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# 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

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June 13, 2002

### Contents

<b>1</b>	<b>Modules</b>	<b>17</b>
1.1	block_size . . . . .	17
1.2	direct_symmetric . . . . .	17
1.3	direct_unsymmetric . . . . .	17
1.4	facet_struct . . . . .	18
1.5	factorized_matrix_struct . . . . .	18
1.6	feti_data . . . . .	19
1.7	feti_param . . . . .	20
1.8	interf_descriptor_struct . . . . .	20
1.9	interf_mesh_struct . . . . .	22
1.10	load_curve_struct . . . . .	22
1.11	mesh_feti_struct . . . . .	23
1.12	mesh_struct . . . . .	23
1.13	model . . . . .	24
1.14	mpif . . . . .	25
1.15	nodal_list_struct . . . . .	25
1.16	outfil . . . . .	26
1.17	realloc . . . . .	26
1.18	region_property_struct . . . . .	27
1.19	solver_param . . . . .	27
1.20	sparse_matrix_struct . . . . .	28

---

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<b>2</b>	<b>Functions</b>	<b>29</b>
2.1	add_interf_matrix . . . . .	29
2.2	add_interf_matrix_structure . . . . .	29
2.3	add_sparse_sym_matrix . . . . .	30
2.4	add_sparse_sym_struct . . . . .	30
2.5	add_sparse_unsym_matrix . . . . .	31
2.6	add_sparse_unsym_struct . . . . .	31
2.7	assemble_bc . . . . .	32
2.8	assemble_facet_bc . . . . .	32
2.9	assemble_impedance . . . . .	33
2.10	assemble_interf_matrix . . . . .	33
2.11	assemble_nodal_bc . . . . .	34
2.12	bcast_acoustic_property . . . . .	35
2.13	bcast_admittance_property . . . . .	35
2.14	bcast_facet . . . . .	36
2.15	bcast_infinite_property . . . . .	36
2.16	bcast_load_curve . . . . .	37
2.17	bcast_model_attribute . . . . .	37
2.18	bcast_model_parameters . . . . .	38
2.19	bcast_nodal_list . . . . .	38
2.20	bcast_solver_parameters . . . . .	39
2.21	build_diag . . . . .	39
2.22	build_dirich_aug . . . . .	40
2.23	build_interf_matrix_structure . . . . .	40
2.24	build_interface . . . . .	41
2.25	build_matrix_structure . . . . .	41
2.26	build_node_eq . . . . .	42
2.27	build_rev_geometry . . . . .	42
2.28	build_rev_nodid . . . . .	43
2.29	build_sparse_sym_struct . . . . .	43
2.30	build_sparse_unsym_struct . . . . .	44
2.31	build_topology . . . . .	44
2.32	calpd . . . . .	45
2.33	cmk_number . . . . .	45
2.34	condens_1 . . . . .	45

---

2.35	condens_2 . . . . .	46
2.36	condens_3 . . . . .	47
2.37	copy_block . . . . .	47
2.38	dirichlet_bc . . . . .	48
2.39	distribute_model . . . . .	48
2.40	echo_facet . . . . .	49
2.41	echo_mesh . . . . .	49
2.42	echo_mesh_femview . . . . .	49
2.43	echo_model . . . . .	50
2.44	echo_nodal_list . . . . .	50
2.45	equation_setup . . . . .	51
2.46	extent_i1 . . . . .	51
2.47	extent_r2 . . . . .	52
2.48	extract_submesh . . . . .	52
2.49	facet_rhs . . . . .	53
2.50	factorize_numeric . . . . .	53
2.51	factorize_symbolic . . . . .	54
2.52	feti_abort . . . . .	54
2.53	feti_finalize . . . . .	55
2.54	feti_init . . . . .	55
2.55	fill_sym_sparse . . . . .	56
2.56	fill_unsym_sparse . . . . .	56
2.57	frontal_numb . . . . .	57
2.58	full_schur_b . . . . .	57
2.59	full_blo . . . . .	58
2.60	full_fwbw . . . . .	58
2.61	full_ldlt . . . . .	59
2.62	full_ldlt_b . . . . .	59
2.63	full_ldu . . . . .	59
2.64	full_ldu_b . . . . .	60
2.65	full_schur_b_sparse . . . . .	60
2.66	full_sto . . . . .	61
2.67	full_unsto . . . . .	61
2.68	galerkin_error . . . . .	62
2.69	galerkin_meshsize . . . . .	62

---

2.70	galerkin_tau . . . . .	63
2.71	gather_nodid . . . . .	63
2.72	gather_sol . . . . .	64
2.73	global_eq_mask . . . . .	64
2.74	global_solution . . . . .	65
2.75	globaldotproduct . . . . .	65
2.76	globalsum . . . . .	66
2.77	globalsumc . . . . .	66
2.78	globalsumi . . . . .	67
2.79	half_schur_b . . . . .	67
2.80	half_blo . . . . .	68
2.81	half_fwbw . . . . .	68
2.82	half_mm_b . . . . .	69
2.83	half_schur_b_sparse . . . . .	69
2.84	half_sto . . . . .	70
2.85	half_unsto . . . . .	70
2.86	ilu_0 . . . . .	70
2.87	ilu_preconditioner . . . . .	71
2.88	imprim . . . . .	71
2.89	imprim2 . . . . .	72
2.90	init_model . . . . .	72
2.91	initialize . . . . .	73
2.92	inivec . . . . .	73
2.93	input_data . . . . .	74
2.94	interf_full_sym_struct . . . . .	74
2.95	interf_full_unsym_struct . . . . .	75
2.96	interf_sparse_sym_struct . . . . .	75
2.97	interf_sparse_unsym_struct . . . . .	76
2.98	interface_assemb . . . . .	76
2.99	interface_average . . . . .	77
2.100	interface_equation . . . . .	77
2.101	interface_exchange . . . . .	78
2.102	interface_init . . . . .	78
2.103	interface_jump . . . . .	78
2.104	interface_jump2 . . . . .	79

