1 Top Level Initial Functions

In simple.py, calling solve_direct
In `generic.py` solve_direct
calling solve_evolutionary_op from solve_direct
in solve_evolutionary_op

$$state0 = \left[\begin{array}{ccccc} 0 & 0 & 0 & 0 & 0 \ \ldots \\ 0 & 0 & 0 & 0 & 0 \end{array} \right] \tag{1}$$
$$\tag{2}$$

in solve_evolutionary_op, before for loop, calling the __call__ method of time_solver
In SimpleTimeSteppingSolver.__call__ in `sfepy/solvers/ts.py`
before the **for** loop of SimpleTimeSteppingSolver.__call__

$$self.ts = \begin{bmatrix} 0 & 0 \\ 1 & 0.5 \\ 2 & 1 \end{bmatrix} \tag{3}$$

2 Pass 1 of the for loop of SimpleTimeSteppingSolver.__call__

$$step = 0 \tag{4}$$

$$time = 0 \tag{5}$$

calling step_fun from SimpleTimeSteppingSolver.__call__
in time_step_function

$$ts.time = 0 \tag{6}$$

$$ts.step = 0 \tag{7}$$

time_update, calling update_materials
in traction_load of `axial_rod_sfepy.py`

$$nt = 0 \tag{8}$$

time_update, after update_materials

2.0.1 In the ts.step == 0 case

ts.step = 0
in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{9}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 1 \end{bmatrix} \tag{10}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'traction' : Material : traction, 'ts' : TimeStepper, 'v' : Variable : v \tag{11}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 1 \\ 1 \\ 12 \\ 1 \end{bmatrix} \tag{12}$$

$$state = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{13}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{14}$$

$$state.shape = \begin{bmatrix} 36 \end{bmatrix} \tag{15}$$

2.1 Pass 1 of the for loop of solve_evolutionary_op

$$ts.time = 0 \tag{16}$$

$$state = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{17}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{18}$$

$$state.shape = \begin{bmatrix} 36 \end{bmatrix} \tag{19}$$

3 Pass 2 of the for loop of SimpleTimeSteppingSolver.__call__

$$step = 1 \tag{20}$$

$$time = 0.5 \tag{21}$$

calling step_fun from SimpleTimeSteppingSolver.__call__
in time_step_function

$$ts.time = 0.5 \tag{22}$$

$$ts.step = 1 \tag{23}$$

time_update, calling update_materials
in traction_load of `axial_rod_sfepy.py`

$$nt = 0.5 \tag{24}$$

time_update, after update_materials

3.0.1 In the ts.step != 0 case

ts.step != 0
calling problem.solve
calling solvers.nls.__call__ from ProblemDefinition.solve
In Newton.__call__ in `sfepy/solvers/nls.py`
in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{25}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 1 \end{bmatrix} \tag{26}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'traction' : Material : traction, 'ts' : TimeStepper, 'v' : Variable : v \tag{27}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 1 \\ 1 \\ 12 \\ 1 \end{bmatrix} \tag{28}$$

$$vec_r = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{29}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & -0.0125 \end{bmatrix} \tag{30}$$

$$vec_r.shape = \begin{bmatrix} 24 \end{bmatrix} \tag{31}$$

in assemble_matrix

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{32}$$

$$mtx_i n_e ls.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 24 \end{bmatrix} \tag{33}$$

$$args = 'traction' : Material : traction, 'ts' : TimeStepper, 'v' : Variable : v \tag{34}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{35}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 1 \end{bmatrix} \tag{36}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'traction' : Material : traction, 'ts' : TimeStepper, 'v' : Variable : v \tag{37}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 1 \\ 1 \\ 12 \\ 1 \end{bmatrix} \tag{38}$$

$$vec_r = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{39}$$
$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{40}$$

$$vec_r.shape = \begin{bmatrix} 24 \end{bmatrix} \tag{41}$$

at the end of Newton.__call__

$$state = \begin{bmatrix} 0 & 0 & 0 & 0.0002893 & 0.0002893 & \dots \end{bmatrix} \tag{42}$$
$$\begin{bmatrix} -0.0002893 & 0.001486 & -0.0002382 & -0.0002382 & 0.003176 \end{bmatrix} \tag{43}$$

