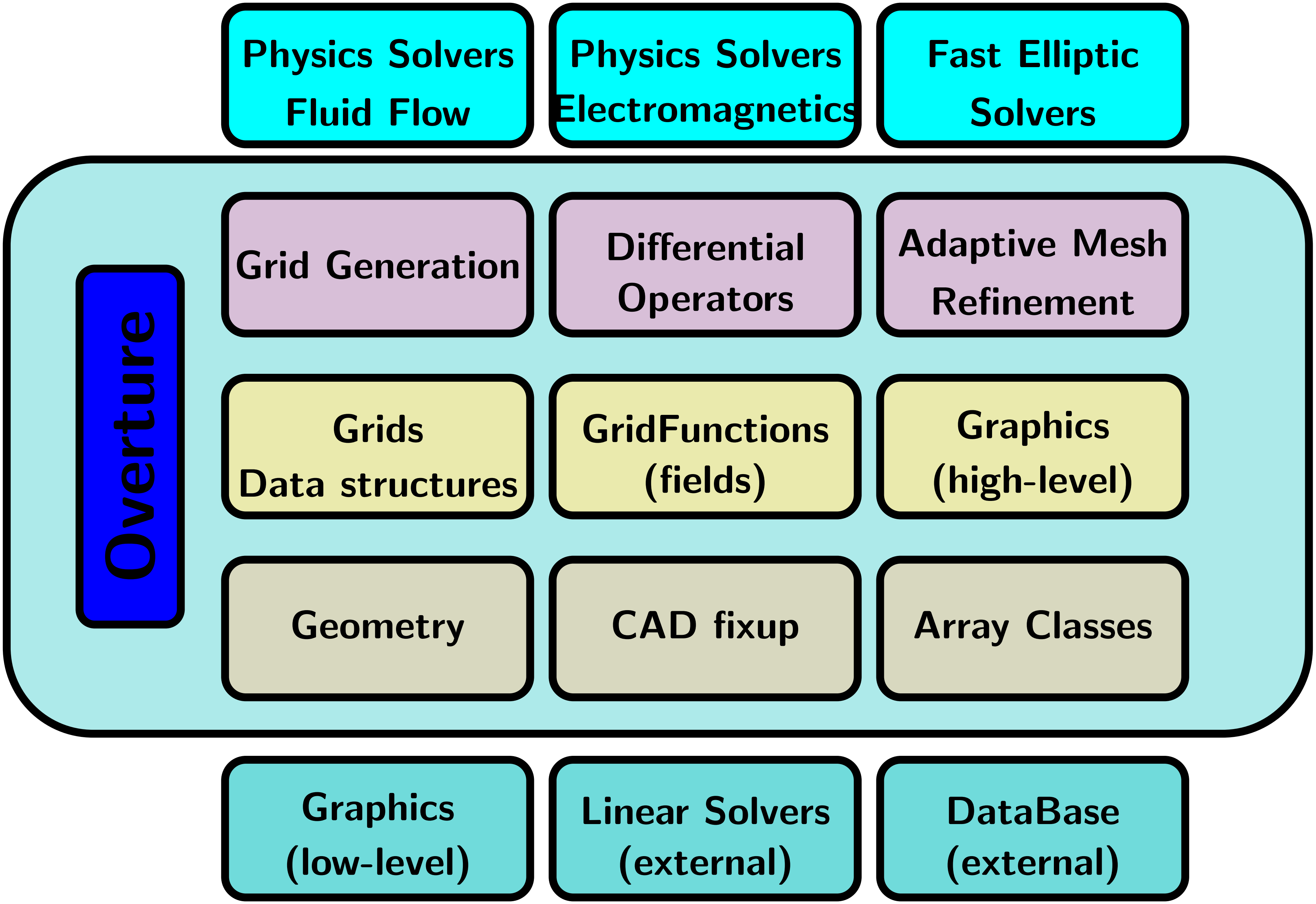
Overture is toolkit for solving partial differential equations on structured, overlapping and hybrid grids.

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.
  - cgcns: 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

Physics Solvers Electromagnetics

Fast Elliptic Solvers

Overture

Grid Generation

Differential Operators

Adaptive Mesh Refinement

Grids Data structures

GridFunctions (fields)

Graphics (high-level)

