Test cases coordinates

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1 Format of input file

The input file is a text file organized in the following lines:

- Line 1: N, toroidal Fourier resolution number;
- Line 2: M, poloidal Fourier resolution number;
- Line 3: L_{rad}, number of radial points;
- Line 4: N_{tor}, number of toroidal points;
- Line 5: N_{pol}, number of poloidal points;
- Line 6: N_{fp}, number of field periods;
- Line 7: ω, omega value;
- Line 8: s, radial values;

The next lines are organized as follows:

$$R(n,m) = \# \quad , \quad Z(n,m) = \#$$

L_{rad} can be different from the length of the s vector. Indicating N and M will select all the components with $n \in [-N, N]$ and $m \in [0, M]$ of the boundary modes. N and M can be smaller than the highest n or m in the boundary modes. N and M can be bigger than the highest n and m: the unspecified boundary coefficients are set to 0. The Zernike resolution is assumed equal to the poloidal one $n_z = M$.

2 Format of the output SPEC file

The output SPEC file is a text file organized as follows. Given the number of points in the s vector, N_{rad}, the file has a total of $4N_{rad}$ lines. Each group of 4 lines corresponds to an increasing s. Each line has $m_z = (2N + 1)(M + 1) - N$ columns, corresponding to the SPEC convention for vectorising R_{nm} and Z_{nm} as R_j and Z_j, being $j(n,m) = |n|$ for $m = 0$, $N + 1 + (m - 1)(2N + 1) + N + n$, otherwise. For each group of 4 lines the convention is:

- $R_{nm}(s_i)$
- $Z_{nm}(s_i)$
- $\dfrac{\partial R_{nm}}{\partial s}(s_i)$
- $\dfrac{\partial Z_{nm}}{\partial s}(s_i)$

3 Format of the output file

The output file is a text file with N_{dof} lines corresponding to the printing as a column vector of the outcome of the minimization process.

4 Test case

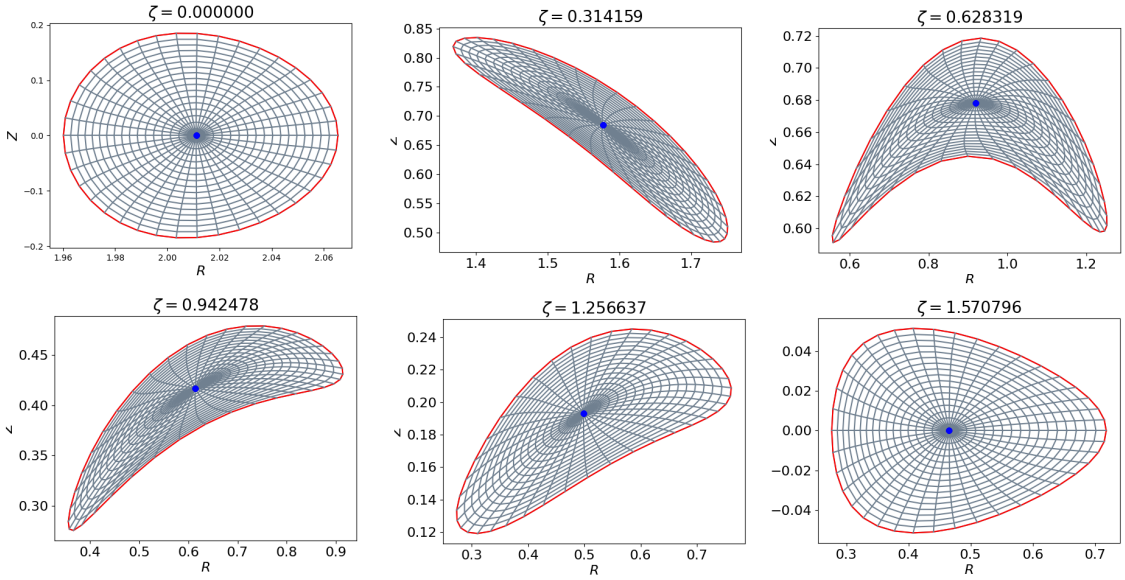
In "main" set the following:

