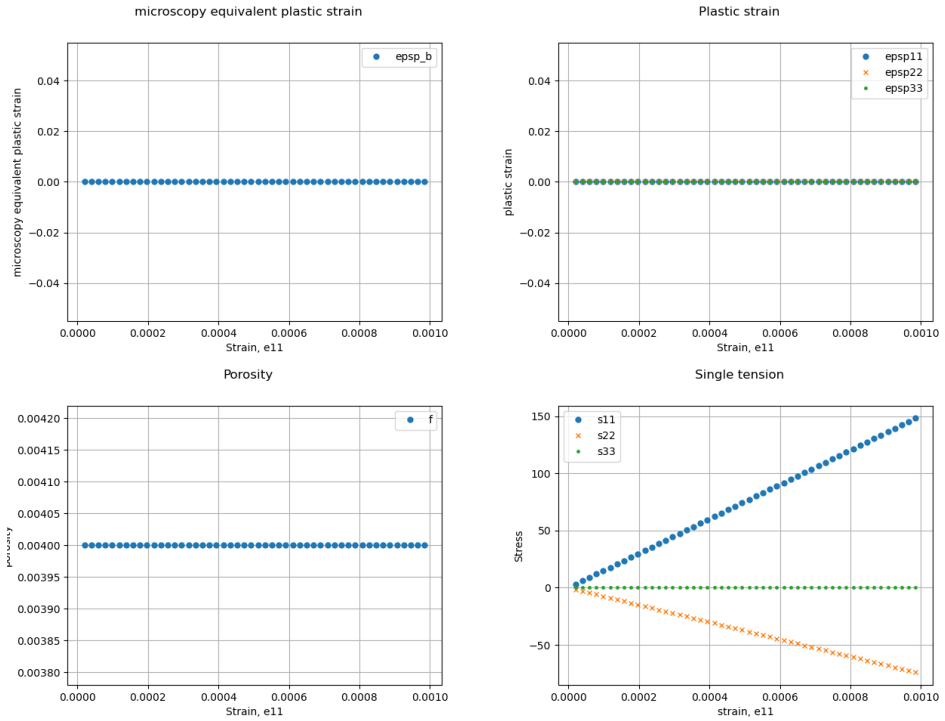

Figure 16: Comparation GTN and VM material laws in the elastic region changing the yield point

7.4 Test case 4:1D material point tension test

Aim: In this test is evaluated the performance of algorithm at the material pointlevel, especially the algortithmic tangent stiffness tensor. When a 1D strain controlled deforation is applied the non-axial component must be zero. In this test the ATS of the nonaxial components is used to to solve the strains.

Expected result: Find that the code is stable and that the algoritmic tangent stiffness drive to a solution of the strain.

Command used to run the program: In the main folder you find the file to run the test. The parameter in this test is the type of material law which is set in the following file as descried in the manula section the program was developed with the von Mises and the GTN options, the VM is only used for test cases.

In the main folder you find File to run the test, this file is based on the notes of the course Plasticity WS2020 TUBAF

`test_1D_Strain_drive.for`

Additionally in the folder 6_1D_Stra_dri/ you find the file to plot the result

`fi_test_strain_drive.py`

To run the test, compile the file in the main folder and run the generated executable file.

```
$ gfortran tensor_ope_module.for material_law_GTN.for test_elast_be.for  -llapack
$ ./a.out

$ gfortran tensor_ope_module.for material_law_GTN.for test_1D_Strain_drive.for -llapack
$ ./a.out
```

The csv file with the results is generated in the folder 6_1D_Stra_dri/. Now, change to that the folder and run the python files

```
$ cd 6_Test_lin_elas0/
$ python3 fi_test_strain_drive.py
```

The figure with the results is generated in the folder 1_1D_VM4.

Obtained result: For the von Mises yield surface the behavior obtained is the expected, figure 7.4. On the other hand, for the GTN The test shows that the implemented code has instabilities, some steps in the drive strain in the plastic zone the results start to diverge. Additionally the behaviour of the iterative newton procedure to find the correction of the volumetric plastic strain and deviatoric plastic strain increments is relatively too slow. The AST was verified and showed that this is not symmetric according to the guideline that a symmetric ATS fullfills the expression $\frac{1}{3}m_{pn} = m_{ql}$ where m_{pn} and m_{ql} are taken from the equations 43 and 44. The code was not developed for this case and could cause the problem but also is not rule out an implementation problem.

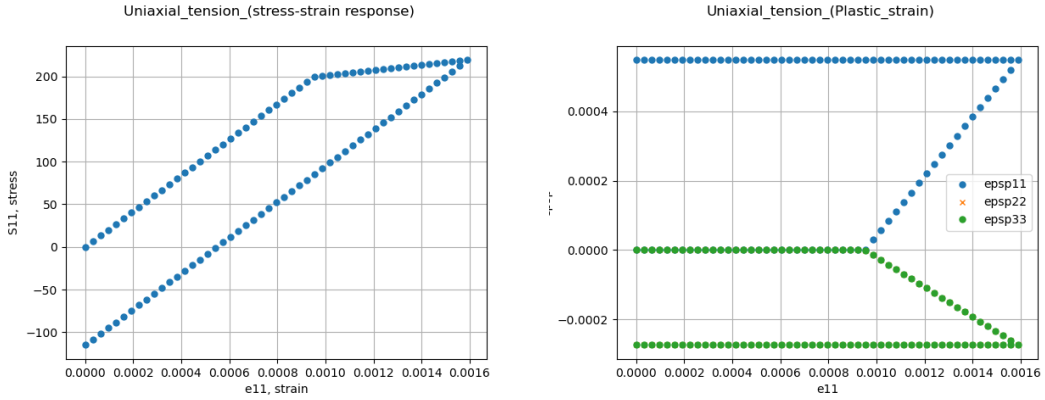

Figure 17: Stress and strain in 1D tension test in material point von Mises yield surface