Geometry

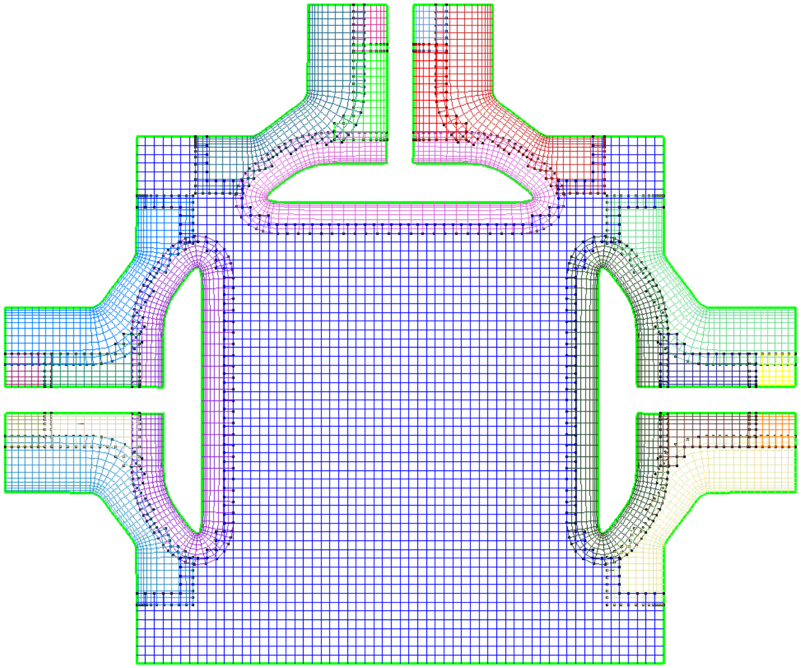
CAD fixup

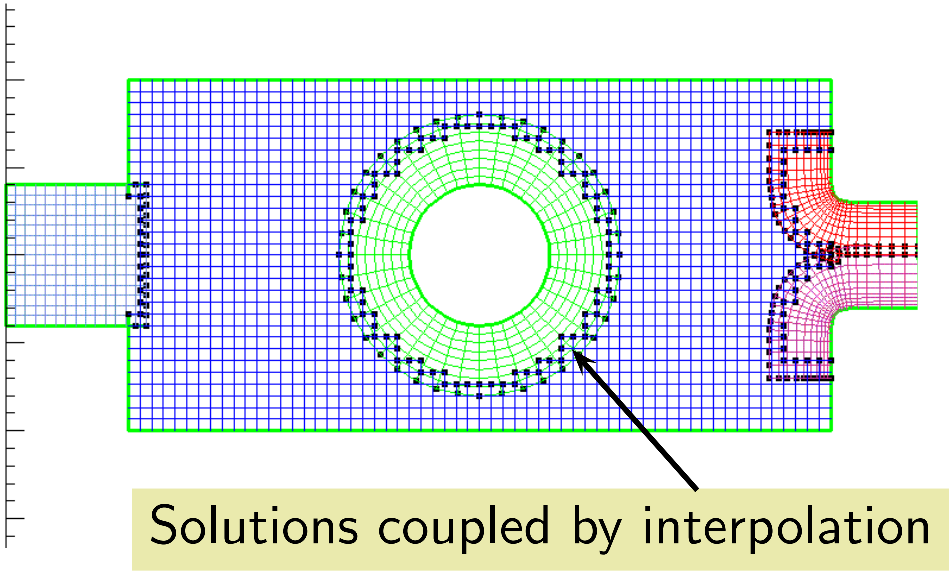
Array Classes

Graphics (low-level)

Linear Solvers (external)

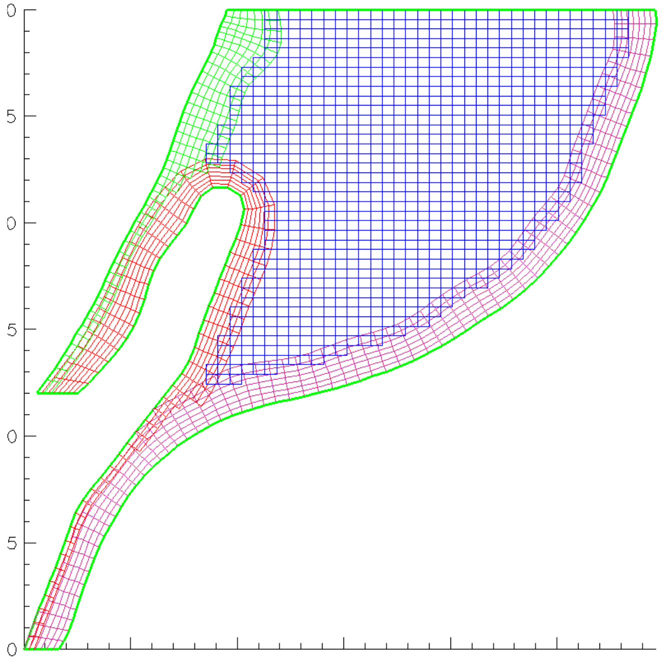
DataBase (external)

