



Parallel Computational Acoustics Library - Reference Manual

Frédéric Magoulès, François-Xavier Roux

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Parallel Computational Acoustics Library

Reference Manual*

by F. Magoulès and F.-X. Roux

June 13, 2002

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1 Modules

1.1 **block_size**

NAME

block_size

SYNOPSIS

```
MODULE block_size
```

DESCRIPTION

Block size for factorization of matrices used in the direct solver.

ARGUMENTS

n1 – integer

n2 – integer

1.2 **direct_symmetric**

NAME

direct_symmetric

SYNOPSIS

```
MODULE direct_symmetric
```

DESCRIPTION

Direct method module for symmetric complex matrix.

ARGUMENTS

ldu_Robin – factorized matrix structure

ldu_Dirichlet – factorized matrix structure

MODULES

```
USE factorized_matrix_struct
```

1.3 **direct_unsymmetric**

NAME

direct_unsymmetric

SYNOPSIS

```
MODULE direct_unsymmetric
```

DESCRIPTION

Direct method module for unsymmetric complex matrix.

ARGUMENTS

ldu_Robin – factorized matrix structure
ldu_Dirichlet – factorized matrix structure

MODULES

USE factorized_matrix_struct

1.4 **facet_struct**

NAME

facet_struct

SYNOPSIS

```
MODULE facet_struct
```

DESCRIPTION

Facet structure module.

ARGUMENTS

numb_facets – integer (= number of facets)
numb_quad – integer (= number of 4-node facets)
numb_tria – integer (= number of 3-node facets)
p_geometry – integer array (= pointer of facet connectivity per nodes)
geometry – integer array (= facet connectivity per nodes)
facet_id – integer array (= id of facet)
type_facet – integer array (= type of facet)
id_mat – integer array (= material associated with facet)
id_curve – integer array (= load curve associated with facet)
value – complex array (= average surface value)

1.5 **factorized_matrix_struct**

NAME

factorized_matrix_struct

SYNOPSIS

```
MODULE factorized_matrix_struct
```

DESCRIPTION

Block tridiagonal sparse matrix structure.

ARGUMENTS

neq – integer (dimension of the matrix)
sparse_size – integer (total number of non zero entries in sparse structure)
nfront – integer (= number of fronts of the tridiagonal structure)
nfront_clamp – integer (= number of last clamped fronts i.e. clamped degrees of freedom)
low_sparse_size – integer (= total size for storage of lower diagonal blocks)
upp_sparse_size – integer (= total size for storage of upper diagonal blocks)
profile_size – integer (= total size for storage of half dense diagonal blocks)
maxdim – integer (= maximum dimension of diagonal blocks)
bc_num – integer
p_row – integer array (= pointer of first entry of each row)
p_diag – integer array (= pointer of first entry of each row in diagonal block)
p_upp – integer array (= pointer of first entry of each row in upper block)
p_ext – integer array (= pointer of first entry of each row in external block)
column_num – integer array (= column number of non zero entry in sparse structure)
p_front – integer array (= pointer of fronts)
new2old – integer array (= equation number correspondance)
p_dia_bloc – integer array (= pointer of half dense diagonal blocks)
bc_mask – integer array
coef – complex array (= sparse matrix coefficients)
dia_blo – complex array (= half dense diagonal blocks)

1.6 **feti_data**

NAME

feti_data

SYNOPSIS

MODULE `feti_data`

DESCRIPTION

Data structures for complex FETI solver.

ARGUMENTS

subdom – mesh feti structure
Dirich – nodal list structure
interfine – interface descriptor structure
mesh_interfine – interface mesh structure
transp – sparse matrix structure
feti_rhs – complex array
feti_solution – complex array

MODULES

USE mesh_feti_struct
 USE nodal_list_struct
 USE interf_descriptor_struct
 USE interf_mesh_struct
 USE sparse_matrix_struct

1.7 **feti_param**

NAME

feti_param

SYNOPSIS

MODULE `feti_param`

DESCRIPTION

FETI parameters.

ARGUMENTS

typre – integer
feti_max_numb_it – integer
feti_numb_dir – integer
numb_restart – integer
feti_eps – real
eps_stagn – real

1.8 **interf_descriptor_struct**

NAME

interf_descriptor_struct

SYNOPSIS

MODULE `interf_descriptor_struct`

DESCRIPTION

Interface structure. The inner and outer data structures are for the case of non conforming grids or multi-level interface management. In case of conforming interfaces they are identical to the interface data structure.

ARGUMENTS

subdom_numb – integer (= subdomain number)
numb_subdom – integer (= number of subdomains)
subdom_neq – integer (= number of equations in subdomain)
numb_neighb – integer (= number of neighbouring subdomains)
list_neighb – integer array (= list of neighbouring subdomains)
signe – integer array (= sign of interface)
interf_nodes – integer (= number of interface nodes in subdomain)
p_intf_nodes – integer array (= pointer of interface nodes)
list_intf_nodes – integer array (= list of interface nodes)
interf_neq – integer (= number of interface equations in subdomain)
p_intf_eq – integer array (= pointer of interface equations)
list_intf_eq – integer array (= list of interface equations)
weight – real array (= weighting factor)
weightd – real array (= weighting factor)
inn_interf_neq – integer (= number of inner interface equations)
p_list_inn – integer array (= pointer of inner interface equations)
list_inn – integer array (= list of inner interface equations)
buff_inn – complex array (= sending buffer of values for inner interface equations)
out_interf_neq – integer (= number of outer interface equations)
p_list_out – integer array (= pointer of outer interface equations)
list_out – integer array (= list of outer interface equations)
buff_out – complex array (= sending buffer of values for outer interface equations)
global_numb_elements – integer (= global number of element)
elem2dom – integer array (= global element to subdomain allocation array)
local_numb_elements – integer (= local number of element)
l2g_elem – integer array (= local to global element number correspondance)

1.9 interf_mesh_struct

NAME

interf_mesh_struct

SYNOPSIS

MODULE `interf_mesh_struct`

DESCRIPTION

Interface mesh structure. The inner and outer data structures are for the case of non conforming grids or multi-level interface management. In case of conforming interfaces they are identical to the interface data structure.

ARGUMENTS

numb_nodes – integer (= number of nodes)
numb_neighb – integer (= number of neighbouring subdomains)
list_neighb – integer array (= list of neighbouring subdomains)
numb_elements – integer (= number of elements)
p_elem – integer array (= pointer of interface elements)
type_elem – integer array
elem_region – integer array
elem_signe – integer array
p_node_id – integer array (= pointer of interface nodes)
node_id – integer array (= list of interface nodes)
p_geometry – integer array (= pointer of nodes in each element)
geometry – integer array (= list of nodes in each element)
neq – integer (= number of
equations) – pointer of equations attached to each node + list
eq_id – integer array
eq_neighb – integer array
p_node_eq – integer array
node_eq – integer array
type_dof – integer array (= pointed list of types of dof)
p_topology – integer array (= pointer of interface equations)
topology – integer array (= list of interface equations)

1.10 load_curve_struct

NAME

load_curve_struct

SYNOPSIS

MODULE `load_curve_struct`

DESCRIPTION

Load curve structure.

ARGUMENTS

id_curve – integer
numb_points – integer
var – real array
factor – real array

1.11 **mesh_feti_struct**

NAME

mesh_feti_struct

SYNOPSIS

MODULE `mesh_feti_struct`

DESCRIPTION

Mesh structure.

ARGUMENTS

numb_elements – integer (= number of elements)
numb_nodes – integer (= number of nodes)
neq – integer (= number of equations)
p_node_eq – integer array (= pointer of node to equation correspondance)
node_eq – integer array (= list of equations associated with each node)
type_dof – integer array (= type of equations associated with each node)
l2g_elem – integer array (= local to global element number correspondance)
l2g_node – integer array (= local to global node number correspondance)

1.12 **mesh_struct**

NAME

mesh_struct

SYNOPSIS

MODULE `mesh_struct`

DESCRIPTION

Mesh structure.

ARGUMENTS

numb_connect – number of connected parts
numb_regions – number of elementary regions
numb_acou_regions – number of acoustic regions
numb_admit_regions – number of admittance regions
numb_infinite_regions – number of infinite regions
numb_nodes – number of nodes
space_dim – number of coordinates per node
node_id – external node id
coordinates – coordinates of nodes
tolerance – relative precision tolerance for coordinates
min_nodid – minimum node id
max_nodid – maximum node id
rev_node_id – internal node id
numb_elements – number of elements
numb_hexa – number of 8-node solid elements
numb_tetra – number of 4-node solid elements
numb_admit_quad – number of 4-node admittance elements
numb_admit_quad – number of 3-node admittance elements
numb_infinite_quad – number of 4-node infinite elements
numb_infinite_tria – number of 3-node infinite elements
geometry – pointed list of nodes in each element
p_geometry – pointer to geometry array
rev_geometry – pointed list of elements each node belongs to
p_rev_geometry – pointer to rev_geometry array
elem_id – id of element
elem_region – internal id of region of element
elem_region_id – external id of region of element
neighb_region – internal id of neighboring region
type_elem – type of element
neq – number of equations
node_eq – pointed list of equations attached to each node
type_dof – pointed list of types of dof attached to each node
p_node_eq – pointer to node_eq and type_dof arrays
topology – pointed list of equations in each element
p_topology – pointer of element connectivity per equations
primal_field – acoustic pressure
dual_field – normal velocity

1.13 **model**

NAME

model

SYNOPSIS

```
MODULE model
```

DESCRIPTION

Data structures used for model.

ARGUMENTS

see module

MODULES

```
USE mesh_struct
USE nodal_list_struct
USE facet_struct
USE sparse_matrix_struct
USE load_curve_struct
USE region_property_struct
```

1.14 **mpif**

NAME

mpif

SYNOPSIS

```
SUBROUTINE mpif
```

DESCRIPTION

FETI communicator declaration and mpif as a module

ARGUMENTS

```
max_count – parameter integer
FETI_COM – integer
COUPLE_COM – integer INCLUDES INCLUDE 'mpif.h'
```

1.15 **nodal_list_struct**

NAME

nodal_list_struct

SYNOPSIS

```
MODULE nodal_list_struct
```

DESCRIPTION

Nodal list structure.

ARGUMENTS

neq – integer (= dimension of problem)
numb – integer (= number of entries in the list)
list_id – integer (= external id of the list)
type_list – integer (= type of the list)
node_id – integer array (= list of nodes)
type_dof – integer array (= type of dof for each entry)
value – complex array (= values)
id_curve – integer array (= curve number associated to each entry)
id_mat – integer array (= material number)
eq_id – integer array (= list of listed equations)
mask – integer array (= mask array equal zero if not a listed equation)

1.16 **outfil**

NAME

outfil

SYNOPSIS

MODULE `outfil`

DESCRIPTION

Output unit structure.

ARGUMENTS

P6 – integer (= output unit)
print_matrix – integer
print_rhs – integer
print_solution – integer
print_mesh – integer

1.17 **realloc**

NAME

realloc

SYNOPSIS

MODULE `realloc`

DESCRIPTION

Functions for memory allocation.

ARGUMENTS

SUBROUTINE realloc_i1
 SUBROUTINE extent_i1
 SUBROUTINE realloc_r1
 SUBROUTINE realloc_c1
 SUBROUTINE realloc_i2
 SUBROUTINE realloc_r2
 SUBROUTINE extent_r2
 SUBROUTINE realloc_c2

1.18 **region_property_struct**

NAME

region_property_struct

SYNOPSIS

MODULE region_property_struct

DESCRIPTION

Module of acoustic, admittance and infinite element material.

ARGUMENTS

density – real
id_curve_density – integer
celerity – complex
id_curve_celerity – integer
impedance – complex
id_curve_impedance – integer
origin – real array
axes – real array
adist – real
bdist – real
cdist – real
order – integer
tolerance – real

1.19 **solver_param**

NAME

solver_param

SYNOPSIS

MODULE solver_param

DESCRIPTION

Solver parameters module.