---

2.105	interface_mesh_equation . . . . .	80
2.106	interface_mesh_geometry . . . . .	80
2.107	interface_mesh_topology . . . . .	81
2.108	interface_node . . . . .	81
2.109	interface_signe . . . . .	82
2.110	invD_times_U . . . . .	82
2.111	invL_times_U . . . . .	83
2.112	invL_times_sparsU . . . . .	83
2.113	invUt_times_sparsU . . . . .	83
2.114	jacobi_convergence . . . . .	84
2.115	jacobi_optimized . . . . .	85
2.116	L_times_invD . . . . .	85
2.117	L_times_invU . . . . .	86
2.118	LdLt_tri_block_numeric . . . . .	86
2.119	LdLt_tri_block_symbolic . . . . .	86
2.120	Ldlt_tri_dirich . . . . .	87
2.121	LdU_tri_block_numeric . . . . .	87
2.122	LdU_tri_block_symbolic . . . . .	88
2.123	LdU_tri_dirich . . . . .	88
2.124	mask_to_list . . . . .	89
2.125	merge_nodal_list . . . . .	89
2.126	mtxv . . . . .	90
2.127	mtxv_par . . . . .	90
2.128	mxvadd . . . . .	91
2.129	nodal_list_equation . . . . .	91
2.130	opti_number . . . . .	92
2.131	output_results . . . . .	92
2.132	point_front . . . . .	93
2.133	post_process . . . . .	93
2.134	print_vector . . . . .	94
2.135	proband . . . . .	94
2.136	probit . . . . .	95
2.137	problem_form . . . . .	95
2.138	problo . . . . .	96
2.139	proplot . . . . .	96

---

2.140	pt_extract . . . . .	97
2.141	read_mesh . . . . .	97
2.142	realloc_c1 . . . . .	98
2.143	realloc_c2 . . . . .	98
2.144	realloc_i1 . . . . .	99
2.145	realloc_i2 . . . . .	99
2.146	realloc_r1 . . . . .	100
2.147	realloc_r2 . . . . .	100
2.148	ren_sym_sparse . . . . .	100
2.149	ren_unsym_sparse . . . . .	101
2.150	renum_eq_mpc . . . . .	101
2.151	renum_facet . . . . .	102
2.152	renum_nodal_list . . . . .	102
2.153	solve_rhs . . . . .	103
2.154	son_3d . . . . .	103
2.155	sort_list . . . . .	104
2.156	sparse_fwbw . . . . .	104
2.157	sparse_matrix_equalization . . . . .	105
2.158	sparse_matrix_equalization2 . . . . .	105
2.159	sparse_prod . . . . .	106
2.160	split_mesh . . . . .	106
2.161	stoprun . . . . .	107
2.162	sym_approx_schur_cpmt . . . . .	107
2.163	sym_build_schur_cpmt . . . . .	108
2.164	sym_condens . . . . .	108
2.165	sym_direct_solve . . . . .	109
2.166	sym_extract . . . . .	110
2.167	sym_fill_tridiag_sparse . . . . .	110
2.168	sym_fwbw_tri_dirichlet . . . . .	111
2.169	sym_multi_level1_feti . . . . .	111
2.170	sym_multi_level2_feti . . . . .	112
2.171	sym_proax . . . . .	113
2.172	sym_renumb_matrix_bc . . . . .	114
2.173	sym_tridiag_struct . . . . .	114
2.174	symfwbw_tri_dirichlet . . . . .	115

---

2.175	symunsym_sparse_mask . . . . .	115
2.176	un_condens . . . . .	116
2.177	un_extract . . . . .	116
2.178	unsym_approx_schur_cpmt . . . . .	117
2.179	unsym_build_schur_cpmt . . . . .	118
2.180	unsym_direct_solve . . . . .	118
2.181	unsym_fill_tridiag_sparse . . . . .	119
2.182	unsym_fwbw_tri_dirichlet . . . . .	119
2.183	unsym_multi_level1_feti . . . . .	120
2.184	unsym_multi_level2_feti . . . . .	120
2.185	unsym_proax . . . . .	121
2.186	unsym_renumb_matrix_bc . . . . .	122
2.187	unsym_tridiag_struct . . . . .	122
2.188	unsymfwbw_tri_dirichlet . . . . .	123
2.189	unsymunsym_sparse_mask . . . . .	123
2.190	update_facet . . . . .	124
2.191	Update_Nodal_List . . . . .	124
2.192	update_region . . . . .	125
2.193	write_field . . . . .	125
2.194	write_field_femview . . . . .	126
2.195	write_matrix . . . . .	126
2.196	write_meshfield_femvtk . . . . .	127
2.197	zorthodir_solver . . . . .	127
2.198	zorthodir_solver_par . . . . .	128