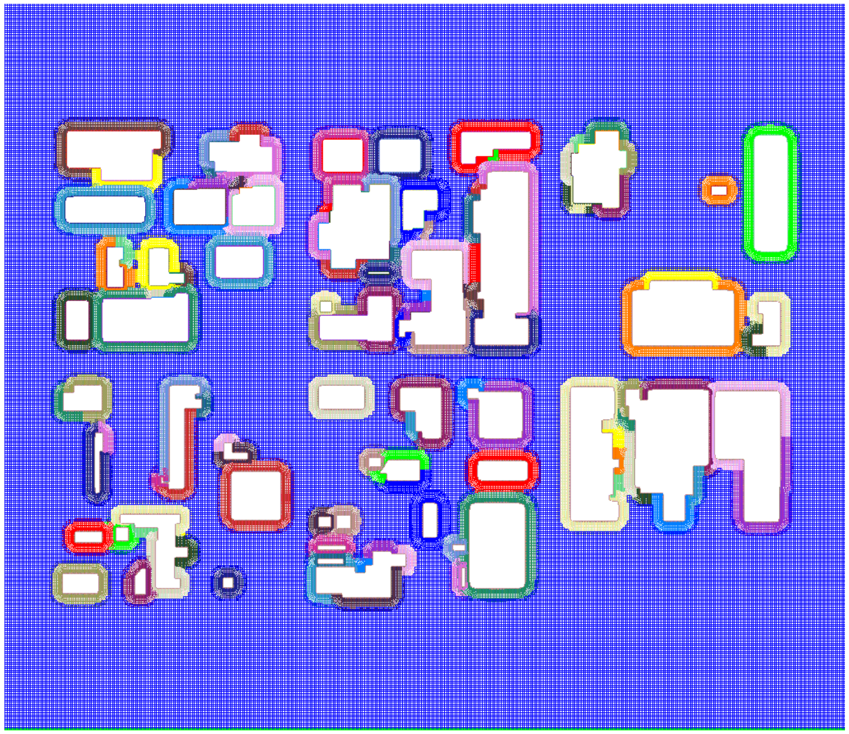




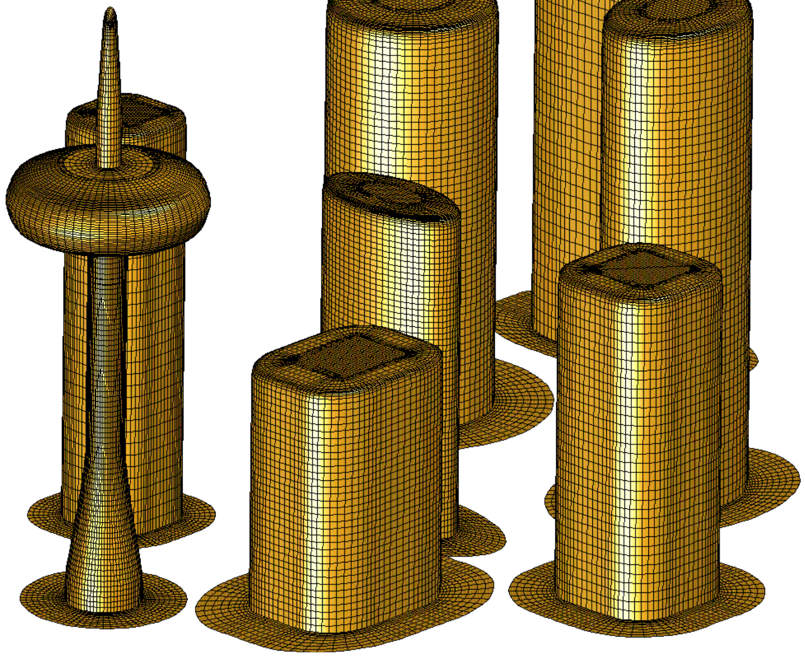
Solutions coupled by interpolation

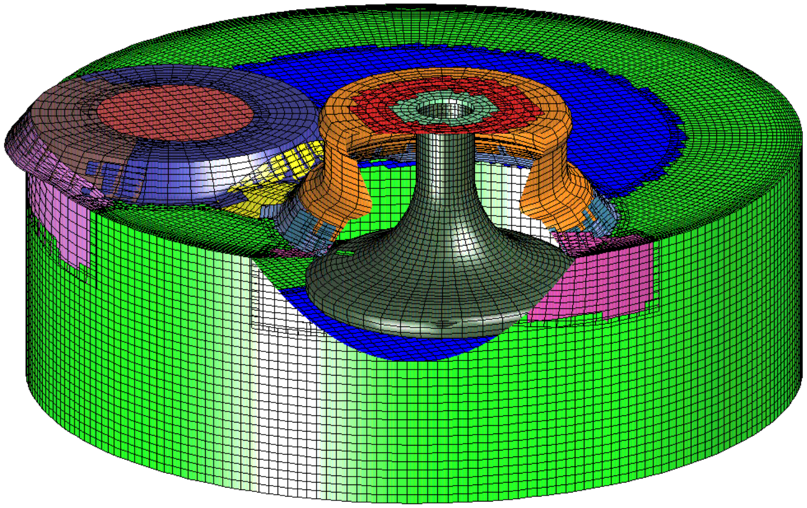