ARGUMENTS

type_galerkin – integer
symmetric_matrix – integer
type_solver – integer
type_precond – integer
max_numb_it – integer
numb_dir – integer
out_of_core – integer
type_opt – integer
nsd – integer
epsilon – real
numb_freq – integer
frequency – real array

1.20 **sparse_matrix_struct**

NAME

sparse_matrix_struct

SYNOPSIS

```
MODULE sparse_matrix_struct
```

DESCRIPTION

Sparse matrix structure.

ARGUMENTS

neq – integer (= dimension of the matrix)
sparse_size – integer (= total number of non zero entries)
p_row – integer array (= position of first entry of each row)
column_numb – integer array (= column number of each non zero entry)
coef – complex array (= non zero entries)
symmetric – integer (= symmetric matrix flag)

2 Functions

2.1 **add_interf_matrix**

NAME

add_interf_matrix

SYNOPSIS

```
SUBROUTINE add_interf_matrix
```

DESCRIPTION

Add interface sparse matrix to impedance sparse matrix.

ARGUMENTS

None

MODULES

```
USE model
USE feti_data
USE solver_param
USE outfil
USE direct_unsymmetric
```

2.2 **add_interf_matrix_structure**

NAME

add_interf_matrix_structure

SYNOPSIS

```
SUBROUTINE add_interf_matrix_structure
```

DESCRIPTION

Add interface sparse matrix data structure.

ARGUMENTS

None

MODULES

```
USE model
USE feti_data
```

2.3 add_sparse_sym_matrix

NAME

add_sparse_sym_matrix

SYNOPSIS

SUBROUTINE `add_sparse_sym_matrix` (`a,b,b2a_eqid`)

DESCRIPTION

Add symmetric interface sparse matrix to impedance matrix.

ARGUMENTS

a – sparse matrix structure
b – sparse matrix structure
b2a_eqid – integer array

MODULES

USE `outfil`
 USE `realloc`
 USE `sparse_matrix_struct`

2.4 add_sparse_sym_struct

NAME

add_sparse_sym_struct

SYNOPSIS

SUBROUTINE `add_sparse_sym_struct` (`a,b,b2a_eqid`)

DESCRIPTION

Add symmetric interface sparse matrix structure.

ARGUMENTS

a – sparse matrix structure
b – sparse matrix structure
b2a_eqid – integer array

MODULES

USE `outfil`
 USE `realloc`
 USE `sparse_matrix_struct`

2.5 add_sparse_unsym_matrix

NAME

add_sparse_unsym_matrix

SYNOPSIS

SUBROUTINE `add_sparse_unsym_matrix` (`a,b,b2a_eqid`)

DESCRIPTION

Add unsymmetric interface sparse matrix to impedance matrix.

ARGUMENTS

a – sparse matrix structure
b – sparse matrix structure
b2a_eqid – integer array

MODULES

USE `outfl`
 USE `realloc`
 USE `sparse_matrix_struct`

2.6 add_sparse_unsym_struct

NAME

add_sparse_unsym_struct

SYNOPSIS

SUBROUTINE `add_sparse_unsym_struct` (`a,b,b2a_eqid`)

DESCRIPTION

Add unsymmetric interface sparse matrix structure.

ARGUMENTS

a – sparse matrix structure
b – sparse matrix structure
b2a_eqid – integer array

MODULES

USE `outfl`
 USE `realloc`
 USE `sparse_matrix_struct`

2.7 assemble_bc

NAME

assemble_bc

SYNOPSIS

```

SUBROUTINE assemble_bc (dom,acou_mat,dim_neumann,Neumann,      &
&                        dim_fneumann,FNeumann,rhs,frequency,dim_lc,&
&                        LC)

```

DESCRIPTION

Assemble right hand side.

ARGUMENTS

dom – mesh structure
acout_mat – region property structure array
dim_neumann – integer
Neumann – nodal list structure array
dim_fneumann – integer
FNeumann – facet structure array
rhs – complex array
frequency – real
dim_lc – integer
LC – load curve structure array

MODULES

```

USE mesh_struct
USE nodal_list_struct
USE facet_struct
USE region_property_struct
USE load_curve_struct
USE outfil

```

2.8 assemble_facet_bc

NAME

assemble_facet_bc

SYNOPSIS

```

SUBROUTINE assemble_facet_bc (dom,acou_mat,FNeumann,rhs,frequency,&
&                             dim_lc,LC)

```

DESCRIPTION

Assemble contribution of facet Neumann boundary conditions to right hand side.

ARGUMENTS

dom – mesh structure
acou_mat – region property structure array
FNeumann – facet structure
rhs – complex array
frequency – real
dim_lc – integer
LC – load curve structure array

MODULES

USE mesh_struct
 USE facet_struct
 USE region_property_struct
 USE load_curve_struct
 USE outfil

2.9 **assemble_impedance**

NAME

assemble_impedance

SYNOPSIS

```

SUBROUTINE assemble_impedance (dom,a,frequency,acou_mat,admi_mat, &
&                               inf_mat,typegalerkin)

```

DESCRIPTION

Assemble impedance sparse matrix on domain.

ARGUMENTS

dom – mesh structure
a – sparse matrix structure
frequency – real
acou_mat – region property structure array
admi_mat – region property structure array
inf_mat – region property structure array
typegalerkin – integer

MODULES

USE sparse_matrix_struct
 USE mesh_struct
 USE region_property_struct
 USE outfil

2.10 **assemble_intf_matrix**

NAME

assemble_intf_matrix

SYNOPSIS

```

SUBROUTINE assemble_intf_matrix (dom,mesh_intf,b,frequency,    &
&                               acou_mat,type_sol,subdom_num)

```

DESCRIPTION

Assemble interface sparse matrix

ARGUMENTS

dom – mesh structure
mesh_intf – interface mesh structure
b – sparse matrix structure
frequency – real
acou_mat – region property structure array
type_sol – integer
subdom_num – integer

MODULES

USE sparse_matrix_struct
USE interf_mesh_struct
USE mesh_struct
USE region_property_struct
USE outfil

WARNINGS

The alpha and beta parameters are the parameters used in the continous relation $(\alpha u + \beta \partial^2 \tau u)$ which gives after discretization $(\alpha M - \beta K)$.

2.11 **assemble_nodal_bc**

NAME

assemble_nodal_bc

SYNOPSIS

```

SUBROUTINE assemble_nodal_bc (dom,acou_mat,Neumann,rhs,frequency,  &
&                             dim_lc,LC)

```

DESCRIPTION

Assemble contribution of nodal Neumann boundary conditions to right hand side.

ARGUMENTS

dom – mesh structure
acou_mat – region property structure array
Neumann – nodal list structure
rhs – complex array
frequency – real
dim_lc – integer
lc – load curve structure array

MODULES

USE mesh_struct
 USE nodal_list_struct
 USE region_property_struct
 USE load_curve_struct
 USE outfl

2.12 **bcast_acoustic_property**

NAME

bcast_acoustic_property

SYNOPSIS

SUBROUTINE `bcast_acoustic_property` (`mat`)

DESCRIPTION

Broadcast acoustic region property to all processes.

ARGUMENTS

mat – region property structure

MODULES

USE region_property_struct
 USE mpif

2.13 **bcast_admittance_property**

NAME

bcast_admittance_property

SYNOPSIS

SUBROUTINE `bcast_admittance_property` (`mat`)

DESCRIPTION

Broadcast admittance region property to all processes.

ARGUMENTS

mat – region property structure

MODULES

USE region_property_struct
USE mpif

2.14 **bcast_facet**

NAME

bcast_facet

SYNOPSIS

SUBROUTINE `bcast_facet (bc,intf)`

DESCRIPTION

Broadcast facet list to all processes and extract.

ARGUMENTS

bc – facet structure
intf – interface descriptor structure

MODULES

USE facet_struct
USE interf_descriptor_struct
USE outfil
USE mpif

2.15 **bcast_infinite_property**

NAME

bcast_infinite_property

SYNOPSIS

SUBROUTINE `bcast_infinite_property (mat)`

DESCRIPTION

Broadcast infinite element region property to all processes.

ARGUMENTS

mat – region property structure

MODULES

USE region_property_struct
USE mpif

2.16 bcast_load_curve

NAME

bcast_load_curve

SYNOPSIS

SUBROUTINE bcast_load_curve (lc)

DESCRIPTION

Broadcast load curve to all processes.

ARGUMENTS

lc – load curve structure

MODULES

USE load_curve_struct
USE outfl
USE mpif

2.17 bcast_model_attribute

NAME

bcast_model_attribute

SYNOPSIS

SUBROUTINE bcast_model_attribute (attribute)

DESCRIPTION

Broadcast model attribute to all processes.

ARGUMENTS

attribute – character string

MODULES

USE mpif

2.18 bcast_model_parameters

NAME

bcast_model_parameters

SYNOPSIS

SUBROUTINE `bcast_model_parameters` (`n1,n2,n3,n4,n5`)

DESCRIPTION

Broadcast model parameters to all processes.

ARGUMENTS

n1 – integer
n2 – integer
n3 – integer
n4 – integer
n5 – integer

MODULES

USE `solver_param`
 USE `outfil`
 USE `mpif`

2.19 bcast_nodal_list

NAME

bcast_nodal_list

SYNOPSIS

SUBROUTINE `bcast_nodal_list` (`bc,intf,opt`)

DESCRIPTION

Broadcast nodal list to all processes and extract.

ARGUMENTS

bc – nodal list structure
intf – interface descriptor structure
opt – integer

MODULES

USE `nodal_list_struct`
 USE `interf_descriptor_struct`
 USE `outfil`
 USE `mpif`

2.20 bcast_solver_parameters

NAME

bcast_solver_parameters

SYNOPSIS

SUBROUTINE `bcast_solver_parameters`

DESCRIPTION

Broadcast solver parameters to all processes.

ARGUMENTS

None

MODULES

USE `solver_param`
USE `block_size`
USE `outfil`
USE `mpif`**2.21 build_diag**

NAME

build_diag

SYNOPSIS

SUBROUTINE `build_diag` (`neq`,`dim`,`p_row`,`column_numb`,`coef`,`diag`)

DESCRIPTION

Define diagonal coefficients of sparse matrix

ARGUMENTS

neq – integer
dim – integer
p_row – integer array
column_numb – integer array
coef – complex array
diag – complex array

MODULES

USE `outfil`

2.22 build_dirich_aug

NAME

build_dirich_aug

SYNOPSIS

```

SUBROUTINE build_dirich_aug (intf_mesh,Dirichlet,Dirich_aug,      &
&                             listintf)

```

DESCRIPTION

Compute Schur complement matrix.

ARGUMENTS

intf_mesh – interface mesh structure
Dirichlet – factorized matrix structure
Dirich_aug – factorized matrix structure
listintf – nodal list structure

MODULES

```

USE solver_param
USE outfil
USE interf_mesh_struct
USE nodal_list_struct
USE realloc
USE factorized_matrix_struct

```

2.23 build_interf_matrix_structure

NAME

build_interf_matrix_structure

SYNOPSIS

```

SUBROUTINE build_interf_matrix_structure

```

DESCRIPTION

Build interface sparse matrix data structure.

ARGUMENTS

None

MODULES

```
USE model
USE feti_data
USE solver_param
USE outfil
```

2.24 build_interface

NAME

build_interface

SYNOPSIS

```
SUBROUTINE build_interface
```

DESCRIPTION

Build subdomain interface.

ARGUMENTS

None

MODULES

```
USE outfil
USE mpif
USE feti_data
USE model
USE feti_param
```

2.25 build_matrix_structure

NAME

build_matrix_structure

SYNOPSIS

```
SUBROUTINE build_matrix_structure
```

DESCRIPTION

Build sparse matrix data structure.

ARGUMENTS

None

MODULES

USE model
USE solver_param

2.26 build_node_eq

NAME

build_node_eq

SYNOPSIS

SUBROUTINE build_node_eq (dom,inf_mat)

DESCRIPTION

Build correspondance between nodes and equations.

ARGUMENTS

dom – mesh structure
intf_mat – region property structure array

MODULES

USE mesh_struct
USE region_property_struct
USE realloc
USE outfil

2.27 build_rev_geometry

NAME

build_rev_geometry

SYNOPSIS

SUBROUTINE build_rev_geometry (dom)

DESCRIPTION

Build pointed list of elements each node belongs to.