## Index

### Alphabetical

add\_interf\_matrix, 29  
add\_interf\_matrix\_structure, 29  
add\_sparse\_sym\_matrix, 30  
add\_sparse\_sym\_struct, 30  
add\_sparse\_unsym\_matrix, 31  
add\_sparse\_unsym\_struct, 31  
assemble\_bc, 32  
assemble\_facet\_bc, 32  
assemble\_impedance, 33  
assemble\_interf\_matrix, 33  
assemble\_nodal\_bc, 34  
bcast\_acoustic\_property, 35  
bcast\_admittance\_property, 35  
bcast\_facet, 36  
bcast\_infinite\_property, 36  
bcast\_load\_curve, 37  
bcast\_model\_attribute, 37  
bcast\_model\_parameters, 38  
bcast\_nodal\_list, 38  
bcast\_solver\_parameters, 39  
block\_size, 17  
build\_diag, 39  
build\_dirich\_aug, 40  
build\_interf\_matrix\_structure , 40  
build\_interface, 41  
build\_matrix\_structure, 41  
build\_node\_eq, 42  
build\_rev\_geometry, 42  
build\_rev\_nodid, 43  
build\_sparse\_sym\_struct, 43  
build\_sparse\_unsym\_struct, 44  
build\_topology, 44  
calpd, 45  
cmk\_number, 45  
condens\_1, 45  
condens\_2, 46  
condens\_3, 47  
copy\_block, 47  
direct\_symmetric, 17  
direct\_unsymmetric, 17  
dirichlet\_bc, 48  
distribute\_model, 48  
echo\_facet, 49  
echo\_mesh, 49  
echo\_mesh\_femview, 49  
echo\_model, 50  
echo\_nodal\_list, 50  
equation\_setup, 51  
extent\_i1, 51  
extent\_r2, 52  
extract\_submesh, 52  
facet\_rhs, 53  
facet\_struct, 18  
factorize\_numeric, 53  
factorize\_symbolic, 54  
factorized\_matrix\_struct, 18  
feti\_abort, 54  
feti\_data, 19  
feti\_finalize, 55  
feti\_init, 55  
feti\_param, 20  
fill\_sym\_sparse, 56  
fill\_unsym\_sparse, 56  
frontal\_num, 57  
full\_blo, 58  
full\_fwbw, 58  
full\_ldlt, 59  
full\_ldlt\_b, 59  
full\_ldu, 59  
full\_ldu\_b, 60  
full\_schur\_b, 57  
full\_schur\_b\_sparse, 60  
full\_sto, 61  
full\_unsto, 61  
galerkin\_error, 62  
galerkin\_meshsize, 62  
galerkin\_tau, 63  
gather\_nodid, 63  
gather\_sol, 64  
global\_eq\_mask, 64  
global\_solution, 65  
globaldotproduct, 65  
globalsum, 66  
globalsumc, 66  
globalsumi, 67  
half\_blo, 68  
half\_fwbw, 68  
half\_mm\_b, 69  
half\_schur\_b, 67  
half\_schur\_b\_sparse, 69  
half\_sto, 70  
half\_unsto, 70  
ilu\_0, 70  
ilu\_preconditioner, 71  
imprim, 71  
imprim2, 72  
init\_model, 72  
initialize, 73

---

inivec, 73  
input\_data, 74  
interf\_descriptor\_struct, 20  
interf\_full\_sym\_struct, 74  
interf\_full\_unsym\_struct, 75  
interf\_mesh\_struct, 22  
interf\_sparse\_sym\_struct, 75  
interf\_sparse\_unsym\_struct, 76  
interface\_assemb, 76  
interface\_average, 77  
interface\_equation, 77  
interface\_exchange, 78  
interface\_init, 78  
interface\_jump, 78  
interface\_jump2, 79  
interface\_mesh\_equation, 80  
interface\_mesh\_geometry, 80  
interface\_mesh\_topology, 81  
interface\_node, 81  
interface\_signe, 82  
invD\_times\_U, 82  
invL\_times\_sparsU, 83  
invL\_times\_U, 83  
invUt\_times\_sparsU, 83  
jacobi\_convergence, 84  
jacobi\_optimized, 85  
L\_times\_invD , 85  
L\_times\_invU, 86  
LdLt\_tri\_block\_numeric, 86  
LdLt\_tri\_block\_symbolic, 86  
Ldlt\_tri\_dirich, 87  
LdU\_tri\_block\_numeric, 87  
LdU\_tri\_block\_symbolic, 88  
LdU\_tri\_dirich, 88  
load\_curve\_struct, 22  
mask\_to\_list, 89  
merge\_nodal\_list, 89  
mesh\_feti\_struct, 23  
mesh\_struct, 23  
model, 24  
mpif, 25  
mtxv, 90  
mtxv\_par, 90  
mxvadd, 91  
nodal\_list\_equation, 91  
nodal\_list\_struct, 25  
opti\_number, 92  
outfil, 26  
output\_results, 92  
point\_front, 93  
post\_process, 93  
print\_vector, 94  
proband, 94  
probit, 95  
problem\_form , 95  
problo, 96  
problot, 96  
pt\_extract, 97  
read\_mesh, 97  
realloc, 26  
realloc\_c1, 98  
realloc\_c2, 98  
realloc\_i1, 99  
realloc\_i2, 99  
realloc\_r1, 100  
realloc\_r2, 100  
region\_property\_struct, 27  
ren\_sym\_sparse, 100  
ren\_unsym\_sparse, 101  
renum\_eq\_mpc, 101  
renum\_facet, 102  
renum\_nodal\_list, 102  
solve\_rhs, 103  
solver\_param, 27  
son\_3d, 103  
sort\_list, 104  
sparse\_fwbw, 104  
sparse\_matrix\_equalization, 105  
sparse\_matrix\_equalization2, 105  
sparse\_matrix\_struct, 28  
sparse\_prod, 106  
split\_mesh, 106  
stoprun, 107  
sym\_approx\_schur\_cpmt, 107  
sym\_build\_schur\_cpmt, 108  
sym\_condens, 108  
sym\_direct\_solve, 109  
sym\_extract, 110  
sym\_fill\_tridiag\_sparse, 110  
sym\_fwbw\_tri\_dirichlet, 111  
sym\_multi\_level1\_feti, 111  
sym\_multi\_level2\_feti, 112  
sym\_proax, 113  
sym\_renumb\_matrix\_bc, 114  
sym\_tridiag\_struct, 114  
symfwbw\_tri\_dirichlet, 115  
symunsym\_sparse\_mask, 115  
un\_condens, 116  
un\_extract, 116  
unsym\_approx\_schur\_cpmt, 117  
unsym\_build\_schur\_cpmt, 118  
unsym\_direct\_solve, 118  
unsym\_fill\_tridiag\_sparse, 119  
unsym\_fwbw\_tri\_dirichlet, 119