Sample 2D overlapping grids

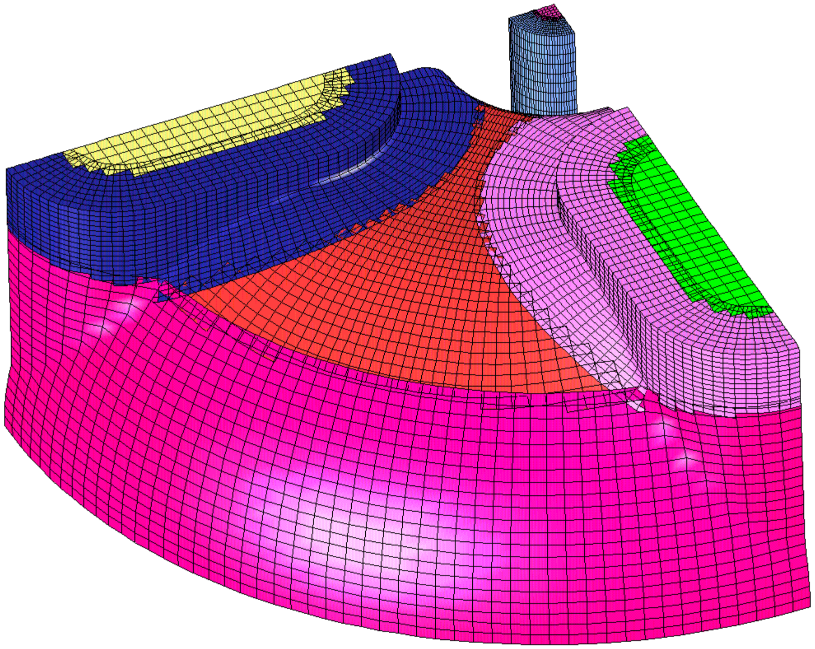


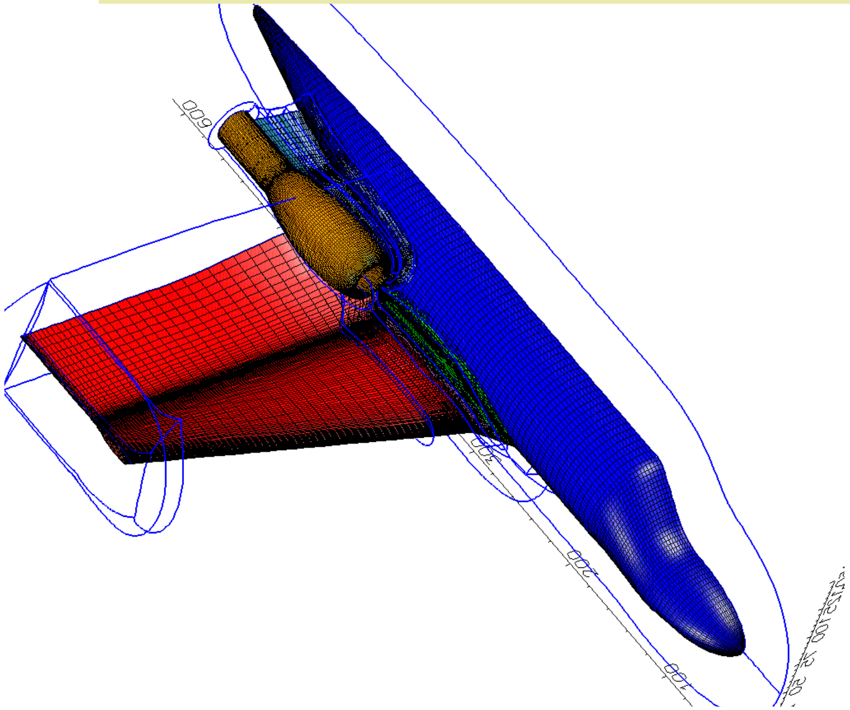


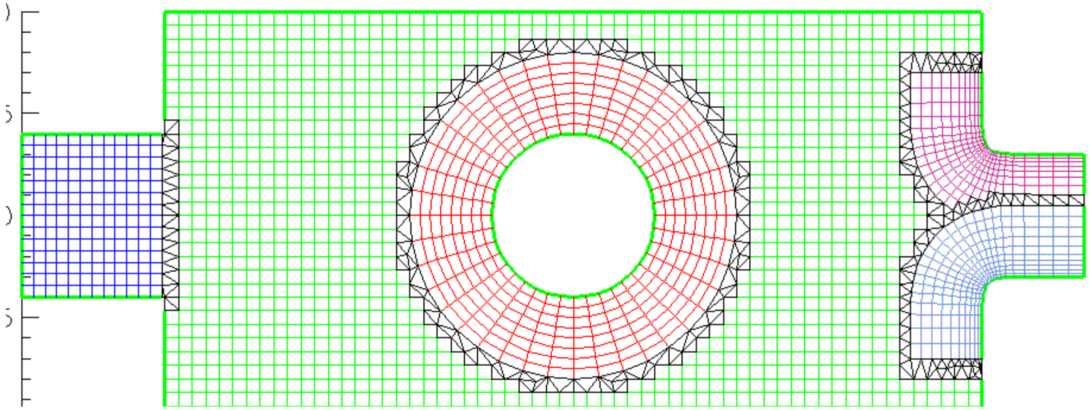
Sample 3D overlapping grids