ARGUMENTS

dom – mesh structure

MODULES

USE outfil
USE realloc
USE mesh_struct

2.28 build_rev_nodid

NAME

build_rev_nodid

SYNOPSIS

SUBROUTINE build_rev_nodid (dom)

DESCRIPTION

Build external to internal node number correspondance and change list of nodes in each element accordingly.

ARGUMENTS

dom – mesh structure

MODULES

USE outfil
USE mesh_struct**2.29 build_sparse_sym_struct**

NAME

build_sparse_sym_struct

SYNOPSIS

SUBROUTINE build_sparse_sym_struct (dom,a)

DESCRIPTION

Build sparse matrix structure.

ARGUMENTS

dom – mesh structure
a – sparse matrix structure

MODULES

USE outfil
USE realloc
USE mesh_struct
USE sparse_matrix_struct

2.30 **build_sparse_unsym_struct**

NAME

build_sparse_unsym_struct

SYNOPSIS

```
SUBROUTINE build_sparse_unsym_struct (dom,a)
```

DESCRIPTION

Build sparse matrix structure.

ARGUMENTS

dom – mesh structure
a – sparse matrix structure

MODULES

```
USE outfil  
USE realloc  
USE mesh_struct  
USE sparse_matrix_struct
```

2.31 **build_topology**

NAME

build_topology

SYNOPSIS

```
SUBROUTINE build_topology (dom)
```

DESCRIPTION

Build list of equations in each element, i.e. .build topology of elements using list of nodes per element and list and type of equations per node.

ARGUMENTS

dom – mesh structure

MODULES

```
USE mesh_struct  
USE outfil  
USE realloc
```

2.32 calpd

NAME

calpd

SYNOPSIS

SUBROUTINE calpd (pl,pc,pd,n,nza)

DESCRIPTION

Determine the cpd pointer which point to the adress inside a of the diagonal coefficient of the matrix. The matrix has a general structure.

ARGUMENTS

pl – integer array
pc – integer array
pd – integer array
n – integer
nza – integer

2.33 cmk_number

NAME

cmk_number

SYNOPSIS

SUBROUTINE cmk_number (nodes,p_graph,graph,list)

DESCRIPTION

Renumber graph via reverse Cuthill-Mac Kee algorithm.

ARGUMENTS

nodes – integer
p_graph – integer array
graph – integer array
list – integer array

MODULES

USE outfil

2.34 condens_1

NAME

condens_1

SYNOPSIS

```
SUBROUTINE condens_1 (lda,dim1,dim2,a,d,e,f,ie0,if0,nop)
```

DESCRIPTION

Compute the Schur complement matrix $[D^{-1}U^{-t}F]^t$ with LDU the Gauss-Jordan factorisation of the matrix A .

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
a – complex array
d – complex array
e – complex array
f – complex array
ie0 – integer array
if0 – integer array
nop – real

MODULES

USE block_size

2.35 **condens_2**

NAME

condens_2

SYNOPSIS

```
SUBROUTINE condens_2 (lda,dim1,dim2,a,e,ie0,nop)
```

DESCRIPTION

Compute $[L^{-1}E]$ matrix where LDU is the Gauss-Jordan factorisation of the matrix A .

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
a – complex array
e – complex array
ie0 – integer array
nop – real

MODULES

USE block_size

2.36 **condens_3**

NAME

condens_3

SYNOPSIS

SUBROUTINE `condens_3` (`lda,dim1,dim2,e,f,c,ie0,if0,nop`)

DESCRIPTION

Compute the Schur complement matrix $C = C - [FU^{-1}d^{-1}][L^{-1}E]$ where $[L^{-1}E]$ and $[FU^{-1}d^{-1}]$ have already been computed.

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
e – complex array
f – complex array
c – complex array
ie0 – integer array
if0 – integer array
nop – real

MODULES

USE `block_size`**2.37** **copy_block**

NAME

copy_block

SYNOPSIS

SUBROUTINE `copy_block` (`lda,dim1,dim2,a,b`)

DESCRIPTION

Copy one block of a matrix.

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
a – complex array
b – complex array

MODULES

USE outfil

2.38 **dirichlet_bc**

NAME

dirichlet_bc

SYNOPSIS

SUBROUTINE dirichlet_bc (frequency,dim_lc,lc,bc)

DESCRIPTION

Build Interpolate Dirichlet boundary condition.

ARGUMENTS

frequency – real
dim_lc – integer
lc – load curve structure array
bc – nodal list structure

MODULES

USE load_curve_struct
 USE nodal_list_struct
 USE outfil

2.39 **distribute_model**

NAME

distribute_model

SYNOPSIS

SUBROUTINE distribute_model

DESCRIPTION

Distribute domain decomposed model.

ARGUMENTS

None

MODULES

USE model
 USE feti_data
 USE outfil

2.40 **echo_facet**

NAME

echo_facet

SYNOPSIS

SUBROUTINE `echo_facet` (`P6`,`bc`)

DESCRIPTION

Print facets data structure.

ARGUMENTS

P6 – integer (= output unit)**bc** – facet structure

MODULES

USE `facet_struct`**2.41** **echo_mesh**

NAME

echo_mesh

SYNOPSIS

SUBROUTINE `echo_mesh` (`P6`,`dom`,`subdom_numb`)

DESCRIPTION

Print mesh data structure.

ARGUMENTS

P6 – integer (output unit)**dom** – mesh structure**subdom_numb** – integer

MODULES

USE `mesh_struct`**2.42** **echo_mesh_femview**

NAME

echo_mesh_femview

SYNOPSIS

```
SUBROUTINE echo_mesh_femview (dom,subdom_num,numb_subdom,elem2dom,&
& title,directory)
```

DESCRIPTION

Write mesh geometrical data in a FEMVIEW file.

ARGUMENTS

dom – mesh structure
subdom_num – integer
numb_subdom – integer
elem2dom – integer array
title – character string
directory – character string

MODULES

USE mesh_struct

2.43 **echo_model**

NAME

echo_model

SYNOPSIS

```
SUBROUTINE echo_model (subdom_num,numb_subdom)
```

DESCRIPTION

Print all model data structures.

ARGUMENTS

subdom_num – integer
numb_subdom – integer

MODULES

USE model
USE outfil

2.44 **echo_nodal_list**

NAME

echo_nodal_list

SYNOPSIS

```
SUBROUTINE echo_nodal_list (P6,bc)
```

DESCRIPTION

Print nodal list structure.

ARGUMENTS

P6 – integer (= output unit)
bc – nodal list structure

MODULES

```
USE nodal_list_struct
```

2.45 **equation_setup**

NAME

equation_setup

SYNOPSIS

```
SUBROUTINE equation_setup
```

DESCRIPTION

Setup system of equations associated with model.

ARGUMENTS

None

MODULES

```
USE model
USE solver_param
USE outfil
```

2.46 **extent_i1**

NAME

extent_i1

SYNOPSIS

```
SUBROUTINE extent_i1 (tab,inc_dim1,ierr)
```

DESCRIPTION

Extension of multi-dimensional integer pointer.

ARGUMENTS

tab – integer array
inc_dim1 – integer
ierr – integer

2.47 **extent_r2**

NAME

extent_r2

SYNOPSIS

SUBROUTINE `extent_r2` (`tab,dim1,inc_dim2,ierr`)

DESCRIPTION

Extension of multi-dimensional real pointer.

ARGUMENTS

tab – real array
dim1 – integer
inc_dim2 – integer
ierr – integer

2.48 **extract_submesh**

NAME

extract_submesh

SYNOPSIS

SUBROUTINE `extract_submesh` (`dom,intf,target_subdom`)

DESCRIPTION

Extract subdomain submesh and send it to associated process. Build topology of elements using list of nodes per element and list and type of equations per node.

ARGUMENTS

dom – mesh structure
intf – interface descriptor structure
target_subdom – integer

MODULES

```

USE mesh_struct
USE interf_descriptor_struct
USE outfil
USE mpif
USE realloc

```

2.49 facet_rhs

NAME

facet_rhs

SYNOPSIS

```
SUBROUTINE facet_rhs (dom, bc)
```

DESCRIPTION

Compute specific values for non homogeneous Robin conditions. $P1$ discretization is used at the nodes of facets.

ARGUMENTS

dom – mesh structure
bc – facet structure

MODULES

```

USE mesh_struct
USE facet_struct
USE outfil

```

2.50 factorize_numeric

NAME

factorize_numeric

SYNOPSIS

```
SUBROUTINE factorize_numeric
```

DESCRIPTION

Numerical factorization of local matrices.

ARGUMENTS

None

MODULES

USE outfl
USE solver_param

2.51 factorize_symbolic

NAME

factorize_symbolic

SYNOPSIS

SUBROUTINE factorize_symbolic

DESCRIPTION

Symbolic factorization of local matrices.

ARGUMENTS

None

MODULES

USE outfl
USE solver_param

2.52 feti_abort

NAME

feti_abort

SYNOPSIS

SUBROUTINE feti_abort

DESCRIPTION

Abort FETI.

ARGUMENTS

None

MODULES

USE mpif
USE outfl

2.53 feti_finalize

NAME

feti_finalize

SYNOPSIS

SUBROUTINE `feti_finalize`

DESCRIPTION

Close FETI communication space and output file.

ARGUMENTS

None

MODULES

USE `mpif`
USE `outfil`**2.54 feti_init**

NAME

feti_init

SYNOPSIS

SUBROUTINE `feti_init` (`subdom_num`,`num_subdom`)

DESCRIPTION

Create FETI communication space, get subdomain number and number of subdomains and open output file.

ARGUMENTS

subdom_num – integer
num_subdom – integer

MODULES

USE `model`
USE `outfil`
USE `mpif`
USE `feti_data`
USE `feti_param`

2.55 **fill_sym_sparse**

NAME

fill_sym_sparse

SYNOPSIS

```

SUBROUTINE fill_sym_sparse (neq,sparse_size,rowp,col,inicoef,      &
&                          new2old,p_row,col_num,coef)

```

DESCRIPTION

Filling of renumbered lower triangular part of the symmetric sparse structure stored row by row from the upper triangular symmetric one.

ARGUMENTS

rowp – pointer of rows of the upper triangular part of the initial matrix
col – list of column indices of rows of the initial matrix
inicoef – list of entries of the initial matrix
new2old – new to old correspondance
p_row – pointer of rows of the lower triangular part of the symmetric matrix
col_num – list of column indices of rows of the renumbered matrix
coef – list of entries of the renumbered matrix

MODULES

USE outfil

2.56 **fill_unsym_sparse**

NAME

fill_unsym_sparse

SYNOPSIS

```

SUBROUTINE fill_unsym_sparse(neq,sparse_size,rowp,col,inicoef,    &
&                          new2old,p_row,col_num,coef)

```

DESCRIPTION

Filling of renumbered unsymmetric sparse structure stored by row

ARGUMENTS

rowp – pointer of rows of the initial matrix
col – list of column indices of rows of the initial matrix
inicoef – list of entries of the initial matrix
new2old – new to old correspondance
p_row – pointer of rows of the renumbered matrix
col_num – list of column indices of rows of the renumbered matrix
coef – list of entries of the renumbered matrix

MODULES

USE outfil

2.57 **frontal_num**

NAME

frontal_num

SYNOPSIS

```
SUBROUTINE frontal_num (nodes,p_graph,graph,i0,list,profile,indic,&
& connect)
```

DESCRIPTION

Frontal renumbering of graph.

ARGUMENTS

nodes – integer
p_graph – integer array
graph – integer array
i0 – integer
list – integer array
profile – real
indic – integer array
connect – integer array

2.58 **full_schur_b**

NAME

full_schur_b

SYNOPSIS

```
SUBROUTINE full_schur_b (lda,nrow,ncol,u,l,s,n2)
```

DESCRIPTION

Compute Schur complement: $S = A - LU$ using a block algorithm.

ARGUMENTS

lda – integer (= dimension of matrix A)
nrow – integer
ncol – integer
u(nrow,ncol) – complex array (= the upper band)
l(ncol,nrow) – complex array (= the lower band)
s(ncol,ncol) – complex array (= the Schur complement)
n2 – integer

2.59 **full_blo**

NAME

full_blo

SYNOPSIS

SUBROUTINE `full_blo` (`lda,n,a,full_a`)

DESCRIPTION

Store a dense diagonal block.