unsym\_multi\_level1\_feti, 120  
 unsym\_multi\_level2\_feti, 120  
 unsym\_proax, 121  
 unsym\_renumb\_matrix\_bc, 122  
 unsym\_tridiag\_struct, 122  
 unsymfwbw\_tri\_dirichlet, 123  
 unsymunsym\_sparse\_mask, 123  
 update\_facet, 124  
 Update\_Nodal\_List, 124  
 update\_region, 125  
 write\_field, 125  
 write\_field\_femview, 126  
 write\_matrix, 126  
 write\_meshfield\_femvtk, 127  
 zorthodir\_solver, 127  
 zorthodir\_solver\_par, 128

## Files

add\_interf\_matrix.f90  
   add\_interf\_matrix, 29  
 add\_interf\_matrix\_struct.f90  
   add\_interf\_matrix\_structure, 29  
 add\_sparse\_sym\_matrix.f90  
   add\_sparse\_sym\_matrix, 30  
 add\_sparse\_sym\_struct.f90  
   add\_sparse\_sym\_struct, 30  
 add\_sparse\_unsym\_matrix.f90  
   add\_sparse\_unsym\_matrix, 31  
 add\_sparse\_unsym\_struct.f90  
   add\_sparse\_unsym\_struct, 31  
 assemble\_bc.f90  
   assemble\_bc, 32  
 assemble\_facet\_bc.f90  
   assemble\_facet\_bc, 32  
 assemble\_impedance.f90  
   assemble\_impedance, 33  
 assemble\_interf\_matrix.f90  
   assemble\_interf\_matrix, 33  
 assemble\_nodal\_bc.f90  
   assemble\_nodal\_bc, 34  
 bcast\_acoustic\_property.f90  
   bcast\_acoustic\_property, 35  
 bcast\_admittance\_property.f90  
   bcast\_admittance\_property, 35  
 bcast\_facet.f90  
   bcast\_facet, 36  
 bcast\_infinite\_property.f90  
   bcast\_infinite\_property, 36  
 bcast\_load\_curve.f90  
   bcast\_load\_curve, 37  
 bcast\_model\_attribute.f90  
   bcast\_model\_attribute, 37

bcast\_model\_parameters.f90  
   bcast\_model\_parameters, 38  
 bcast\_nodal\_list.f90  
   bcast\_nodal\_list, 38  
 bcast\_solver\_parameters.f90  
   bcast\_solver\_parameters, 39  
 block\_size.f90  
   block\_size, 17  
 build\_diag.f90  
   build\_diag, 39  
 build\_dirich\_aug.f90  
   build\_dirich\_aug, 40  
 build\_interf\_matrix\_struct.f90  
   build\_interf\_matrix\_structure, 40  
 build\_interface.f90  
   build\_interface, 41  
 build\_matrix\_struct.f90  
   build\_matrix\_structure, 41  
 build\_node\_eq.f90  
   build\_node\_eq, 42  
 build\_rev\_geometry.f90  
   build\_rev\_geometry, 42  
 build\_rev\_nodid.f90  
   build\_rev\_nodid, 43  
 build\_sparse\_sym\_struct.f90  
   build\_sparse\_sym\_struct, 43  
 build\_sparse\_unsym\_struct.f90  
   build\_sparse\_unsym\_struct, 44  
 build\_topology.f90  
   build\_topology, 44  
 calpd.f90  
   calpd, 45  
 cmk\_number.f90  
   cmk\_number, 45  
 condens.1.f90  
   condens.1, 45  
 condens.2.f90  
   condens.2, 46  
 condens.3.f90  
   condens.3, 47  
 copy\_block.f90  
   copy\_block, 47  
 direct\_symmetric.f90  
   direct\_symmetric, 17  
 direct\_unsymmetric.f90  
   direct\_unsymmetric, 17  
 dirichlet\_bc.f90  
   dirichlet\_bc, 48  
 distribute\_model.f90  
   distribute\_model, 48  
 echo\_facet.f90  
   echo\_facet, 49