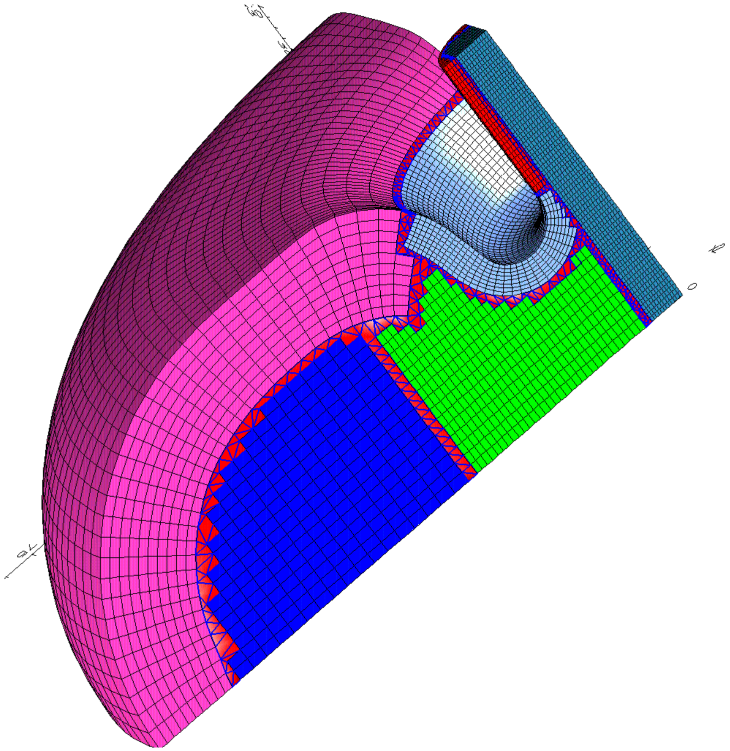




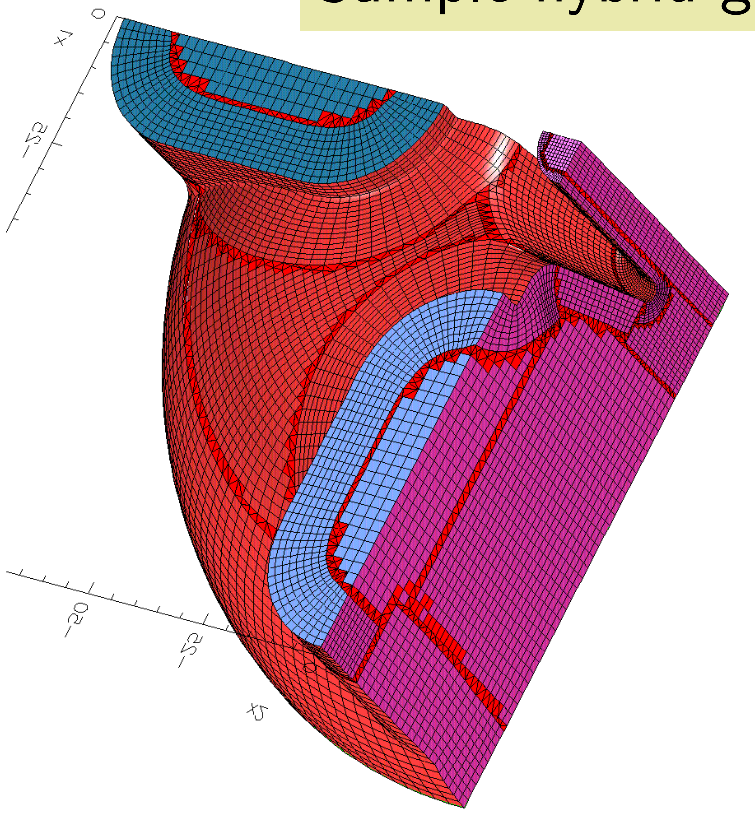


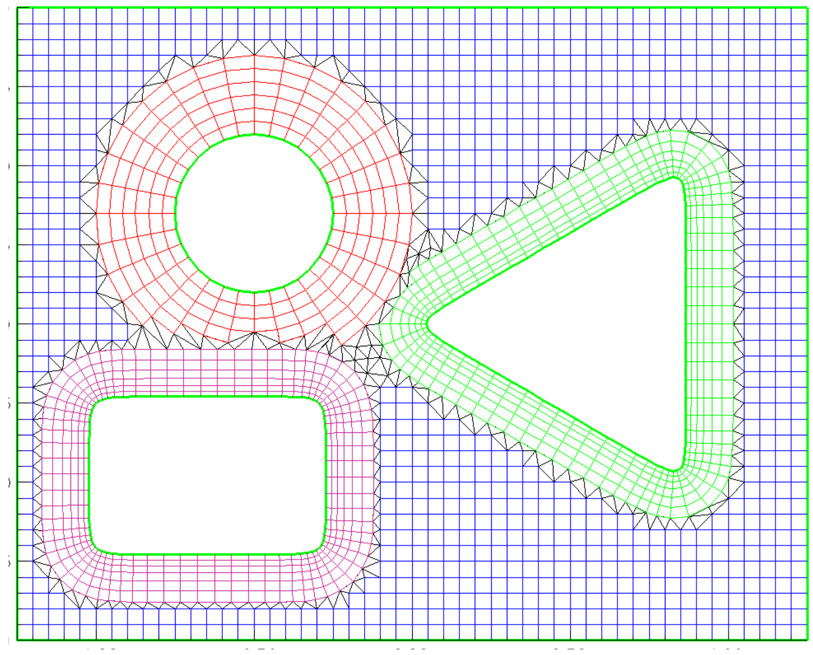




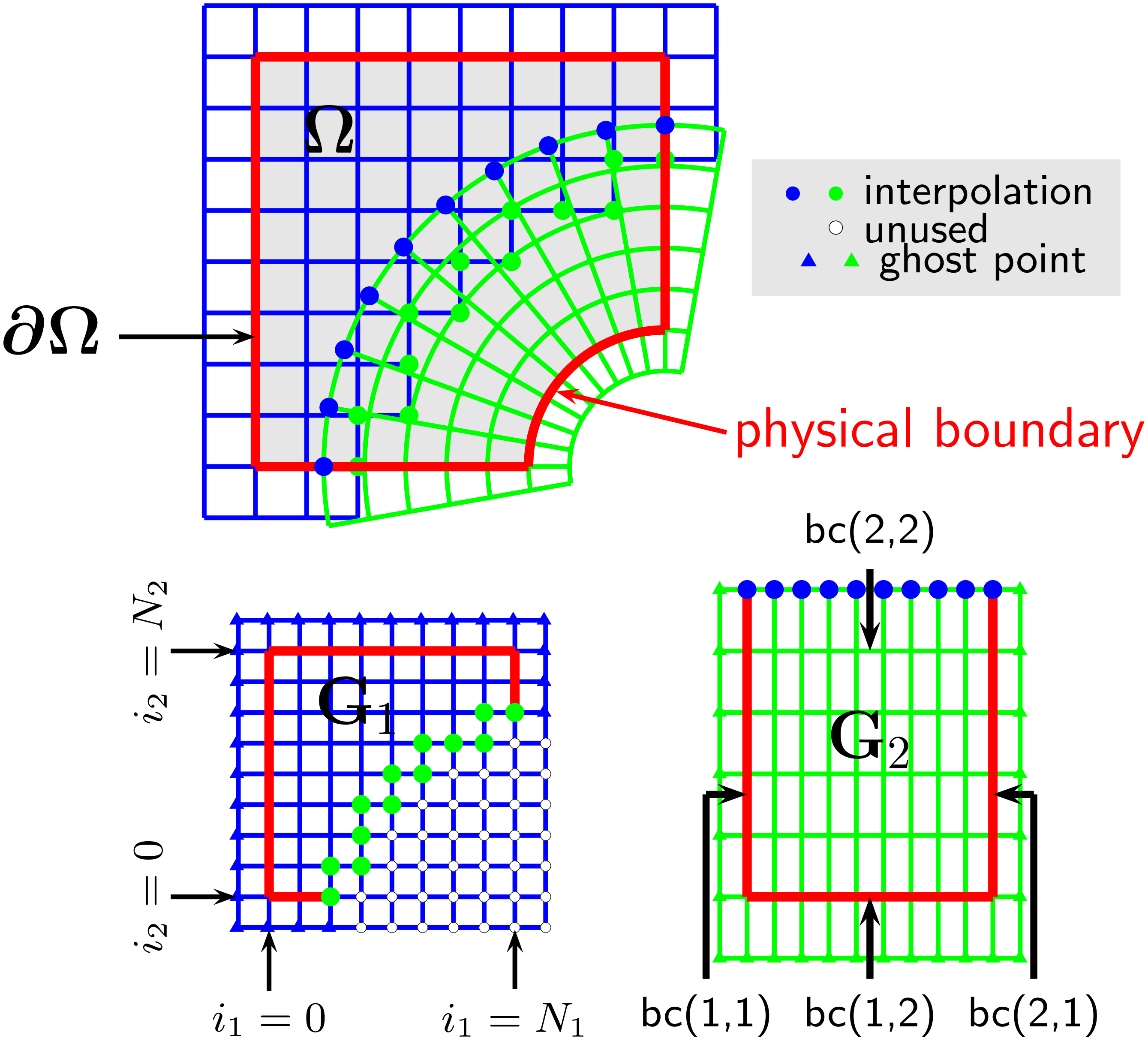