ARGUMENTS

lda – integer
n – integer
a – complex array
full_a – complex array

2.60 **full_fwbw**

NAME

full_fwbw

SYNOPSIS

SUBROUTINE `full_fwbw` (`n,a,y,x`)

DESCRIPTION

Compute dense matrix forward-backward substitution for a dense unsymmetric complex matrix.

ARGUMENTS

n – integer
a – complex array
y – complex array
x – complex array

2.61 full_ldlt

NAME

full_ldlt

SYNOPSIS

SUBROUTINE full_ldlt (lda,n,a,d)

DESCRIPTION

Compute symmetric Gauss Jordan factorization of dense matrix. The lower triangular part only is computed.

ARGUMENTS

lda – integer
n – integer
a – complex array
d – complex array

MODULES

USE block_size

2.62 full_ldlt_b

NAME

full_ldlt_b

SYNOPSIS

SUBROUTINE full_ldlt_b (lda,n,a,d)

DESCRIPTION

Compute symmetric Gauss Jordan factorization of symmetric dense matrix.

ARGUMENTS

lda – integer
n – integer
a – complex array
d – complex array

2.63 full_ldu

NAME

full_ldu

SYNOPSIS

```
SUBROUTINE full_ldu (lda,n,a,d)
```

DESCRIPTION

Compute Gauss-Jordan factorization of dense matrix.

ARGUMENTS

lda – integer
n – integer
a – complex array
d – complex array

MODULES

```
USE block_size
```

2.64 **full_ldu_b**

NAME

full_ldu_b

SYNOPSIS

```
SUBROUTINE full_ldu_b (lda,n,a,d)
```

DESCRIPTION

Compute Gauss-Jordan factorization of dense matrix.

ARGUMENTS

lda – integer
n – integer
a – complex array
d – complex array

MODULES

```
USE block_size
```

2.65 **full_schur_b_sparse**

NAME

full_schur_b_sparse

SYNOPSIS

```
SUBROUTINE full_schur_b_sparse (nrow,ncol,iu0,u,jl0,l,s,lda,n1,n2)
```

DESCRIPTION

Compute Schur complement: $S = A - LU$ using a block algorithm.

ARGUMENTS

nrow – integer
ncol – integer
iu0 – integer
u – complex array
jl0 – integer array
l – complex array
s – complex array
lda – integer
n1 – integer
n2 – integer

2.66 **full_sto**

NAME

full_sto

SYNOPSIS

SUBROUTINE full_sto (lda,n,mat,nblo)

DESCRIPTION

Store a full block.

ARGUMENTS

lda – integer
n – integer
mat – complex array
nblo – integer

2.67 **full_unsto**

NAME

full_unsto

SYNOPSIS

SUBROUTINE full_unsto (n,mat,nblo)

DESCRIPTION

Un-store a dense block.

ARGUMENTS

n – integer
mat – complex array
nblo – integer

2.68 **galerkin_error**

NAME

galerkin_error

SYNOPSIS

SUBROUTINE galerkin_error (subdom_num, frequency)

DESCRIPTION

Compute the finite element error analysis.

ARGUMENTS

subdom_num – integer
frequency – real

MODULES

USE model
 USE outfil
 USE realloc
 USE feti_data
 USE feti_param
 USE mpif

2.69 **galerkin_meshsize**

NAME

galerkin_meshsize

SYNOPSIS

SUBROUTINE galerkin_meshsize (dom, x, h)

DESCRIPTION

Compute the Galerkin meshsize-value.

ARGUMENTS

dom – mesh structure
x – real (= hexaedrom nodes coordinates)
h – real (= mesh size)

MODULES

```
USE mesh_struct
USE outfil
```

2.70 galerkin_tau

NAME

galerkin_tau

SYNOPSIS

```
SUBROUTINE galerkin_tau (k,h,tau)
```

DESCRIPTION

Compute Galerkin tau-value.

ARGUMENTS

k – real (= wavenumber of the Helmholtz equation)
h – real (= mesh size)
tau – real (= tauk2-GLS or tauk4-GGLS coefficient)

MODULES

```
USE outfil
```

2.71 gather_nodid

NAME

gather_nodid

SYNOPSIS

```
SUBROUTINE gather_nodid (numb_nodes,l2g_node,node_id,           &
&                        glob_numb_nodes,glob_node_id)
```

DESCRIPTION

Gather subdomain node ids.

ARGUMENTS

numb_nodes – integer
l2g_node – integer array
node_id – integer array
glob_numb_nodes – integer
glob_node_id – integer array

2.72 gather_sol

NAME

gather_sol

SYNOPSIS

```

SUBROUTINE gather_sol (numb_nodes,l2g_node,p_node_eq,type_dof,    &
&                      node_eq,min_dof,max_dof,glob_numb_nodes,dof,&
&                      neq,v,glob_neq,glob_v)

```

DESCRIPTION

Gather subdomain solutions.

ARGUMENTS

```

numb_nodes – integer
l2g_node – integer array
p_node_eq – integer array
type_dof – integer array
node_eq – integer array
min_dof – integer
max_dof – integer
glob_numb_nodes – integer
dof – integer array
neq – integer
v – complex array
glob_neq – integer
glob_v – complex array

```

2.73 global_eq_mask

NAME

global_eq_mask

SYNOPSIS

```

SUBROUTINE global_eq_mask(numb_nodes,l2g_node,p_node_eq,type_dof, &
&                          min_dof,max_dof,glob_numb_nodes,dof)

```

DESCRIPTION

Build mask of equations in subdomain.

ARGUMENTS

numb_nodes – integer
l2g_node – integer array
p_node_eq – integer array
type_dof – integer array
min_dof – integer
max_dof – integer
glob_numb_nodes – integer
dof – integer array

2.74 **global_solution**

NAME

global_solution

SYNOPSIS

SUBROUTINE `global_solution` (`intf,dom,glob_dom,v,glob_v`)

DESCRIPTION

Gather global mesh and solution field.

ARGUMENTS

intf – interface descriptor structure
dom – mesh structure
glob_dom – mesh structure
v – complex array
glob_v – complex array

MODULES

USE `mesh_struct`
 USE `interf_descriptor_struct`
 USE `outfil`
 USE `mpif`
 USE `realloc`

2.75 **globaldotproduct**

NAME

globaldotproduct

SYNOPSIS

SUBROUTINE `globaldotproduct` (`uv,u,v,intf`)

DESCRIPTION

Global dot-product.

ARGUMENTS

uv – complex
u – complex array
v – complex array
intf – interface descriptor structure

MODULES

USE mpif
 USE interf_descriptor_struct
 USE outfil

2.76 **globalsum**

NAME

globalsum

SYNOPSIS

SUBROUTINE `globalsum (buf,n)`

DESCRIPTION

Sum the vector `buf(n)` across the network.

ARGUMENTS

buff – real array
n – integer

MODULES

USE mpif

2.77 **globalsumc**

NAME

globalsumc

SYNOPSIS

SUBROUTINE `globalsumc (buf,n)`

DESCRIPTION

Sum the vector `buf(n)` across the network.

ARGUMENTS

buf – complex array
n – integer

MODULES

USE mpif
 USE outfil

2.78 **globalsumi**

NAME

globalsumi

SYNOPSIS

SUBROUTINE `globalsumi (buf,n)`

DESCRIPTION

Sum the vector `buf(n)` across the network.

ARGUMENTS

buf – integer array
n – integer

MODULES

USE mpif

2.79 **half_schur_b**

NAME

half_schur_b

SYNOPSIS

SUBROUTINE `half_schur_b (lda,nrow,ncol,u,l,s,n2)`

DESCRIPTION

Compute upper triangular part of Schur complement matrix $S = A - LU$ using a block algorithm.

ARGUMENTS

lda – integer
nrow – integer
ncol – integer
u – complex array
l – complex array
s – complex array
n2 – integer

2.80 **half_blo**

NAME

half_blo

SYNOPSIS

SUBROUTINE `half_blo` (`lda,n,a,half_a`)

DESCRIPTION

Store the lower triangular part of matrix A row by row.

ARGUMENTS

lda – integer
n – integer
a – complex array
half_a – complex array

2.81 **half_fwbw**

NAME

half_fwbw

SYNOPSIS

SUBROUTINE `half_fwbw` (`n,a,y,x`)

DESCRIPTION

Compute dense matrix forward-backward substitution in the case of only the upper triangular part of symmetric matrix A is stored column by column.

ARGUMENTS

n – integer
a – complex array
y – complex array
x – complex array

2.82 half_mm_b

NAME

half_mm_b

SYNOPSIS

```
SUBROUTINE half_mm_b (ncol,nrow,l,ldl,u,ldu,s,lds)
```

DESCRIPTION

Compute upper triangular part of Schur complement matrix $S = A - LU$.

ARGUMENTS

ncol – integer
nrow – integer
l(ncol,nrow) – complex array (= the lower band)
ldl – integer
u(nrow,ncol) – complex array (= the upper band)
ldu – integer
s(ncol,ncol) – complex array (= the Schur complement)
lds – integer (= the dimension of matrix A)

2.83 half_schur_b_sparse

NAME

half_schur_b_sparse

SYNOPSIS

```
SUBROUTINE half_schur_b_sparse (nrow,ncol,i0,u,l,s,lda,n1,n2)
```

DESCRIPTION

Compute upper triangular part of Schur complement matrix $S = A - LU$ using a block algorithm.

ARGUMENTS

nrow – integer
ncol – integer
i0(ncol) – integer array (= the position of the last non zero entry in columns of u and rows of l)
u(nrow,ncol) – complex array (= the upper band)
l(ncol,nrow) – complex array (= the lower band)
s(lda,ncol) – complex array (= the Schur complement)
lda – integer
n1 – integer
n2 – integer

2.84 **half_sto**

NAME

half_sto

SYNOPSIS

SUBROUTINE `half_sto` (`lda,n,mat,nblo`)

DESCRIPTION

Store the lower triangular part of matrix *A* row by row.

ARGUMENTS

lda – integer
n – integer
mat – complex array
nblo – integer

2.85 **half_unsto**

NAME

half_unsto

SYNOPSIS

SUBROUTINE `half_unsto` (`n, half_mat, nblo`)

DESCRIPTION

Un-store the upper triangular part of matrix *A* column by column.

ARGUMENTS

n – integer
half_mat – complex array
nblo – integer

2.86 **ilu_0**

NAME

ilu_0

SYNOPSIS

SUBROUTINE `ilu_0` (`neq, sparse_size, p_row, column_numb, coef, lu, p_diag`)

DESCRIPTION

Preconditioner of a general matrix with `ilu(0)`.

ARGUMENTS

neq – integer
sparse_size – integer
p_row – integer array
column_num – integer array
coef – complex array
lu – sparse matrix structure
p_diag – integer array

MODULES

USE `sparse_matrix_struct`
 USE `outfil`

2.87 **ilu_preconditioner**

NAME

ilu_preconditioner

SYNOPSIS

SUBROUTINE `ilu_preconditioner` (`coef,pl,pc,pd,n,nza,ierr`)

DESCRIPTION

`ilu(0)` preconditioner.

ARGUMENTS

coef – complex array
pl – integer array
pc – integer array
pd – integer array
n – integer
nza – integer
ierr – integer

2.88 **imprim**

NAME

imprim

SYNOPSIS

SUBROUTINE `imprim` (`frequency,subdom_num,numb_subdom`)

DESCRIPTION

Print the matrix of domain.

ARGUMENTS

frequency – real
subdom_num – integer
numb_subdom – integer

MODULES

USE model
 USE outfil

2.89 **imprim2**

NAME

imprim2

SYNOPSIS

SUBROUTINE `imprim2` (`frequency`,`subdom_num`,`numb_subdom`)

DESCRIPTION

Print the matrix of interface.

ARGUMENTS

frequency – real
subdom_num – integer
numb_subdom – integer

MODULES

USE model
 USE feti_data
 USE outfil

2.90 **init_model**

NAME

init_model

SYNOPSIS

SUBROUTINE `init_model` (`subdom_num`)

DESCRIPTION

Initialize domain data.