---

echo\_mesh.f90  
   echo\_mesh, 49  
 echo\_mesh\_femview.f90  
   echo\_mesh\_femview, 49  
 echo\_model.f90  
   echo\_model, 50  
 echo\_nodal\_list.f90  
   echo\_nodal\_list, 50  
 equation\_setup.f90  
   equation\_setup, 51  
 extent\_i1.f90  
   extent\_i1, 51  
 extent\_r2.f90  
   extent\_r2, 52  
 extract\_submesh.f90  
   extract\_submesh, 52  
 facet\_rhs.f90  
   facet\_rhs, 53  
 facet\_struct.f90  
   facet\_struct, 18  
 factorize\_numeric.f90  
   factorize\_numeric, 53  
 factorize\_symbolic.f90  
   factorize\_symbolic, 54  
 factorized\_matrix\_struct.f90  
   factorized\_matrix\_struct, 18  
 feti\_abort.f90  
   feti\_abort, 54  
 feti\_data.f90  
   feti\_data, 19  
 feti\_finalize.f90  
   feti\_finalize, 55  
 feti\_init.f90  
   feti\_init, 55  
 feti\_param.f90  
   feti\_param, 20  
 fill\_sym\_sparse.f90  
   fill\_sym\_sparse, 56  
 fill\_unsym\_sparse.f90  
   fill\_unsym\_sparse, 56  
 frontal\_num\_b.f90  
   frontal\_num\_b, 57  
 full\_blo.f90  
   full\_blo, 58  
 full\_fwbw.f90  
   full\_fwbw, 58  
 full\_ldt.f90  
   full\_ldt, 59  
 full\_ldt\_b.f90  
   full\_ldt\_b, 59  
 full\_ldu.f90  
   full\_ldu, 59  
   full\_ldu\_b, 60  
   full\_schur\_b.f90  
     full\_schur\_b, 57  
   full\_schur\_b\_sparse.f90  
     full\_schur\_b\_sparse, 60  
 full\_sto.f90  
   full\_sto, 61  
 full\_unsto.f90  
   full\_unsto, 61  
 galerkin\_error.f90  
   galerkin\_error, 62  
 galerkin\_meshsize.f90  
   galerkin\_meshsize, 62  
 galerkin\_tau.f90  
   galerkin\_tau, 63  
 gather\_nodid.f90  
   gather\_nodid, 63  
 gather\_sol.f90  
   gather\_sol, 64  
 global\_eq\_mask.f90  
   global\_eq\_mask, 64  
 global\_solution.f90  
   global\_solution, 65  
 globaldotproduct.f90  
   globaldotproduct, 65  
 globalsum.f90  
   globalsum, 66  
 globalsumc.f90  
   globalsumc, 66  
 globalsumi.f90  
   globalsumi, 67  
 half\_blo.f90  
   half\_blo, 68  
 half\_fwbw.f90  
   half\_fwbw, 68  
 half\_mm\_b.f90  
   half\_mm\_b, 69  
 half\_Schur\_b.f90  
   half\_schur\_b, 67  
 half\_schur\_b\_sparse.f90  
   half\_schur\_b\_sparse, 69  
 half\_sto.f90  
   half\_sto, 70  
 half\_unsto.f90  
   half\_unsto, 70  
 ilu\_0.f90  
   ilu\_0, 70  
 ilu\_preconditioner.f90  
   ilu\_preconditioner, 71  
 imprim.f90  
   imprim, 71

---

imprim2.f90  
   imprim2, 72  
 init\_model.f90  
   init\_model, 72  
 initialize.f90  
   initialize, 73  
 inivec.f90  
   inivec, 73  
 input\_data.f90  
   input\_data, 74  
 interf\_descriptor\_struct.f90  
   interf\_descriptor\_struct, 20  
 interf\_full\_sym\_struct.f90  
   interf\_full\_sym\_struct, 74  
 interf\_full\_unsym\_struct.f90  
   interf\_full\_unsym\_struct, 75  
 interf\_mesh\_struct.f90  
   interf\_mesh\_struct, 22  
 interf\_sparse\_sym\_struct.f90  
   interf\_sparse\_sym\_struct, 75  
 interf\_sparse\_unsym\_struct.f90  
   interf\_sparse\_unsym\_struct, 76  
 interface\_assemb.f90  
   interface\_assemb, 76  
 interface\_average.f90  
   interface\_average, 77  
 interface\_equation.f90  
   interface\_equation, 77  
 interface\_exchange.f90  
   interface\_exchange, 78  
 interface\_init.f90  
   interface\_init, 78  
 interface\_jump.f90  
   interface\_jump, 78  
 interface\_jump2.f90  
   interface\_jump2, 79  
 interface\_mesh\_equation.f90  
   interface\_mesh\_equation, 80  
 interface\_mesh\_geometry.f90  
   interface\_mesh\_geometry, 80  
 interface\_mesh\_topology.f90  
   interface\_mesh\_topology, 81  
 interface\_node.f90  
   interface\_node, 81  
 interface\_signe.f90  
   interface\_signe, 82  
 invD\_times\_U.f90  
   invD\_times\_U, 82  
 invl\_times\_sparsu.f90  
   invL\_times\_sparsU, 83  
 invL\_times\_U.f90  
   invL\_times\_U, 83  
 invut\_times\_sparsu.f90  
   invUt\_times\_sparsU, 83  
 jacobi\_convergence.f90  
   jacobi\_convergence, 84  
 jacobi\_optimized.f90  
   jacobi\_optimized, 85  
 l\_times\_invD.f90  
   L\_times\_invD, 85  
 l\_times\_invU.f90  
   L\_times\_invU, 86  
 ldlt\_tri\_block\_numeric.f90  
   LdLt\_tri\_block\_numeric, 86  
 ldlt\_tri\_block\_symbolic.f90  
   LdLt\_tri\_block\_symbolic, 86  
 ldlt\_tri\_dirich.f90  
   Ldlt\_tri\_dirich, 87  
 ldu\_tri\_block\_numeric.f90  
   LdU\_tri\_block\_numeric, 87  
 ldu\_tri\_block\_symbolic.f90  
   LdU\_tri\_block\_symbolic, 88  
 ldu\_tri\_dirich.f90  
   LdU\_tri\_dirich, 88  
 load\_curve\_struct.f90  
   load\_curve\_struct, 22  
 mask\_to\_list.f90  
   mask\_to\_list, 89  
 merge\_nodal\_list.f90  
   merge\_nodal\_list, 89  
 mesh\_feti\_struct.f90  
   mesh\_feti\_struct, 23  
 mesh\_struct.f90  
   mesh\_struct, 23  
 model.f90  
   model, 24  
 mpif.f90  
   mpif, 25  
 mtvx.f90  
   mtvx, 90  
 mtvx\_par.f90  
   mtvx\_par, 90  
 mxvadd.f90  
   mxvadd, 91  
 nodal\_list\_equation.f90  
   nodal\_list\_equation, 91  
 nodal\_list\_struct.f90  
   nodal\_list\_struct, 25  
 opti\_number.f90  
   opti\_number, 92  
 outfil.f90  
   outfil, 26  
 output\_results.f90  
   output\_results, 92