$$state.shape = \begin{bmatrix} 36 \end{bmatrix} \tag{44}$$

3.1 Pass 2 of the for loop of solve_evolutionary_op

$$ts.time = 0.5 \tag{45}$$

$$state = \begin{bmatrix} 0 & 0 & 0 & 0.0002893 & 0.0002893 & \dots \end{bmatrix} \tag{46}$$
$$\begin{bmatrix} -0.0002893 & 0.001486 & -0.0002382 & -0.0002382 & 0.003176 \end{bmatrix} \tag{47}$$

$$state.shape = \begin{bmatrix} 36 \end{bmatrix} \tag{48}$$

4 Pass 3 of the for loop of SimpleTimeSteppingSolver.__call__

$$step = 2 \tag{49}$$

$$time = 1 \tag{50}$$

calling step_fun from SimpleTimeSteppingSolver.__call__
in time_step_function

$$ts.time = 1 \tag{51}$$

$$ts.step = 2 \tag{52}$$

time_update, calling update_materials
in traction_load of `axial_rod_sfepy.py`

$$nt = 1 \tag{53}$$

time_update, after update_materials

4.0.1 In the ts.step != 0 case

ts.step != 0
calling problem.solve
calling solvers.nls.__call__ from ProblemDefinition.solve
In Newton.__call__ in `sfepy/solvers/nls.py`
in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{54}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 1 \end{bmatrix} \tag{55}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'traction' : Material : traction, 'ts' : TimeStepper, 'v' : Variable : v \tag{56}$$

$$vec_i n_e ls.shape = \begin{bmatrix} 1 \\ 1 \\ 12 \\ 1 \end{bmatrix} \tag{57}$$

$$vec_r = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{58}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & -0.0125 \end{bmatrix} \tag{59}$$

$$vec_r.shape = \begin{bmatrix} 24 \end{bmatrix} \tag{60}$$

in assemble_matrix

$$args = 'solid' : Material : solid, 'u' : Variable : u, 'ts' : TimeStepper, 'v' : Variable : v \tag{61}$$

$$mtx_in_els.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 24 \end{bmatrix} \tag{62}$$

$$args = 'traction' : Material : traction,' ts' : TimeStepper,' v' : Variable : v \tag{63}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'solid' : Material : solid,' u' : Variable : u,' ts' : TimeStepper,' v' : Variable : v \tag{64}$$

$$vec_in_els.shape = \begin{bmatrix} 2 \\ 1 \\ 24 \\ 1 \end{bmatrix} \tag{65}$$

in assemble_vector of `sfepy/fem/evaulate.py`

$$args = 'traction' : Material : traction,' ts' : TimeStepper,' v' : Variable : v \tag{66}$$

$$vec_in_els.shape = \begin{bmatrix} 1 \\ 1 \\ 12 \\ 1 \end{bmatrix} \tag{67}$$

$$vec_r = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \dots \end{bmatrix} \tag{68}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{69}$$

$$vec_r.shape = \begin{bmatrix} 24 \end{bmatrix} \tag{70}$$

at the end of Newton.__call__

$$state = \begin{bmatrix} 0 & 0 & 0 & 0.0005785 & 0.0005785 & \dots \end{bmatrix} \tag{71}$$

$$\begin{bmatrix} -0.0005785 & 0.002972 & -0.0004764 & -0.0004764 & 0.006353 \end{bmatrix} \tag{72}$$

$$state.shape = \begin{bmatrix} 36 \end{bmatrix} \tag{73}$$

4.1 Pass 3 of the for loop of solve_evolutionary_op

$$ts.time = 1 \tag{74}$$

$$\begin{aligned} state \;=\; \big[\; & 0 \quad 0 \quad 0 \quad 0.0005785 \quad 0.0005785 \quad \ldots & (75)\\ & -0.0005785 \quad 0.002972 \quad -0.0004764 \quad -0.0004764 \quad 0.006353 \;\big] & (76) \end{aligned}$$

$$state.shape = \big[36\big] \tag{77}$$