ARGUMENTS

subdom_num – integer

MODULES

USE model

2.91 initialize

NAME

initialize

SYNOPSIS

SUBROUTINE initialize

DESCRIPTION

Initialize all model nodal data structures.

ARGUMENTS

None

MODULES

USE model
USE solver_param
USE outfl

2.92 inivec

NAME

inivec

SYNOPSIS

SUBROUTINE inivec (lx,x)

DESCRIPTION

Pseudo random initialization.

ARGUMENTS

lx – integer
x – complex array

2.93 **input_data**

NAME

input_data

SYNOPSIS

SUBROUTINE `input_data`

DESCRIPTION

Input domain data.

ARGUMENTS

None

MODULES

USE `model`
USE `solver_param`
USE `block_size`
USE `outfil`**2.94** **interf_full_sym_struct**

NAME

interf_full_sym_struct

SYNOPSIS

SUBROUTINE `interf_full_sym_struct` (`intf_mesh,a`)

DESCRIPTION

Build symmetric interface full matrix structure.

ARGUMENTS

intf_mesh – interface mesh structure
a – sparse matrix structure

MODULES

USE `outfil`
USE `realloc`
USE `interf_mesh_struct`
USE `sparse_matrix_struct`

2.95 interf_full_unsym_struct

NAME

interf_full_unsym_struct

SYNOPSIS

SUBROUTINE `interf_full_unsym_struct` (`intf_mesh,a`)

DESCRIPTION

Build symmetric interface full matrix structure.

ARGUMENTS

intf_mesh – interface mesh structure
a – sparse matrix structure

MODULES

USE `outfil`
USE `realloc`
USE `interf_mesh_struct`
USE `sparse_matrix_struct`**2.96 interf_sparse_sym_struct**

NAME

interf_sparse_sym_struct

SYNOPSIS

SUBROUTINE `interf_sparse_sym_struct` (`intf_mesh,a`)

DESCRIPTION

Build symmetric interface sparse matrix structure.

ARGUMENTS

intf_mesh – interface mesh structure
a – sparse matrix structure

MODULES

USE `outfil`
USE `realloc`
USE `interf_mesh_struct`
USE `sparse_matrix_struct`

2.97 interf_sparse_unsym_struct

NAME

interf_sparse_unsym_struct

SYNOPSIS

SUBROUTINE `interf_sparse_unsym_struct (intf_mesh,a)`

DESCRIPTION

Build unsymmetric interface sparse matrix structure.

ARGUMENTS

intf_mesh – interface mesh structure
a – sparse matrix structure

MODULES

USE `outfil`
USE `realloc`
USE `interf_mesh_struct`
USE `sparse_matrix_struct`**2.98 interface_assemb**

NAME

interface_assemb

SYNOPSIS

SUBROUTINE `interface_assemb (intf,unassemb,assemb)`

DESCRIPTION

Assemble a field along the interface.

ARGUMENTS

intf – interface descriptor structure
unassemb – complex array
assemb – complex array

MODULES

USE `interf_descriptor_struct`
USE `outfil`

2.99 interface_average

NAME

interface_average

SYNOPSIS

SUBROUTINE `interface_average` (`intf`,`unassemb`,`assemb`)

DESCRIPTION

Average a field along the interface

ARGUMENTS

intf – interface descriptor structure
unassemb – complex array (= unassembled field as input)
assemb – complex array (= averaged field along the interface as output)

MODULES

USE `interf_descriptor_struct`**2.100 interface_equation**

NAME

interface_equation

SYNOPSIS

SUBROUTINE `interface_equation` (`dom`,`intf`)

DESCRIPTION

Detect interface equations.

ARGUMENTS

dom – mesh structure
intf – interface descriptor structure

MODULES

USE `outfl`
USE `mesh_struct`
USE `interf_descriptor_struct`
USE `mpif`
USE `realloc`

2.101 interface_exchange

NAME

interface_exchange

SYNOPSIS

SUBROUTINE `interface_exchange (intf)`

DESCRIPTION

Exchange interface data with neighbouring subdomains.

ARGUMENTS

intf – interface descriptor structure

MODULES

USE `mpif`
USE `interf_descriptor_struct`
USE `outfil`**2.102 interface_init**

NAME

interface_init

SYNOPSIS

SUBROUTINE `interface_init (intf)`

DESCRIPTION

Initialize interface structure.

ARGUMENTS

intf – interface descriptor structure

MODULES

USE `interf_descriptor_struct`
USE `realloc`
USE `outfil`**2.103 interface_jump**

NAME

interface_jump

SYNOPSIS

```
SUBROUTINE interface_jump (intf,v,w)
```

DESCRIPTION

Compute the jump of a field along the interface.

ARGUMENTS

intf – interface descriptor structure
v – complex array (= local field as input)
w – complex array (= jump of v as output)

MODULES

USE interf_descriptor_struct

2.104 **interface_jump2**

NAME

interface_jump2

SYNOPSIS

```
SUBROUTINE interface_jump2 (intf,k,v,lambda,g)
```

DESCRIPTION

Compute interface gradient.

ARGUMENTS

intf – interface descriptor structure
k – sparse matrix structure
v – complex array
lambda – complex array
g – complex array

MODULES

USE interf_descriptor_struct
 USE sparse_matrix_struct
 USE outfil

SEE ALSO

interface_jump.f90

2.105 interface_mesh_equation

NAME

interface_mesh_equation

SYNOPSIS

SUBROUTINE `interface_mesh_equation` (`dom,intf,mesh_intf`)

DESCRIPTION

Build interface equation per node.

ARGUMENTS

dom – mesh structure
intf – interface descriptor structure
mesh_intf – interface mesh structure

MODULES

USE `outfil`
 USE `interf_descriptor_struct`
 USE `interf_mesh_struct`
 USE `facet_struct`
 USE `mesh_struct`
 USE `mpif`
 USE `realloc`

2.106 interface_mesh_geometry

NAME

interface_mesh_geometry

SYNOPSIS

SUBROUTINE `interface_mesh_geometry` (`dom,intf,mesh_intf`)

DESCRIPTION

Detect interface facets.

ARGUMENTS

dom – mesh structure
intf – interface descriptor structure
mesh_intf – interface mesh structure

MODULES

```

USE outfil
USE interf_descriptor_struct
USE facet_struct
USE mesh_struct
USE interf_mesh_struct
USE mpif
USE realloc

```

2.107 interface_mesh_topology

NAME

interface_mesh_topology

SYNOPSIS

```
SUBROUTINE interface_mesh_topology (mesh_intf)
```

DESCRIPTION

Build list of equations in each element.

ARGUMENTS

mesh_intf – interface mesh structure

MODULES

```

USE interf_mesh_struct
USE outfil
USE realloc

```

2.108 interface_node

NAME

interface_node

SYNOPSIS

```
SUBROUTINE interface_node (intf)
```

DESCRIPTION

Detect interface nodes.

ARGUMENTS

intf – interface descriptor structure

MODULES

```

USE outfil
USE interf_descriptor_struct
USE mpif
USE realloc

```

2.109 interface_signe

NAME

interface_signe

SYNOPSIS

```

SUBROUTINE interface_signe (intf)

```

DESCRIPTION

Sign sub-domains and interfaces.

ARGUMENTS

intf – interface descriptor structure

MODULES

```

USE interf_descriptor_struct
USE outfil
USE mpif

```

2.110 invD_times_U

NAME

invD_times_U

SYNOPSIS

```

SUBROUTINE invD_times_U (lda,nrow,d,ncol,u)

```

DESCRIPTION

Compute $[D]^{-1}U$.

ARGUMENTS

lda – integer
nrow – integer
d – complex array
ncol – integer
u – complex array

2.111 invL_times_U

NAME

invL_times_U

SYNOPSIS

SUBROUTINE `invL_times_U (lda,nrow,ldlt,ncol,u)`

DESCRIPTION

Compute $[L]^{-1}U$.

ARGUMENTS

lda – integer
nrow – integer
ldlt – complex array
ncol – integer
u – complex array

2.112 invL_times_sparsU

NAME

invL_times_sparsU

SYNOPSIS

SUBROUTINE `invL_times_sparsU (n,ldlt,lda,ncol_u,i0,u,n1,n2)`

DESCRIPTION

Compute $[L]^{-1}U$

ARGUMENTS

n – integer
ldlt – complex array
lda – integer
ncol_u – integer
i0 – integer array
u – complex array
n1 – integer
n2 – integer

2.113 invUt_times_sparsU

NAME

invUt_times_sparsU

SYNOPSIS

```
SUBROUTINE invUt_times_sparsU (n,ldu,lda,ncol_u,i0,u,n1,n2)
```

DESCRIPTION

Compute $[U]^{-t}U$.

ARGUMENTS

n – integer
ldu – complex array
lda – integer
ncol_u – integer
i0 – integer array
u – complex array
n1 – integer
n2 – integer

2.114 **jacobi_convergence**

NAME

jacobi_convergence

SYNOPSIS

```
SUBROUTINE jacobi_convergence (omega,omega_moins,omega_plus,k_max,&
&                               p1,q1,p2,q2,rho_max)
```

DESCRIPTION

Compute maximum value of convergence rate of jacobi algorithm.

ARGUMENTS

omega – real
omega_moins – real
omega_plus – real
k_max – real
p1 – real
q1 – real
p2 – real
q2 – real
rho_max – real

MODULES

USE outfil

2.115 jacobi_optimized

NAME

jacobi_optimized

SYNOPSIS

```

SUBROUTINE jacobi_optimized (type_optimized,omega,h,L,      &
&                          alpha_left,alpha_right,      &
&                          beta_left,beta_right)

```

DESCRIPTION

Compute optimized coefficient of jacobi algorithm.

ARGUMENTS

type_optimized – integer
omega – real
h – real
L – real
alpha_left – complex
alpha_right – complex
beta_left – complex
beta_right – complex

MODULES

```

USE mesh_struct
USE outfil

```

2.116 L_times_invD

NAME

L_times_invD

SYNOPSIS

```

SUBROUTINE L_times_invD (lda,nrow,d,ncol,u)

```

DESCRIPTION

Compute $L[D]^{-1}$.

ARGUMENTS

lda – integer
nrow – integer
d – complex array
ncol – integer
u – complex array

2.117 L_times_invU

NAME

L_times_invU

SYNOPSIS

SUBROUTINE L_times_invU (lda,nrow,ldu,ncol,l)

DESCRIPTION

Compute $L[U]^{-1}$.

ARGUMENTS

lda – integer (= the dimension of matrix A)
nrow – integer
ldu – complex array (= the ldu factorization of diagonal block)
ncol – integer
l – complex array (= the lower band)

2.118 LdLt_tri_block_numeric

NAME

LdLt_tri_block_numeric

SYNOPSIS

SUBROUTINE LdLt_tri_block_numeric

DESCRIPTION

Numerical factorization using tridiagonal block LdLt algorithm.

ARGUMENTS

None

MODULES

USE solver_param
 USE feti_data
 USE model
 USE outfil
 USE direct_symmetric

2.119 LdLt_tri_block_symbolic

NAME

LdLt_tri_block_symbolic

SYNOPSIS

```
SUBROUTINE LdLt_tri_block_symbolic
```

DESCRIPTION

Symbolic factorization for block tridiagonal LDL^t algorithm.

ARGUMENTS

None

MODULES

```
USE model
USE outfil
USE solver_param
USE feti_data
USE direct_symmetric
```

2.120 **Ldlt_tri_dirich**

NAME

Ldlt_tri_dirich

SYNOPSIS

```
SUBROUTINE Ldlt_tri_dirich (nop,ldu)
```

DESCRIPTION

Block tridiagonal factorization of a sparse symmetric matrix with reverse Cuthill Mac Kee numbering. Case of Dirichlet conditions for the last block.

ARGUMENTS

nop – real
ldu – factorized matrix structure

MODULES

```
USE solver_param
USE outfil
USE factorized_matrix_struct
```

2.121 **LdU_tri_block_numeric**

NAME

LdU_tri_block_numeric

SYNOPSIS

```
SUBROUTINE LdU_tri_block_numeric
```

DESCRIPTION

Numerical factorization using tridiagonal block *LDU* algorithm.