---

point\_front.f90  
   point\_front, 93  
 post\_process.f90  
   post\_process, 93  
 print\_vector.f90  
   print\_vector, 94  
 proband.f90  
   proband, 94  
 probit.f90  
   probit, 95  
 problem\_form.f90  
   problem\_form , 95  
 problo.f90  
   problo, 96  
 problot.f90  
   problot, 96  
 pt\_extract.f90  
   pt\_extract, 97  
 read\_mesh.f90  
   read\_mesh, 97  
 realloc.f90  
   realloc, 26  
 realloc\_c1.f90  
   realloc\_c1, 98  
 realloc\_c2.f90  
   realloc\_c2, 98  
 realloc\_i1.f90  
   realloc\_i1, 99  
 realloc\_i2.f90  
   realloc\_i2, 99  
 realloc\_r1.f90  
   realloc\_r1, 100  
 realloc\_r2.f90  
   realloc\_r2, 100  
 region\_property\_struct.f90  
   region\_property\_struct, 27  
 ren\_sym\_sparse.f90  
   ren\_sym\_sparse, 100  
 ren\_unsym\_sparse.f90  
   ren\_unsym\_sparse, 101  
 renum\_eq\_mpc.f90  
   renum\_eq\_mpc, 101  
 renum\_facet.f90  
   renum\_facet, 102  
 renum\_nodal\_list.f90  
   renum\_nodal\_list, 102  
 solve\_rhs.f90  
   solve\_rhs, 103  
 solver\_param.f90  
   solver\_param, 27  
 son\_3D.f90  
   son\_3d, 103  
 sort\_list.f90  
   sort\_list, 104  
 sparse\_fwbw.f90  
   sparse\_fwbw, 104  
 sparse\_matrix\_equalization.f90  
   sparse\_matrix\_equalization, 105  
 sparse\_matrix\_equalization2.f90  
   sparse\_matrix\_equalization2, 105  
 sparse\_matrix\_struct.f90  
   sparse\_matrix\_struct, 28  
 sparse\_prod.f90  
   sparse\_prod, 106  
 split\_mesh.f90  
   split\_mesh, 106  
 stoprun.f90  
   stoprun, 107  
 sym\_approx\_schur\_cpmt.f90  
   sym\_approx\_schur\_cpmt, 107  
 sym\_build\_schur\_cpmt.f90  
   sym\_build\_schur\_cpmt, 108  
 sym\_condens.f90  
   sym\_condens, 108  
 sym\_direct\_solve.f90  
   sym\_direct\_solve, 109  
 sym\_extract.f90  
   sym\_extract, 110  
 sym\_fill\_tridiag\_sparse.f90  
   sym\_fill\_tridiag\_sparse, 110  
 sym\_fwbw\_tri\_dirichlet.f90  
   sym\_fwbw\_tri\_dirichlet, 111  
 sym\_multi\_level1\_feti.f90  
   sym\_multi\_level1\_feti, 111  
 sym\_multi\_level2\_feti.f90  
   sym\_multi\_level2\_feti, 112  
 sym\_proax.f90  
   sym\_proax, 113  
 sym\_renumb\_matrix\_bc.f90  
   sym\_renumb\_matrix\_bc, 114  
 sym\_tridiag\_struct.f90  
   sym\_tridiag\_struct, 114  
 symfwbw\_tri\_dirichlet.f90  
   symfwbw\_tri\_dirichlet, 115  
 symunsym\_sparse\_mask.f90  
   symunsym\_sparse\_mask, 115  
 un\_condens.f90  
   un\_condens, 116  
 un\_extract.f90  
   un\_extract, 116  
 unsym\_approx\_schur\_cpmt.f90  
   unsym\_approx\_schur\_cpmt, 117  
 unsym\_build\_schur\_cpmt.f90  
   unsym\_build\_schur\_cpmt, 118

