

MULTIGRID

Paolo Luchini

CPLcode.net

May 5, 2022

Abstract

CPL library that solves the constant-coefficient 2D and 3D Poisson equation with multigrid iteration.

poissonmg2d.cpl usage

```
SUBROUTINE poissonmg(POINTER TO ARRAY(*,*) OF REAL fvar, frhs;  
SUBROUTINE(POINTER TO ARRAY(*,*) OF REAL var) makeghosts))
```

performs one iteration of multigrid relaxation for the second-order, constant-stepsize, 2D Poisson equation with array of unknowns `fvar` and right-hand-side `frhs`. Each iteration reduces the maximum residual by an empirical factor of about 8, at an equivalent cost of about 5 red-black Jacobi iterations.

General boundary conditions can be specified, through suitable ghost points, in a routine passed as the third parameter `makeghosts`.

A usage example and test is provided as a comment at the end of the source file.

poissonmg3d.cpl usage

```
SUBROUTINE poissonmg(POINTER TO ARRAY(*,*,*) OF REAL fvar, frhs;  
SUBROUTINE(POINTER TO ARRAY(*,*,*) OF REAL var) makeghosts))
```

performs one iteration of multigrid relaxation for the second-order, constant-stepsize, 3D Poisson equation with array of unknowns `fvar` and right-hand-side `frhs`. Each iteration reduces the maximum residual by an empirical factor of about 100, at an equivalent cost of about 10 red-black Jacobi iterations.

A usage example and test is provided as a comment at the end of the source file.

References

A. Brandt and O. E. Livne. **Multigrid Techniques: 1984 Guide with Applications to Fluid Dynamics**. SIAM, 2011