```
main_init
  |  parallel_init ---> no changes
  |  random_init ---> no changes
  |  parallel_get_inputname(input_name) ---> no changes
  |  parser_init ---> no changes
  |  parser_parsefile(input_namei) ---> no changes
  |  geometry_init
  |    |  parallel_init_filesystem ---> no changes
  |    |  config_get_schemes(nover) ---> no changes (width differential scheme)
  |    |  geometry_read_config(iunit) ---> no changes (set extremes)
  |    |  masks_init(iunit)---> no changes (Need do be reviewed)
  |    |  geometry_notations
  |    |  parallel_init_topology(xper,yper,zper)
  |    |  partition_init
  |    |    |  memory_init
  |    |  structure_init---> no changes (Need do be reviewed)
  |    |  borders_init
  |    |    |  borders_inlet
  |    |    |  borders_outlet
  |  data_init
  |    |  data_read
  |  optdata_init
  |    |  optdata_read
  |  simulation_init
  |    |  monitor_pre_init
  |    |    |  timing_pre_init
  |    |    |  probe_init
  |    |    |  monitor_conservation_init
  |    |    |  case specific init
  |    |  time_info_init
  |    |  boundary_init
  |    |  metric_generic_init
  |    |  metric_velocity_conv_init
  |    |  metric_velocity_visc_init
  |    |  scalar_init
  |    |    |  boundary_update_border
  |    |    |    |  communication_border
```

| | | | cernterline_update_y
| | | | cernterline_update_ym
| | | boundary_scalar_dirichlet
| | | | inflow_scalar
| | | | inflow_scalar_R
| | | | inflow_scalar_B
| | | boundary_scalar_outflow
| | | | outflow_scalar
| | | | outflow_scalar_L
| | | | outflow_scalar_T
| | | | outflow_scalar_B
| | | boundary_scalar_neumann
| | | | boundary_neumann
| | | scalar_weno3_init (or other schemes) →has preferred direction for BC
| | | monitor
| | combustion_init
| | | *none*
| | | combustion_density
| | | combustion_viscosity
| | | combustion_diffusivity
| | | boundary_update_border
| | | combustion_CHI
| | | | gradient_squared
| | | | | boundary_update_border
| | | | | boundary_neumann
| | | | chemtable_lookup
| | | combustion_ZVAR
| | | | sgsmodel_ZVAR
| | | *finite chem*
| | | finitechem_init
| | | combustion_viscosity
| | | | finitechem_ viscosity
| | | combustion_diffusivity
| | | | finitechem_diffusivity
| | | combustion_CHI
| | | combustion_ZVAR
| | | combustion_density

```
  |   |   |   | finitechem_density
  |   |   | boundary_update_border
  |   |   | combustion_temperature
  |   | spray_init
  |   | pollutants_init
  |   | velocity_init
  |   |   | boundary_update_border
  |   |   | rho_multiply
  |   |   |   | boundary_update_border
  |   |   | boundary_momentum_neumann
  |   |   |   | boundary_neumann
  |   |   | velocity_predict_outlet
  |   |   | implicit_init
  |   |   | monitor_create_file_step
  |   |   | monitor_set_header
  |   | interpolate_init
  |   | interpolate_velocities
  |   |   | boundary_update_border
  |   |   | boundary_neumann
  |   | strainrate_init
  |   | bodyforce_init
  |   | pressure_init
  |   | sgsmodel_init
  |   | dump_init
  |   | stat_init
  |   | inflow_generation_init
  |   | monitor_post_init
  |   | monitor_timestep
simulation_run
  | predict_timestepsize
  | increase time and step
  | combustion_prestep
  |   | combustion_viscosity
  |   | combustion_temperature
  |   | combustion_ZVAR
  |   | combustion_CHI
  | spray_prestep
```

```
| pollutants_prestep
| velocity_CFL_centerline
|   | boundary_update_border
| scalar_prestep
|   | sgsmodel_src_sc
| velocity_prestep
|   | bodyforce_src
|   |   | channel or pipe
|   |   | bodyforce_pipe_channel
|   |   |   | compute_friction