unsym\_direct\_solve.f90  
   unsym\_direct\_solve, 118  
 unsym\_fill\_tridiag\_sparse.f90  
   unsym\_fill\_tridiag\_sparse, 119  
 unsym\_fwbw\_tri\_dirichlet.f90  
   unsym\_fwbw\_tri\_dirichlet, 119  
 unsym\_multi\_level1\_feti.f90  
   unsym\_multi\_level1\_feti, 120  
 unsym\_multi\_level2\_feti.f90  
   unsym\_multi\_level2\_feti, 120  
 unsym\_proax.f90  
   unsym\_proax, 121  
 unsym\_renumb\_matrix\_bc.f90  
   unsym\_renumb\_matrix\_bc, 122  
 unsym\_tridiag\_struct.f90  
   unsym\_tridiag\_struct, 122  
 unsymfwbw\_tri\_dirichlet.f90  
   unsymfwbw\_tri\_dirichlet, 123  
 unsymunsym\_sparse\_mask.f90  
   unsymunsym\_sparse\_mask, 123  
 update\_facet.f90  
   update\_facet, 124  
 update\_nodal\_list.f90  
   Update\_Nodal\_List, 124  
 update\_region.f90  
   update\_region, 125  
 write\_field.f90  
   write\_field, 125  
 write\_field\_femview.f90  
   write\_field\_femview, 126  
 write\_matrix.f90  
   write\_matrix, 126  
 write\_meshfield\_femvtk.f90  
   write\_meshfield\_femvtk, 127  
 zorthodir\_solver.f90  
   zorthodir\_solver, 127  
 zorthodir\_solver\_par.f90  
   zorthodir\_solver\_par, 128

Sorted

Functions

add\_interf\_matrix, 29  
 add\_interf\_matrix\_structure, 29  
 add\_sparse\_sym\_matrix, 30  
 add\_sparse\_sym\_struct, 30  
 add\_sparse\_unsym\_matrix, 31  
 add\_sparse\_unsym\_struct, 31  
 assemble\_bc, 32  
 assemble\_facet\_bc, 32  
 assemble\_impedance, 33  
 assemble\_interf\_matrix, 33  
 assemble\_nodal\_bc, 34  
 bcast\_acoustic\_property, 35  
 bcast\_admittance\_property, 35  
 bcast\_facet, 36  
 bcast\_infinite\_property, 36  
 bcast\_load\_curve, 37  
 bcast\_model\_attribute, 37  
 bcast\_model\_parameters, 38  
 bcast\_nodal\_list, 38  
 bcast\_solver\_parameters, 39  
 build\_diag, 39  
 build\_dirich\_aug, 40  
 build\_interf\_matrix\_structure, 40  
 build\_interface, 41  
 build\_matrix\_structure, 41  
 build\_node\_eq, 42  
 build\_rev\_geometry, 42  
 build\_rev\_nodid, 43  
 build\_sparse\_sym\_struct, 43  
 build\_sparse\_unsym\_struct, 44  
 build\_topology, 44  
 calpd, 45  
 cmk\_number, 45  
 condens\_1, 45  
 condens\_2, 46  
 condens\_3, 47  
 copy\_block, 47  
 dirichlet\_bc, 48  
 distribute\_model, 48  
 echo\_facet, 49  
 echo\_mesh, 49  
 echo\_mesh\_femview, 49  
 echo\_model, 50  
 echo\_nodal\_list, 50  
 equation\_setup, 51  
 extent\_i1, 51  
 extent\_r2, 52  
 extract\_submesh, 52  
 facet\_rhs, 53  
 factorize\_numeric, 53  
 factorize\_symbolic, 54  
 feti\_abort, 54  
 feti\_finalize, 55  
 feti\_init, 55  
 fill\_sym\_sparse, 56  
 fill\_unsym\_sparse, 56  
 frontal\_num, 57  
 full\_blo, 58  
 full\_fwbw, 58  
 full\_dlt, 59  
 full\_dlt\_b, 59  
 full\_du, 59  
 full\_du\_b, 60