Sample hybrid grids





Components of an Overlapping Grid

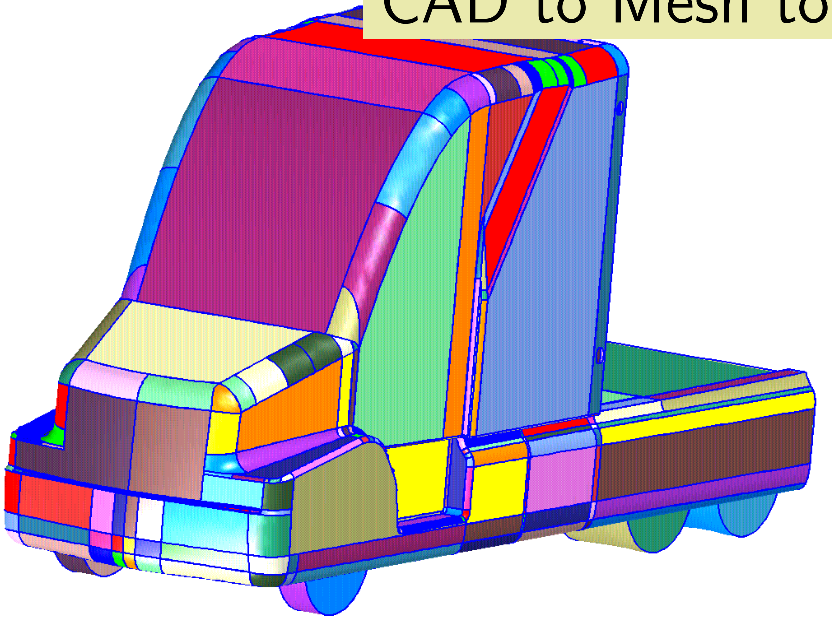


Overture supports a high-level C++ interface (but is built mainly upon Fortran kernels):