|   |   |   | compute_massflowrate
|   |   | boundary layer
|   |   | bodyforce_boundary_layer
|   |   | bodyforce_gravity
|   | sgsmodel_src_vel
| velocity_predict_density
|   | velocity_compute_divergencevim cf_FA
|   | boundary_density_neumann
|   |   | boundary_neumann
|   | boundary_update_border
| LOOP
| scalar_step
|   | combustion_diffusivity
|   | pollutants_diffusivity
|   | scalar_rho_divide
|   |   | boundary_update_border
|   |strang_splitting
|   | combustion_source_scalar
|   |   | finitechem_pressuredivergence
|   |   |   | finitechem_W
|   |   |   | finitechem_Cp
|   |   |   |   | COMPTHERMODATA
|   |   | gradient_dotproduc
|   |   |   | boundary_update_border
|   |   |   | boundary_neumann
|   |   | finitechem_source_transport
|   |   |   | finitechem_diffusion
```

```
|   |   |   |   | finitechem_W
|   |   |   |   | COMPTHERMODATA
|   |   |   |   | finitechem_Cp
|   | pollutants_source_scalar
|   | spray_source_scalar
|   | scalar_weno3_residual
|   |   | finitechem_mono_rhs
|   |   |   | finitechem_compute_rhs
|   |   |   |   | finitechem_W
|   |   |   |   | finitechem_Cp
|   |   |   |   | PRODRATES
|   |   |   |   | CONSRATES
|   |   | scalar_weno3_coeff
|   | scalar_weno3_inverse
|   |   | finitechem_solve_AF
|   |   |   | finitechem_compute_rhs
|   |   |   |   | finitechem_W
|   |   |   |   | finitechem_Cp
|   |   |   |   | PRODRATES
|   |   |   |   | CONSRATES
|   |   |   |   | COMPCHEMJACOBIAN
|   |   |   |   | DGESV
|   |   | scalar_weno3_coeff
|   |   | implicit_solve_x
|   |   |   | pentadiagonal (case5)
|   |   | implicit_solve_y
|   |   |   | pentadiagonal (case5)
|   |   | implicit_solve_z
|   |   |   | pentadiagonal (case5)
|   | boundary_update_border
|   | combustion_source_scalar_full
|   |   | finitechem_source_chemistry
|   |   |   | FNVINITS
|   |   |   | FCVMALLOC
|   |   |   | FCVREINIT
|   |   |   | FCVSETRIN
|   |   |   | FCVSETIIN
```

```
|   |   |   | FCVDENSE
|   |   |   | FCVODE
|   |   |   | finitechem_Cp
|   |   |   | FCVFREE
|   | boundary_update_border
|   | combustion_diffusivity
|   |else
|   | combustion_source_scalar
|   |   | finitechem_pressuredivergence
|   |   |   | finitechem_W
|   |   |   | finitechem_Cp
|   |   |   |   | COMPTHERMODATA
|   |   | gradient_dotproduc
|   |   |   | boundary_update_border
|   |   |   | boundary_neumann
|   |   | finitechem_source_transport
|   |   |   | finitechem_diffusion
|   |   |   |   | finitechem_W
|   |   |   |   | COMPTHERMODATA
|   |   |   |   | finitechem_Cp
|   | pollutants_source_scalar
|   | spray_source_scalar
|   | scalar_weno3_residual
|   |   | finitechem_mono_rhs
|   |   |   | finitechem_compute_rhs
|   |   |   |   | finitechem_W
|   |   |   |   | finitechem_Cp
|   |   |   |   | PRODRATES
|   |   |   |   | CONSRATES
|   |   | scalar_weno3_coeff
|   | scalar_weno3_inverse
|   |   | finitechem_solve_AF
|   |   |   | finitechem_compute_rhs
|   |   |   |   | finitechem_W
|   |   |   |   | finitechem_Cp
|   |   |   |   | PRODRATES
|   |   |   |   | CONSRATES
```

```
|   |   |   |   | COMPCHEMJACOBIAN
|   |   |   |   | DGESV
|   |   | scalar_weno3_coeff
|   |   | implicit_solve_x
|   |   |   | pentadiagonal (case5)
|   |   | implicit_solve_y
|   |   |   | pentadiagonal (case5)
|   |   | implicit_solve_z
|   |   |   | pentadiagonal (case5)
|   | combustion_source_scalar_full
|   |   | finitechem_source_chemistry
|   |   |   | FNVINITS
|   |   |   | FCVMALLOC
|   |   |   | FCVREINIT
|   |   |   | FCVSETRIN
|   |   |   | FCVSETIIN
|   |   |   | FCVDENSE