ARGUMENTS

None

MODULES

```
USE solver_param
USE feti_data
USE model
USE outfil
USE direct_unsymmetric
```

2.122 LdU_tri_block_symbolic

NAME

LdU_tri_block_symbolic

SYNOPSIS

```
SUBROUTINE LdU_tri_block_symbolic
```

DESCRIPTION

Symbolic factorization for block tridiagonal LdU algorithm.

ARGUMENTS

None

MODULES

```
USE model
USE outfil
USE solver_param
USE feti_data
USE direct_unsymmetric
```

2.123 LdU_tri_dirich

NAME

LdU_tri_dirich

SYNOPSIS

```
SUBROUTINE LdU_tri_dirich (nop,ldu)
```

DESCRIPTION

Block tridiagonal factorization of a sparse symmetric matrix with reverse Cuthill Mac Kee numbering.

ARGUMENTS

nop – real
ldu – factorized matrix structure

MODULES

USE solver_param
 USE outfl
 USE factorized_matrix_struct

2.124 **mask_to_list**

NAME

mask_to_list

SYNOPSIS

```
SUBROUTINE mask_to_list (dim,mask,ntrue,list,P6)
```

DESCRIPTION

Build concatenated list from a mask array.

ARGUMENTS

dim – integer
mask – integer array
ntrue – integer
list – integer array
P6 – integer

2.125 **merge_nodal_list**

NAME

merge_nodal_list

SYNOPSIS

```
SUBROUTINE merge_nodal_list (neq,dim_bc,bc,tot)
```

DESCRIPTION

Build concatenated boundary condition.

ARGUMENTS

neq – integer
dim_bc – integer
bc – nodal list structure array
tot – nodal list structure

MODULES

USE ...

2.126 **mtxv**

NAME

mtxv

SYNOPSIS

SUBROUTINE *mtxv* (*n,m,a,x,y*)

DESCRIPTION

Conjugate matrix-vector product: $y = A^*x$.

ARGUMENTS

n – integer
m – integer
a – complex array
x – complex array
y – complex array

2.127 **mtxv_par**

NAME

mtxv_par

SYNOPSIS

SUBROUTINE *mtxv_par* (*n,m,a,x,y,intf*)

DESCRIPTION

Parallel conjugate matrix-vector product: $y = A^*x$.

ARGUMENTS

n – integer
m – integer
a – complex array
x – complex array
y – complex array
intf – interface descriptor structure

MODULES

USE interf_descriptor_struct
 USE outfil

2.128 **mxvadd**

NAME

mxvadd

SYNOPSIS

SUBROUTINE `mxvadd (n,m,a,x,y)`

DESCRIPTION

Add matrix-vector product: $y = y + Ax$.

ARGUMENTS

n – integer
m – integer
a – complex array
x – complex array
y – complex array

2.129 **nodal_list_equation**

NAME

nodal_list_equation

SYNOPSIS

SUBROUTINE `nodal_list_equation (dom,bc)`

DESCRIPTION

Build list and mask of boundary equations.

ARGUMENTS

dom – mesh structure
bc – nodal list structure

MODULES

```

USE mesh_struct
USE nodal_list_struct
USE realloc
USE outfil

```

2.130 **opti_number**

NAME

opti_number

SYNOPSIS

```

SUBROUTINE opti_number (nodes,p_graph,graph,list_opt)

```

DESCRIPTION

Reorder subgraph via Cuthill-Mac Kee algorithm.

ARGUMENTS

```

nodes – integer
p_graph – integer array
graph – integer array
list_opt – integer array

```

MODULES

```

USE outfil

```

2.131 **output_results**

NAME

output_results

SYNOPSIS

```

SUBROUTINE output_results (frequency,freq_num)

```

DESCRIPTION

Print results.

ARGUMENTS

```

frequency – real
freq_num – integer

```

MODULES

```

USE outfil
USE model
USE feti_data
USE mpif

```

2.132 point_front

NAME

point_front

SYNOPSIS

```

SUBROUTINE point_front (neq,p_row,sparse_size,col_numb,new2old,    &
&                        nfront,p_front,nclamp,nfront_clamp)

```

DESCRIPTION

Build pointer of fronts of block tridiagonal sparse matrix.

ARGUMENTS

```

    neq - integer
    p_row - integer array (= pointer of rows of unsymmetric matrix)
    sparse_size - integer
    col_numb - integer array (= list of column indices of rows of unsym-
        metric matrix)
    new2old - integer array (= new to old correspondance)
    nfront - integer
    p_front - integer array (= pointer of fronts)
    nclamp - integer
    nfront_clamp - integer

```

MODULES

```

USE outfil

```

2.133 post_process

NAME

post_process

SYNOPSIS

```

SUBROUTINE post_process

```

DESCRIPTION

Post process results.

ARGUMENTS

None

MODULES

USE solver_param
USE model**2.134** **print_vector**

NAME

print_vector

SYNOPSIS

SUBROUTINE print_vector (n,v)

DESCRIPTION

Print vector.

ARGUMENTS

n – integer
v – complex array

MODULES

USE outfil

2.135 **proband**

NAME

proband

SYNOPSIS

SUBROUTINE proband (n,i1,i2,prow1,prow2,lmorse,ncol,a,x,y)

DESCRIPTION

Compute product by a rectangular sub-block of a symmetric sparse matrix.

ARGUMENTS

n – integer
i1 – integer
i2 – integer
prowl – integer array
prow2 – integer array
lmorse – integer
ncol – integer array
a – complex array
x – complex array
y – complex array

2.136 **probit**

NAME

probit

SYNOPSIS

SUBROUTINE `probit` (`intf,w,bitw`)

DESCRIPTION

Compute the local right-hand-side associated with a Neumann boundary condition on the interface.

ARGUMENTS

intf – interface descriptor structure
w – complex array
bitw – complex array

MODULES

USE `interf_descriptor_struct`
 USE `outfil`

2.137 **problem_form**

NAME

problem_form

SYNOPSIS

SUBROUTINE `problem_form` (`frequency,subdom_num,subdom,typesol,&`
 & `symm,k_opt,typegalerkin`)

DESCRIPTION

Form the matrix of domain.

ARGUMENTS

frequency – real
subdom_numb – integer
numb_subdom – integer
typesol – integer
symm – integer
k_opt – integer
typegalerkin – integer

MODULES

USE model
 USE outfil
 USE feti_data

2.138 **problo**

NAME

problo

SYNOPSIS

SUBROUTINE *problo* (n,i1,i2,prow1,prow2,lmorse,ncol,a,x,y)

DESCRIPTION

Compute product by a sub-block of a sparse matrix.

ARGUMENTS

n – integer
i1 – integer
i2 – integer
prow1 – integer array
prow2 – integer array
lmorse – integer
ncol – integer array
a – complex array
x – complex array
y – complex array

2.139 **problot**

NAME

problot

SYNOPSIS

SUBROUTINE *problot* (n,i1,i2,prow1,prow2,lmorse,ncol,a,x,y)

DESCRIPTION

Compute product by a transposed sub-block of a sparse matrix.

ARGUMENTS

n – integer
i1 – integer
i2 – integer
proW1 – integer array
proW2 – integer array
lmorse – integer
ncol – integer array
a – complex array
x – complex array
y – complex array

2.140 **pt_extract**

NAME

pt_extract

SYNOPSIS

```
SUBROUTINE pt_extract (n,i1,i2,j0,proW1,proW2,lmorse,ncol,a,dim2, &
& dim1,blo)
```

DESCRIPTION

Extract transposed renumbered block associated to rows i1 to i2 and delimited by pointers proW1 et proW2 from sparse matrix stored by row.

ARGUMENTS

n – integer
i1 – integer
i2 – integer
j0 – integer
proW1 – integer array
proW2 – integer array
lmorse – integer
ncol – integer array
a – complex array
dim2 – integer
dim1 – integer
blo – complex array

2.141 **read_mesh**

NAME

read_mesh

SYNOPSIS

```
SUBROUTINE read_mesh (file_num,dom,max_numb_f,numb_f,f)
```

DESCRIPTION

Input mesh in free format.

ARGUMENTS

file_num – integer
dom – mesh structure
max_numb_f – integer
numb_f – integer
f – facet structure array

MODULES

```
USE mesh_struct
USE facet_struct
USE realloc
USE outfil
```

2.142 **realloc_c1**

NAME

realloc_c1

SYNOPSIS

```
SUBROUTINE realloc_c1 (tab,dim1,ierr)
```

DESCRIPTION

Reallocation of multi-dimensional complex pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – complex array
dim1 – integer
ierr – integer

2.143 **realloc_c2**

NAME

realloc_c2

SYNOPSIS

```
SUBROUTINE realloc_c2 (tab,dim1,dim2,ierr)
```

DESCRIPTION

Reallocation of multi-dimensional complex pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – complex array
dim1 – integer
dim2 – integer
ierr – integer

2.144 **realloc_i1**

NAME

realloc_i1

SYNOPSIS

SUBROUTINE `realloc_i1` (`tab,dim1,ierr`)

DESCRIPTION

Reallocation of multi-dimensional integer pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – integer array
dim1 – integer
ierr – integer

2.145 **realloc_i2**

NAME

realloc_i2

SYNOPSIS

SUBROUTINE `realloc_i2` (`tab,dim1,dim2,ierr`)

DESCRIPTION

Reallocation of multi-dimensional integer pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – integer array
dim1 – integer
dim2 – integer
ierr – integer

2.146 realloc_r1

NAME

realloc_r1

SYNOPSIS

SUBROUTINE `realloc_r1 (tab,dim1,ierr)`

DESCRIPTION

Reallocation of multi-dimensional real pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – real array
dim1 – integer
ierr – integer

2.147 realloc_r2

NAME

realloc_r2

SYNOPSIS

SUBROUTINE `realloc_r2 (tab,dim1,dim2,ierr)`

DESCRIPTION

Reallocation of multi-dimensional real pointer in the case where the pointer has been allocated.

ARGUMENTS

tab – real array
dim1 – integer
dim2 – integer
ierr – integer

2.148 ren_sym_sparse

NAME

ren_sym_sparse

SYNOPSIS

SUBROUTINE `ren_sym_sparse (neq,sparse_size,rowp,col,new2old,p_row, &
& col_num)`

DESCRIPTION

Construction of renumbered lower triangular part of the symmetric sparse structure stored row by row from the upper triangular symmetric one.

ARGUMENTS

rowp – pointer of rows of the upper triangular part of the initial matrix
col – list of column indices of rows of the initial matrix
new2old – new to old correspondance
p_row – pointer of rows of the lower triangular part of the symmetric matrix
col_numb – list of column indices of rows of the renumbered matrix
 ... – ...

MODULES

USE outfil

2.149 **ren_unsym_sparse**

NAME

ren_unsym_sparse

SYNOPSIS

```
SUBROUTINE ren_unsym_sparse (neq,sparse_size,rowp,col,new2old,      &
&                             p_row,col_numb)
```

DESCRIPTION

Construction of renumbered unsymmetric sparse structure stored row by row.

ARGUMENTS

rowp – pointer of rows of the initial matrix
col – list of column indices of rows of the initial matrix
new2old – new to old correspondance
p_row – pointer of rows of the unsymmetric matrix
col_numb – list of column indices of rows of the renumbered matrix

MODULES

USE outfil

2.150 **renum_eq_mpc**

NAME

renum_eq_mpc

SYNOPSIS

```
SUBROUTINE renum_eq_mpc (dom,dim_mpc,mpc)
```

DESCRIPTION

Change equation numbering to take into account multi-point constraints.

ARGUMENTS

dom – mesh structure
dim_mpc – integer
mpc – nodal list structure array

MODULES

```
USE outfil
USE mesh_struct
USE Nodal_List_struct
```

2.151 **renum_facet**

NAME

renum_facet

SYNOPSIS

```
SUBROUTINE renum_facet (dom,bc)
```

DESCRIPTION

Replace external to internal node number in list of nodes of facet.