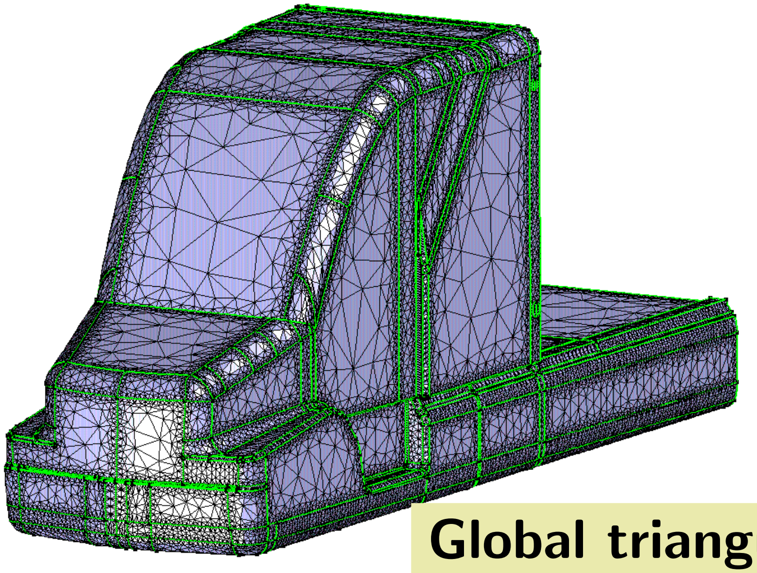
Solve $u_t + au_x + bu_y = \nu(u_{xx} + u_{yy})$

```
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();
}
```

