Help

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#ifndef GRIDSPARSE_FUNCTIONS_H
#define GRIDSPARSE_FUNCTIONS_H

#include "gridsparse_constructor.h"

extern int log2int(int x);


extern double GridSparse_real_value_at_points(GridSparse *
    G,int d,int i);
extern void Nodal_to_Hier_in_dir(int Dir, const PnlVect  *
    V,PnlVect *Vout, const GridSparse * G);
extern void Hier_to_Nodal_in_dir(int Dir, const PnlVect  *
    V, PnlVect *Vout,  const GridSparse * G);
extern void Nodal_to_Hier(PnlVect * V, const GridSparse *
    G);
extern void Hier_to_Nodal(PnlVect* V, const GridSparse *G);
extern PnlVect * V_Hier_to_Nodal(const PnlVect * Vin,const
    GridSparse * G);
extern double FD_Lap_Stencil_Center(const int i,const int
    dir,
                                    const PnlVect * v,
                                    GridSparse * G,
                                    int l_Ind_neig,
                                    int r_Ind_neig);
extern double FD_Conv_Stencil_Center(const int i,const int
    dir,
                                     const PnlVect * v,
                                     const GridSparse * G,
                                     int l_Ind_neig,
                                     int r_Ind_neig);


extern double FD_Conv_Stencil_DeCenter(const int i,const
    int dir,
                                       const PnlVect * v,
                                       const GridSparse *
    G,
                                       int Ind_neig);
extern double FD_Lap_Center(const int i,const int dir,
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                            const PnlVect * v,
                            GridSparse * G);
extern double FD_Conv_Center(const int i,const int dir,
                      const PnlVect *v,
                             const GridSparse * G);

extern double FD_Conv_DeCenter(const int i,const int dir,
                               const PnlVect *v,
                               const GridSparse * G,
                               const double coeff);

extern void GridSparse_apply_function(GridSparse * G, PnlV
    ect * Vout, double (*apply)(const PnlVect *));

extern void GridSparse_fprint(FILE *fic,GridSparse * G,
                              PnlVect * Vout);


extern void GridSparse_Solve_Operator(GridSparse * G, cons
    t PnlVect * Vin,PnlVect * Vout,
                                      void (*operator)(
    GridSparse * G0,
                                                       cons
    t PnlVect * V0,
                                                       cons
    t double a ,const double b,
                                                       PnlV
    ect * V1),
                                      void (*operator_PC)(
    GridSparse * G0,

    const PnlVect * V0,

    const double a,const double b,

    PnlVect * V1)
                                      );

typedef struct LaplacienSparseOp{
  GridSparse *G;
  PnlVect  * V_tmp0;
```

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  PnlVect  * V_tmp1;
}LaplacienSparseOp;


extern LaplacienSparseOp * create_laplacien_sparse_operator
    ();
extern void initialise_laplacien_sparse_operator(LaplacienS
    parseOp * Op);
extern void laplacien_sparse_operator_free(LaplacienSparseO
    p ** Op);

extern void GridSparse_apply_Laplacien(LaplacienSparseOp *
    Op, const PnlVect * Vin,
                                       const double a ,cons
    t double b,
                                       PnlVect * Vout);
extern void GridSparse_Solve_Laplacien(LaplacienSparseOp *
    Op, const PnlVect * Vin,
                                       PnlVect * Vout);

typedef struct HeatSparseOp{
  double eta;
  double theta_time_scheme;
  PremiaPDETimeGrid * TG;
  GridSparse *G;
  PnlVect  *PC,* V_tmp0,* V_tmp1;
}HeatSparseOp;

extern HeatSparseOp * create_heat_sparse_operator(double et
    a);
extern void initialise_heat_sparse_operator(HeatSparseOp *
    Op);
extern void heat_sparse_operator_free(HeatSparseOp ** Op);

extern void GridSparse_apply_heat(HeatSparseOp * Op, const
    PnlVect * Vin,
         const double a ,const double b,
         PnlVect * Vout);
extern void GridSparse_Solve_heat(HeatSparseOp * Op, const
    PnlVect * Vin,
         PnlVect * Vout);
```

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#endif
```

References