ARGUMENTS

dom – mesh structure
bc – facet structure

MODULES

```
USE mesh_struct
USE facet_struct
```

2.152 **renum_nodal_list**

NAME

renum_nodal_list

SYNOPSIS

```
SUBROUTINE renum_nodal_list (dom,bc)
```

DESCRIPTION

Replace external to internal node number in nodal list.

ARGUMENTS

dom – mesh structure
bc – nodal list structure

MODULES

USE mesh_struct
 USE nodal_list_struct

2.153 solve_rhs

NAME

solve_rhs

SYNOPSIS

SUBROUTINE solve_rhs (subdom_num)

DESCRIPTION

Solve problem for a single right hand side.

ARGUMENTS

subdom_num – integer

MODULES

USE solver_param
 USE model
 USE outfil
 USE realloc
 USE feti_data
 USE feti_param
 USE mpif

2.154 son_3d

NAME

son_3d

SYNOPSIS

PROGRAM son_3d

DESCRIPTION

FETI demonstration code.

ARGUMENTS

None

MODULES

USE solver_param

2.155 **sort_list**

NAME

sort_list

SYNOPSIS

```
SUBROUTINE sort_list (dim,list)
```

DESCRIPTION

Sort list of interger in increasing ordering.

ARGUMENTS

dim – integer
list – integer array

2.156 **sparse_fwbw**

NAME

sparse_fwbw

SYNOPSIS

```
SUBROUTINE sparse_fwbw (neq,sparse_size,p_row,column_num,a,      &
&                        p_diag,b,z)
```

DESCRIPTION

Sparse forward-backward solution of $Ax = b$ with $A = LU$.

ARGUMENTS

neq – integer
sparse_size – integer
p_row – integer array
column_numb – integer array
a – complex array
p_diag – integer array
b – complex array
z – complex array

2.157 **sparse_matrix_equalization**

NAME

sparse_matrix_equalization

SYNOPSIS

SUBROUTINE `sparse_matrix_equalization` (b,a)

DESCRIPTION

Equalize sparse matrix.

ARGUMENTS

b – sparse matrix structure
a – sparse matrix structure

MODULES

USE `sparse_matrix_struct`
 USE `realloc`
 USE `outfil`

2.158 **sparse_matrix_equalization2**

NAME

sparse_matrix_equalization2

SYNOPSIS

SUBROUTINE `sparse_matrix_equalization2` (b,a)

DESCRIPTION

Equalize sparse matrix.

ARGUMENTS

b – sparse matrix structure
a – sparse matrix structure

MODULES

USE sparse_matrix_struct

2.159 **sparse_prod**

NAME

sparse_prod

SYNOPSIS

SUBROUTINE sparse_prod (a,x,y)

DESCRIPTION

Compute sparse matrix vector product in the case of a symmetric matrix with upper triangular part stored by rows.

ARGUMENTS

a – sparse matrix structure
x – complex array
y – complex array

MODULES

USE sparse_matrix_struct

2.160 **split_mesh**

NAME

split_mesh

SYNOPSIS

SUBROUTINE split_mesh (numb_subdom)

DESCRIPTION

Build elements to subdomain correspondance.

ARGUMENTS

numb_subdom – integer

MODULES

USE model
 USE feti_data
 USE outfil

2.161 stoprun

NAME

stoprun

SYNOPSIS

SUBROUTINE stoprun

DESCRIPTION

Abort run.

ARGUMENTS

None

MODULES

USE outfil

2.162 sym_approx_schur_cpmt

NAME

sym_approx_schur_cpmt

SYNOPSIS

SUBROUTINE sym_approx_schur_cpmt (a, ainit, reg, intf, intf_mesh, Diri, &
 & Dir)

DESCRIPTION

Compute Schur complement.

ARGUMENTS

a – sparse matrix structure
ainit – sparse matrix structure
reg – sparse matrix structure
intf – interface descriptor structure
intf_mesh – interface mesh structure
Diri – nodal list structure
Dir – nodal list structure

MODULES

```

USE mpif
USE solver_param
USE feti_data
USE sparse_matrix_struct
USE direct_symmetric
USE interf_mesh_struct
USE interf_descriptor_struct
USE nodal_list_struct
USE outfil
USE realloc

```

2.163 **sym_build_schur_cpmt**

NAME

sym_build_schur_cpmt

SYNOPSIS

```

SUBROUTINE sym_build_schur_cpmt (ainit,reg,intf,intf_mesh,Diri,   &
&                               Dir)

```

DESCRIPTION

Compute Schur complement.

ARGUMENTS

ainit – sparse matrix structure
reg – sparse matrix structure
intf – interface descriptor structure
intf_mesh – interface mesh structure
Diri – nodal list structure
Dir – nodal list structure

MODULES

```

USE mpif
USE solver_param
USE feti_data
USE sparse_matrix_struct
USE direct_symmetric
USE interf_mesh_struct
USE interf_descriptor_struct
USE nodal_list_struct
USE outfil

```

2.164 **sym_condens**

NAME

sym_condens

SYNOPSIS

```
SUBROUTINE sym_condens (lda,dim1,dim2,a,d,b,c,bt,i0,nop)
```

DESCRIPTION

Compute the Schur complement: $C = C - [L^{-1}B]^t[L^{-1}B]$ where L is the lower triangular part of the Choleski factorisation of A .

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
a – complex array
d – complex array
b – complex array
c – complex array
bt – complex array
i0 – integer array
nop – real

MODULES

```
USE block_size
```

2.165 **sym_direct_solve**

NAME

sym_direct_solve

SYNOPSIS

```
SUBROUTINE sym_direct_solve (y,x)
```

DESCRIPTION

Forward-backward substitution using tridiagonal block LdU factorization.

ARGUMENTS

y – complex array
x – complex array

MODULES

```
USE model  

USE direct_symmetric
```

2.166 sym_extract

NAME

sym_extract

SYNOPSIS

```

SUBROUTINE sym_extract (n,i1,i2,j0,prow1,prow2,lmorse,ncol,a,lda, &
& dim2,blo)

```

DESCRIPTION

Extract block associated to rows *i1* to *i2* and delimited by pointers *prow1* et *prow2* from sparse matrix stored by row.

ARGUMENTS

n – integer
i1 – integer
i2 – integer
j0 – integer
prow1 – integer array
prow2 – integer array
lmorse – integer
ncol – integer
a – complex array
lda – integer
dim2 – integer
blo – complex array

2.167 sym_fill_tridiag_sparse

NAME

sym_fill_tridiag_sparse

SYNOPSIS

```

SUBROUTINE sym_fill_tridiag_sparse (a,ldu)

```

DESCRIPTION

Fill renumbered matrix with storage of lower triangular part.

ARGUMENTS

a – sparse matrix structure
ldu – factorized matrix structure

MODULES

```

USE sparse_matrix_struct
USE factorized_matrix_struct

```

2.168 **sym_fwbw_tri_dirichlet**

NAME

sym_fwbw_tri_dirichlet

SYNOPSIS

SUBROUTINE `sym_fwbw_tri_dirichlet` (`y,x`)

DESCRIPTION

Forward-backward substitution using tridiagonal block *LDU* factorization.

ARGUMENTS

`y` – complex array
`x` – complex array

MODULES

USE `model`
USE `direct_symmetric`**2.169** **sym_multi_level1_feti**

NAME

sym_multi_level1_feti

SYNOPSIS

SUBROUTINE `sym_multi_level1_feti` (`rhs,solution,a,a_init,` &
& `Dirichlet,interfine,typre,numb_dir,` &
& `max_numb_it,numb_restart,epsilon,` &
& `epstagn,multi_rhs`)

DESCRIPTION

Level-1 FETI solution with multi-Krylov projection.

ARGUMENTS

rhs – complex array
solution – complex array
a – sparse matrix structure
a_init – sparse matrix structure
Dirichlet – nodal list structure
interfine – interface descriptor structure
typre – integer
numb_dir – integer
max_numb_it – integer
numb_restart – integer
epsilon – real
epstagn – real
multi_rhs – integer

MODULES

USE mpif
 USE direct_symmetric
 USE factorized_matrix_struct
 USE sparse_matrix_struct
 USE interf_descriptor_struct
 USE nodal_list_struct
 USE outfil

2.170 **sym_multi_level2_feti**

NAME

sym_multi_level2_feti

SYNOPSIS

```

SUBROUTINE sym_multi_level2_feti (rhs,solution,a,a_init,b,      &
&                               Dirichlet,interfineP,typre,    &
&                               numb_dir,max_numb_it,numb_restart, &
&                               epsilon,epstagn,multi_rhs)

```

DESCRIPTION

Solution of interface problem using a Jacobi algorithm.

ARGUMENTS

rhs – complex array
solution – complex array
a – sparse matrix structure
a_init – sparse matrix structure
Dirichlet – nodal list structure
interfineP – interface descriptor structure
typre – integer
numb_dir – integer
max_numb_it – integer
numb_restart – integer
epsilon – real
epstagn – real
multi_rhs – integer

MODULES

USE mpif
 USE direct_symmetric
 USE factorized_matrix_struct
 USE sparse_matrix_struct
 USE interf_descriptor_struct
 USE nodal_list_struct
 USE feti_data
 USE outfil

2.171 **sym_proax**

NAME

sym_proax

SYNOPSIS

SUBROUTINE *sym_proax* (*neq,p_row,sparse_size,column_num,coef,x,y*)

DESCRIPTION

Compute sparse matrix vector product in the case of a symmetric matrix with upper triangular part stored by rows.

ARGUMENTS

neq – integer
p_row – integer array
sparse_size – integer
column_num – integer array
coef – complex array
x – complex array
y – complex array

2.172 **sym_renumb_matrix_bc**

NAME

sym_renumb_matrix_bc

SYNOPSIS

SUBROUTINE `sym_renumb_matrix_bc` (`a`,`ldu`)

DESCRIPTION

Build renumbered matrix with storage of lower triangular part.

ARGUMENTS

`a` – sparse matrix structure
`ldu` – factorized matrix structure

MODULES

USE `sparse_matrix_struct`
USE `nodal_list_struct`
USE `outfil`
USE `realloc`
USE `factorized_matrix_struct`**2.173** **sym_tridiag_struct**

NAME

sym_tridiag_struct

SYNOPSIS

SUBROUTINE `sym_tridiag_struct` (`ldu`)

DESCRIPTION

Build block tridiagonal sparse matrix structure of symmetric matrix renumbered via Cuthill Mac Kee.

ARGUMENTS

`ldu` – factorized matrix structure

MODULES

USE `solver_param`
USE `outfil`
USE `realloc`
USE `factorized_matrix_struct`

2.174 **symfwbw_tri_dirichlet**

NAME

symfwbw_tri_dirichlet

SYNOPSIS

SUBROUTINE `symfwbw_tri_dirichlet` (`y,x,ldu`)

DESCRIPTION

Forward-backward substitution with tridiagonal block sparse matrix. Case of Dirichlet conditions for the last block.

ARGUMENTS

`y` – complex array
`x` – complex array
`ldu` – factorized matrix structure

MODULES

USE `solver_param`
 USE `outfil`

2.175 **symunsym_sparse_mask**

NAME

symunsym_sparse_mask

SYNOPSIS

SUBROUTINE `symunsym_sparse_mask` (`neq,rowp,lcol,col,p_row,` &
 & `sparse_size,col_numb,mask`)

DESCRIPTION

Construction of the un-symmetric sparse structure from the upper triangular part of the symmetric one stored row by row.

ARGUMENTS

`rowp` – pointer of rows of upper triangular part of symmetric matrix
`col` – list of column indices of rows of upper triangular part
`p_row` – pointer of rows of unsymmetric matrix
`col_numb` – list of column indices of rows of unsymmetric matrix
`mask` – mask of eliminated equations

MODULES

USE `outfil`

2.176 un_condens

NAME

un_condens

SYNOPSIS

```
SUBROUTINE un_condens (lda,dim1,dim2,a,d,e,f,c,v,ie0,if0,nop)
```

DESCRIPTION

Compute the Schur complement $C = C - [U^{-t}F]^t d^{-1} [L^{-1}E]$ LDU is the Gauss-Jordan factorisation of A .