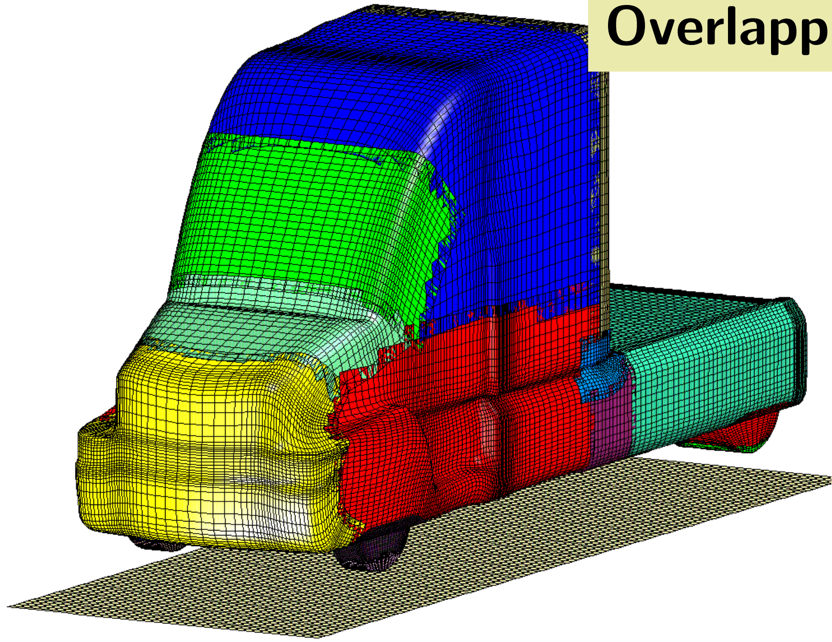
CAD to Mesh to Solution with Overture



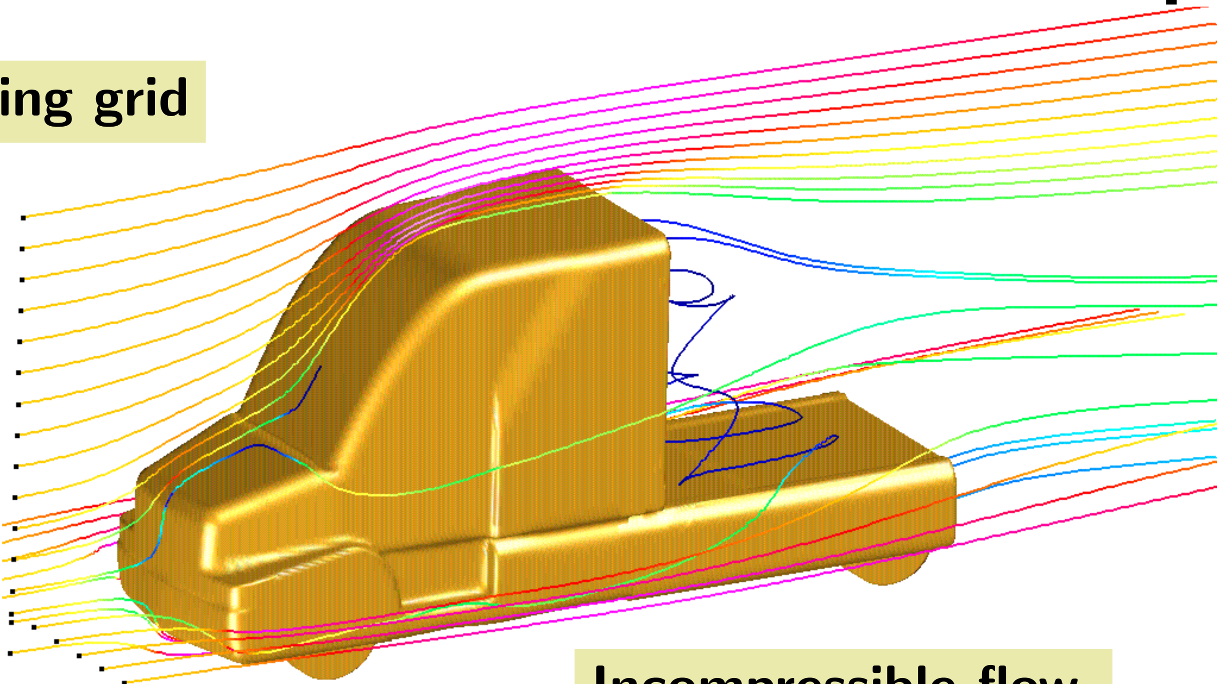
Cad fixup



Global triangulation



Overlapping grid



Incompressible flow.