---

full\_schur\_b, 57  
 full\_schur\_b\_sparse, 60  
 full\_sto, 61  
 full\_unsto, 61  
 galerkin\_error, 62  
 galerkin\_meshsize, 62  
 galerkin\_tau, 63  
 gather\_nodid, 63  
 gather\_sol, 64  
 global\_eq\_mask, 64  
 global\_solution, 65  
 globaldotproduct, 65  
 globalsum, 66  
 globalsumc, 66  
 globalsumi, 67  
 half\_blo, 68  
 half\_fwbw, 68  
 half\_mm\_b, 69  
 half\_schur\_b, 67  
 half\_schur\_b\_sparse, 69  
 half\_sto, 70  
 half\_unsto, 70  
 ilu\_0, 70  
 ilu\_preconditioner, 71  
 imprim, 71  
 imprim2, 72  
 init\_model, 72  
 initialize, 73  
 inivec, 73  
 input\_data, 74  
 interf\_full\_sym\_struct, 74  
 interf\_full\_unsym\_struct, 75  
 interf\_sparse\_sym\_struct, 75  
 interf\_sparse\_unsym\_struct, 76  
 interface\_assemb, 76  
 interface\_average, 77  
 interface\_equation, 77  
 interface\_exchange, 78  
 interface\_init, 78  
 interface\_jump, 78  
 interface\_jump2, 79  
 interface\_mesh\_equation, 80  
 interface\_mesh\_geometry, 80  
 interface\_mesh\_topology, 81  
 interface\_node, 81  
 interface\_signe, 82  
 invD\_times\_U, 82  
 invL\_times\_sparsU, 83  
 invL\_times\_U, 83  
 invUt\_times\_sparsU, 83  
 jacobi\_convergence, 84  
 jacobi\_optimized, 85  
 L\_times\_invD, 85  
 L\_times\_invU, 86  
 LdLt\_tri\_block\_numeric, 86  
 LdLt\_tri\_block\_symbolic, 86  
 Ldlt\_tri\_dirich, 87  
 LdU\_tri\_block\_numeric, 87  
 LdU\_tri\_block\_symbolic, 88  
 LdU\_tri\_dirich, 88  
 mask\_to\_list, 89  
 merge\_nodal\_list, 89  
 mtxv, 90  
 mtxv\_par, 90  
 mxvadd, 91  
 nodal\_list\_equation, 91  
 opti\_number, 92  
 output\_results, 92  
 point\_front, 93  
 post\_process, 93  
 print\_vector, 94  
 proband, 94  
 probit, 95  
 problem\_form, 95  
 problo, 96  
 problot, 96  
 pt\_extract, 97  
 read\_mesh, 97  
 realloc\_c1, 98  
 realloc\_c2, 98  
 realloc\_i1, 99  
 realloc\_i2, 99  
 realloc\_r1, 100  
 realloc\_r2, 100  
 ren\_sym\_sparse, 100  
 ren\_unsym\_sparse, 101  
 renum\_eq\_mpc, 101  
 renum\_facet, 102  
 renum\_nodal\_list, 102  
 solve\_rhs, 103  
 son\_3d, 103  
 sort\_list, 104  
 sparse\_fwbw, 104  
 sparse\_matrix\_equalization, 105  
 sparse\_matrix\_equalization2, 105  
 sparse\_prod, 106  
 split\_mesh, 106  
 stoprun, 107  
 sym\_approx\_schur\_cpmt, 107  
 sym\_build\_schur\_cpmt, 108  
 sym\_condens, 108  
 sym\_direct\_solve, 109  
 sym\_extract, 110  
 sym\_fill\_tridiag\_sparse, 110



---

sym\_fwbw\_tri\_dirichlet, 111  
sym\_multi\_level1\_feti, 111  
sym\_multi\_level2\_feti, 112  
sym\_proax, 113  
sym\_renumb\_matrix\_bc, 114  
sym\_tridiag\_struct, 114  
symfwbw\_tri\_dirichlet, 115  
symunsym\_sparse\_mask, 115  
un\_condens, 116  
un\_extract, 116  
unsym\_approx\_schur\_cpmt, 117  
unsym\_build\_schur\_cpmt, 118  
unsym\_direct\_solve, 118  
unsym\_fill\_tridiag\_sparse, 119  
unsym\_fwbw\_tri\_dirichlet, 119  
unsym\_multi\_level1\_feti, 120  
unsym\_multi\_level2\_feti, 120  
unsym\_proax, 121  
unsym\_renumb\_matrix\_bc, 122  
unsym\_tridiag\_struct, 122  
unsymfwbw\_tri\_dirichlet, 123  
unsymunsym\_sparse\_mask, 123  
update\_facet, 124  
Update\_Nodal\_List, 124  
update\_region, 125  
write\_field, 125  
write\_field\_femview, 126  
write\_matrix, 126  
write\_meshfield\_femvtk, 127  
zorthodir\_solver, 127  
zorthodir\_solver\_par, 128

Modules

block\_size, 17  
direct\_symmetric, 17  
direct\_unsymmetric, 17  
facet\_struct, 18  
factorized\_matrix\_struct, 18  
feti\_data, 19  
feti\_param, 20  
interf\_descriptor\_struct, 20  
interf\_mesh\_struct, 22  
load\_curve\_struct, 22  
mesh\_feti\_struct, 23  
mesh\_struct, 23  
model, 24  
mpif, 25  
nodal\_list\_struct, 25  
outfil, 26  
realloc, 26  
region\_property\_struct, 27  
solver\_param, 27  
sparse\_matrix\_struct, 28

## 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

**type** – 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 `outfil`  
 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 `outfil`  
 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\_interf\_matrix**

## NAME

*assemble\_interf\_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 continuous 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 outfil

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,num_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

Re-number 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,numb_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\_num** – 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,pro1,pro2,lmorse,ncol,a,lda, &
&                        dim2,blo)

```

DESCRIPTION

Extract block associated to rows *i1* to *i2* and delimited by pointers *pro1* et *pro2* from sparse matrix stored by row.

ARGUMENTS

**n** – integer  
**i1** – integer  
**i2** – integer  
**j0** – integer  
**pro1** – integer array  
**pro2** – 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,pro1,pro2,lmorse,ncol,a,lda, &
& dim2,blo)
```

DESCRIPTION

Extract block associated to rows  $i1$  to  $i2$  and delimited by pointers  $pro1$  et  $pro2$  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_unsymmetric
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,dm,field)

```

## DESCRIPTION

Print field entries node by node

## ARGUMENTS

**file\_num** – integer  
**dm** – mesh structure  
**field** – complex array

## MODULES

```
USE outfil
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 outfil
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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