ARGUMENTS

lda – integer
dim1 – integer
dim2 – integer
a – complex array
d – complex array
e – complex array
f – complex array
c – complex array
v – complex array
ie0 – integer array
if0 – integer array
nop – real

2.177 un_extract

NAME

un_extract

SYNOPSIS

```
SUBROUTINE un_extract(n,i1,i2,j0,proW1,proW2,lmorse,ncol,a,lda, &
& dim2,blo)
```

DESCRIPTION

Extract block associated to rows $i1$ to $i2$ and delimited by pointers $proW1$ et $proW2$ from sparse matrix stored by row

ARGUMENTS

n – integer
i1 – integer
i2 – integer
j0 – integer
proW1 – integer array
proW2 – integer array
lmorse – integer
ncol – integer array
a – complex array
lda – integer
dim2 – integer
blo – complex array

2.178 **unsym_approx_schur_cpmt**

NAME

unsym_approx_schur_cpmt

SYNOPSIS

```

SUBROUTINE unsym_approx_schur_cpmt(a, ainit, reg, intf, intf_mesh,    &
&                                     Diri, Dir)

```

DESCRIPTION

Compute Schur complement.

ARGUMENTS

a – sparse matrix structure
ainit – sparse matrix structure
reg – sparse matrix structure
intf – interface descriptor structure
intf_mesh – interface mesh structure
Diri – nodal list structure
Dir – nodal list structure

MODULES

```

USE mpif
USE solver_param
USE feti_data
USE sparse_matrix_struct
USE direct_unsymmetric
USE interf_mesh_struct
USE interf_descriptor_struct
USE nodal_list_struct
USE outfil
USE realloc

```

2.179 **unsym_build_schur_cpmt**

NAME

unsym_build_schur_cpmt

SYNOPSIS

```

SUBROUTINE unsym_build_schur_cpmt (ainit,reg,intf,intf_mesh,Diri, &
&                               Dir)

```

DESCRIPTION

Compute Schur complement

ARGUMENTS

ainit – sparse matrix structure
reg – sparse matrix structure
intf – interface descriptor structure
intf_mesh – interface mesh structure
Diri – nodal list structure
Dir – modal list structure

MODULES

```

USE mpif
USE solver_param
USE feti_data
USE sparse_matrix_struct
USE direct_undefined
USE interf_mesh_struct
USE interf_descriptor_struct
USE nodal_list_struct
USE outfil
USE realloc

```

2.180 **unsym_direct_solve**

NAME

unsym_direct_solve

SYNOPSIS

```

SUBROUTINE unsym_direct_solve (y,x)

```

DESCRIPTION

Forward-backward substitution using tridiagonal block LdU factorization

ARGUMENTS

y – complex array
x – complex array

MODULES

USE model
 USE direct_unsymmetric

2.181 unsym_fill_tridiag_sparse

NAME

unsym_fill_tridiag_sparse

SYNOPSIS

SUBROUTINE `unsym_fill_tridiag_sparse (a,ldu)`

DESCRIPTION

Fill renumbered matrix

ARGUMENTS

a – sparse matrix structure
ldu – factorized matrix structure

MODULES

USE sparse_matrix_struct
 USE factorized_matrix_struct

2.182 unsym_fwbw_tri_dirichlet

NAME

unsym_fwbw_tri_dirichlet

SYNOPSIS

SUBROUTINE `unsym_fwbw_tri_dirichlet(y,x)`

DESCRIPTION

Forward-backward substitution using tridiagonal block LdU factorization.

ARGUMENTS

y – complex array
x – complex array

MODULES

```
USE model
USE direct_unsymmetric
```

2.183 unsym_multi_level1_feti

NAME

unsym_multi_level1_feti

SYNOPSIS

```
SUBROUTINE unsym_multi_level1_feti(rhs,solution,a,a_init,      &
&                               Dirichlet, interfine,type,    &
&                               numb_dir,max_numb_it,numb_restart, &
&                               epsilon,epstagn,multi_rhs)
```

DESCRIPTION

Level-1 FETI solution with multi-Krylov projection

ARGUMENTS

rhs – complex array
solution – complex array
a – sparse matrix structure
a_init – sparse matrix structure
Dirichlet – nodal list structure
interfine – interface descriptor structure
type – integer
numb_dir – integer
max_numb_it – integer
numb_restart – integer
epsilon – real
epstagn – real
multi_rhs – integer

MODULES

```
USE mpif
USE direct_unsymmetric
USE factorized_matrix_struct
USE sparse_matrix_struct
USE interf_descriptor_struct
USE nodal_list_struct
USE outfil
```

2.184 unsym_multi_level2_feti

NAME

unsym_multi_level2_feti

SYNOPSIS

```

SUBROUTINE unsym_multi_level2_feti (rhs,solution,a,a_init,b,      &
&                                  Dirichlet,interfine,  typre,    &
&                                  numb_dir,max_numb_it,numb_restart, &
&                                  epsilon,epstagn,multi_rhs)

```

DESCRIPTION

Level-2 FETI solution with multi-Krylov projection.

ARGUMENTS

rhs – complex array
solution – complex array
a – sparse matrix structure
a_init – sparse matrix structure
Dirichlet – nodal list structure
interfineP – interface descriptor structure
typre – integer
numb_dir – integer
max_numb_it – integer
numb_restart – integer
epsilon – real
epstagn – real
multi_rhs – integer

MODULES

```

USE mpif
USE direct_unsymmetric
USE factorized_matrix_struct
USE sparse_matrix_struct
USE interf_descriptor_struct
USE interf_mesh_struct
USE nodal_list_struct
USE outfil

```

2.185 **unsym_proax**

NAME

unsym_proax

SYNOPSIS

```

SUBROUTINE unsym_proax (neq,p_row,sparse_size,column_num,coef,x,y)

```

DESCRIPTION

Compute sparse matrix vector product in the case of an unsymmetric matrix stored by rows.

ARGUMENTS

neq – integer
p_row – integer array
sparse_size – integer
column_numb – integer array
coef – complex array
x – complex array
y – complex array

2.186 **unsym_renumb_matrix_bc**

NAME

unsym_renumb_matrix_bc

SYNOPSIS

SUBROUTINE `unsym_renumb_matrix_bc` (`a`,`ldu`)

DESCRIPTION

Build renumbered matrix.

ARGUMENTS

a – sparse matrix structure
nrow – factorized matrix structure

MODULES

USE `sparse_matrix_struct`
 USE `nodal_list_struct`
 USE `outfil`
 USE `realloc`
 USE `factorized_matrix_struct`

2.187 **unsym_tridiag_struct**

NAME

unsym_tridiag_struct

SYNOPSIS

SUBROUTINE `unsym_tridiag_struct`(`ldu`)

DESCRIPTION

Build block tridiagonal sparse matrix structure of unsymmetric matrix renumbered via Cuthill Mac Kee.

ARGUMENTS

ldu – factorized matrix struct

MODULES

USE solver_param
 USE outfl
 USE realloc
 USE factorized_matrix_struct

2.188 unsymfwbw_tri_dirichlet

NAME

unsymfwbw_tri_dirichlet

SYNOPSIS

SUBROUTINE `unsymfwbw_tri_dirichlet` (`y,x,ldu`)

DESCRIPTION

Forward-backward substitution with tridiagonal block sparse matrix. Case of Dirichlet conditions for the last block.

ARGUMENTS

y – complex array
x – complex array
ldu – factorized matrix structure

MODULES

USE solver_param
 USE outfl
 USE factorized_matrix_struct

2.189 unsymunsym_sparse_mask

NAME

unsymunsym_sparse_mask

SYNOPSIS

SUBROUTINE `unsymunsym_sparse_mask`(`neq,rowp,lcol,col,p_row,` &
 & `sparse_size,col_numb,mask`)

DESCRIPTION

Construction of the non-symmetric sparse structure with elimination of non diagonal entries of clamped rows and columns.

ARGUMENTS

rowp – pointer of rows of non symmetric matrix
col – list of column indices of rows
p_row – pointer of rows of compressed matrix
col_numb – list of column indices of rows of compressed matrix
mask – mask of eliminated equations

MODULES

USE outfil

2.190 **update_facet**

NAME

update_facet

SYNOPSIS

SUBROUTINE update_facet (dom,bc)

DESCRIPTION

Find facets material number.

ARGUMENTS

dom – mesh structure
bc – facet structure

MODULES

USE mesh_struct
 USE facet_struct
 USE outfil

2.191 **Update_Nodal_List**

NAME

Update_Nodal_List

SYNOPSIS

SUBROUTINE Update_Nodal_List (dom,bc)

DESCRIPTION

Find neighboring elements of boundary nodes

ARGUMENTS

dom – mesh structure
bc – nodal list structure

MODULES

```

USE mesh_struct
USE nodal_list_struct
USE realloc
USE outfil

```

2.192 **update_region**

NAME

update_region

SYNOPSIS

```
SUBROUTINE update_region (dom,acou_mat,admi_mat,inf_mat)
```

DESCRIPTION

Change region id to internal region number for elements and build internal region number of adjacent element.

ARGUMENTS

dom – mesh structure
acou_mat – region property structure array
admi_mat – region property structure array
inf_mat – region property structure array

MODULES

```

USE mesh_struct
USE region_property_struct
USE outfil

```

2.193 **write_field**

NAME

write_field

SYNOPSIS

```
SUBROUTINE write_field (file_num,dom,field)
```

DESCRIPTION

Print field entries node by node

ARGUMENTS

file_num – integer
dom – mesh structure
field – complex array

MODULES

USE outfl
USE mesh_struct

2.194 write_field_femview

NAME

write_field_femview

SYNOPSIS

SUBROUTINE write_field_femview (file_num,dom,field)

DESCRIPTION

Write the complex components of pressure in a FEMVIEW file

ARGUMENTS

file_num – integer
dom – mesh structure
field – complex array

MODULES

USE outfl
USE mesh_struct

2.195 write_matrix

NAME

write_matrix

SYNOPSIS

SUBROUTINE write_matrix (a,frequency,subdom_num,numb_subdom, &
& directory)

DESCRIPTION

Print complex sparse matrix.

ARGUMENTS

a – sparse matrix structure
frequency – real
subdom_num – integer
numb_subdom – integer
directory – character string

MODULES

```
USE outfil
USE sparse_matrix_struct
```

2.196 write_meshfield_femvtk

NAME

write_meshfield_femvtk

SYNOPSIS

```
SUBROUTINE write_meshfield_femvtk (file_num,dom,field)
```

DESCRIPTION

Write the complex components of pressure in a VTK file

ARGUMENTS

```
file_num – integer
dom – mesh structure
field – complex array
```

MODULES

```
USE outfil
USE mesh_struct
```

2.197 zorthodir_solver

NAME

zorthodir_solver

SYNOPSIS

```
SUBROUTINE zorthodir_solver (rhs,x,a,Dirichlet,type_precond,      &
&                            numb_dir,max_numb_it,epsilon,      &
&                            subdom_numb)
```

DESCRIPTION

Iterative solution of complex problem by Orthodir algorithm with restarts.

ARGUMENTS

rhs – complex array
x – complex array
a – sparse matrix structure
Dirichlet – nodal list structure
type_precond – integer
numb_dir – integer
max_numb_it – integer
epsilon – real
subdom_numb – integer

MODULES

USE sparse_matrix_struct
 USE nodal_list_struct
 USE outfil

2.198 **zorthodir_solver_par**

NAME

zorthodir_solver_par

SYNOPSIS

```

SUBROUTINE zorthodir_solver_par (rhs,x,a,Dirichlet,intf,           &
&                               type_precond,numb_dir,max_numb_it,epsilon,&
&                               subdom_numb)
  
```

DESCRIPTION

Parallel Iterative solution of complex problem by Orthodir algorithm with restarts.

ARGUMENTS

rhs – complex array
x – complex array
a – sparse matrix structure
Dirichlet – nodal list structure
intf – interface descriptor structure
type_precond – integer
numb_dir – integer
max_numb_it – integer
epsilon – real
subdom_numb – integer

MODULES

USE sparse_matrix_struct
 USE nodal_list_struct
 USE interf_descriptor_struct
 USE outfil

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