|   |   |   | FCVODE
|   |   |   | finitechem_Cp
|   |   |   | FCVFREE
|   |   | boundary_scalar_dirichlet
|   |   |   | inflow_scalar
|   |   |   | inflow_scalar_R
|   |   |   | inflow_scalar_B
|   |   | boundary_scalar_neumann
|   |   |   | boundary_neumann
|   |   | boundary_scalar_outflow
|   |   |   | outflow_scalar
|   |   |   | outflow_scalar_L
|   |   |   | outflow_scalar_T
|   |   |   | outflow_scalar_B
|   | boundary_update_border
|   | combustion_diffusivity
| combustion_step
|   | combustion_invert_density
|   |   | finitechem_density
|   | combustion_rescale_density
```

```
|   |   | combustion_mean_density
|   | filter_global_3D (n)
|   | boundary_update_border
|   |   |   | boundary_neumann
|   | combustion_sum_drho
|   |   | parallel_sum
|   | combustion_temperature
|   | finitechem_HR
|   |   | COMPTHERMODATA
|   | parallel_max
|   | monitor_select_file
|   | monitor_set_single_value
|   | monitor_set_single_value
| sgsmodel_eddyVISC
| velocity_step
|   | velocity_residuals_u
|   | velocity_inverse_u
|   |   | implicit_solve_x
|   |   | implicit_solve_y
|   |   | implicit_solve_z
|   | velocity_residuals_v
|   | velocity_inverse_v
|   |   | implicit_solve_x
|   |   | implicit_solve_y
|   |   | implicit_solve_z
|   | velocity_residuals_w
|   | velocity_inverse_w
|   |   | implicit_solve_x
|   |   | implicit_solve_y
|   |   | implicit_solve_z
|   | parallel_max
|   | parallel_max
|   | parallel_max
|   | boundary_velocity_dirichlet
|   |   | inflow_velocity
|   |   | inflow_velocity_R
|   |   | inflow_velocity_B
```

```
|   |   | boundary_dirichlet
|   | boundary_velocity_neumann
|   |   | boundary_neumann
|   | boundary_velocity_outflow
|   |   | outflow_velocity
|   |   | outflow_velocity_L
|   |   | outflow_velocity_T
|   |   | outflow_velocity_B
|   | boundary_update_border
|   | boundary_update_border
|   | boundary_update_border
|   | rho_multiply
|   |   | boundary_update_border
|   | boundary_momentum_neumann
|   |   | boundary_neumann
|   | monitor_select_file
|   | monitor_set_single_value
|   | monitor_set_single_value
|   | monitor_set_single_value
| velocity_pressure
|   | boundary_velocity_massflux
|   |   | boundary_massflux
|   |   |   | parallel_su
|   |   | boundary_masschange
|   |   | boundary_massadded
|   |   |   | parallel_sum
|   |   | outflow_correction
|   |   | outflow_correction_L
|   |   | outflow_correction_T
|   |   | outflow_correction_B
|   | velocity_compute_divergence
|   | pressure_step
|   |   | parallel_sum
|   |   | pressure_RHS
|   |   |   | fourier_rhs
|   |   |   |   | dfftw_execute_r2r
|   |   |   | hypre_rhs_transfer
```

```
  |   |   |   | hypre_amg_rhs_transfer
  |   |   | pressure_SOLVE
  |   |   |   | hypre_solve
  |   |   |   | hypre_sol_transfer
  |   |   |   | hypre_amg_solve
  |   |   |   | hypre_amg_sol_transfer
  |   |   |   | bicgstab_solve
  |   |   |   | fourier_dp
  |   |   |   |   | dfftw_execute_r2r
  |   |   | pressure_DP_BC
  |   |   |   | parallel_sum
  |   |   | boundary_update_border
  |   | velocity_apply_pressure
  |   | boundary_update_border
  |   | rho_divide
  |   |   | boundary_neumann
  | monitor_iteration
  | END LOOP
  | monitor_timestep
  | interpolate_velocities
  |   | boundary_update_border
  |   | boundary_neumann
  | simulation_write(.false.)
  |   | data_write
  |   |   | data_write_full3D
  |   | optdata_write
  |   |   | optdata_write_full3D
  | dump_result
  | dump_statistics
  | inflow_generation_save
main_stop
  | simulation_finalize
  | parallel_final
```