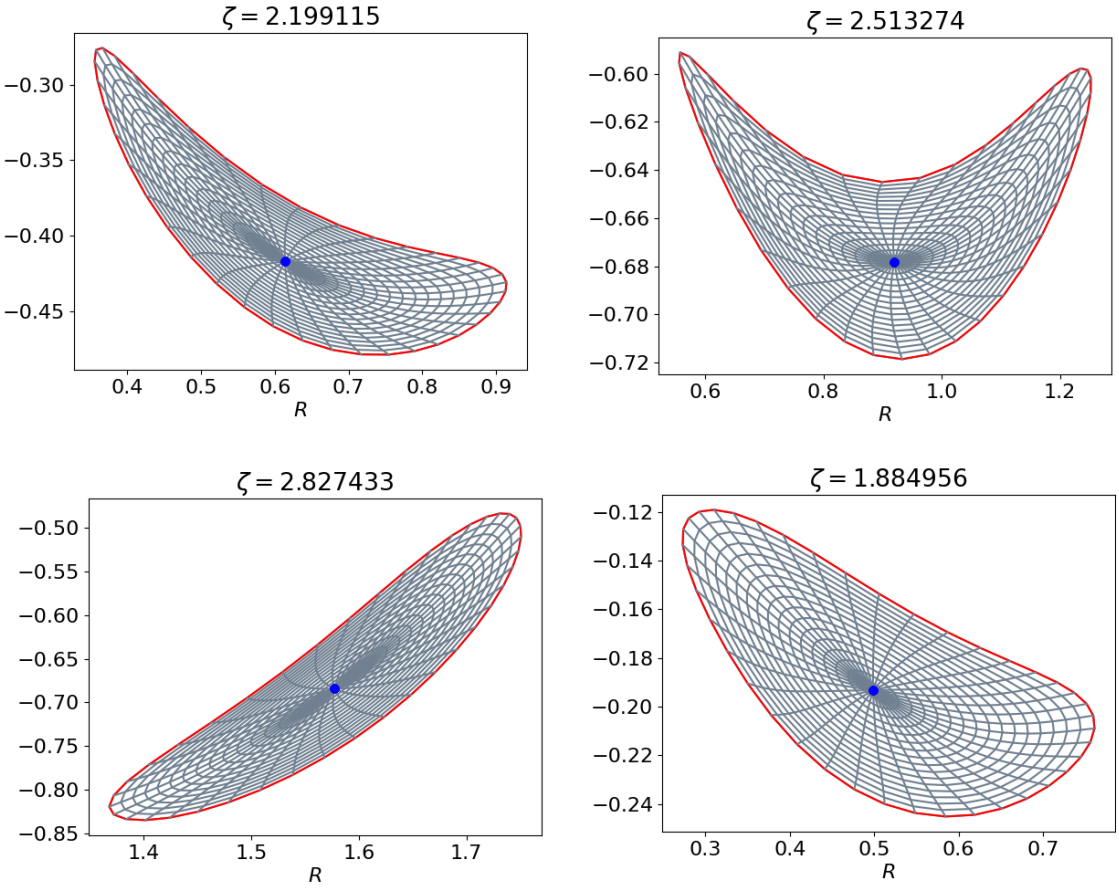
```
file_in = 'Test_1.txt'
file_out = 'Out_Vec.txt'
file_spec = 'Out_SPEC.txt'
run(file_in, file_out, file_spec)
```

It corresponds to $N = 5$, $M = 5$, $L_{rad} = 16$, $N_{tor} = 10$, $N_{pol} = 40$, $N_{fp} = 2$, and $\omega = 10^{-2}$. The s vector, the R_{nm}, and Z_{nm} sets can be inspected directly from the input file "*Test_1.txt*". The files "*Out_Vec.txt*" and "*Out_SPEC.txt*" are the output and the SPEC output files, respectively. After having run the code, the outcome of the minimization should be:

```
Warning: Desired error not necessarily achieved due to precision loss.
         Current function value: 0.728233
         Iterations: 85
         Function evaluations: 174
         Gradient evaluations: 162
```

The plots for the resulting optimized grid are shown on the next page.


$\zeta = 0.000000$
$\zeta = 0.314159$
$\zeta = 0.628319$
$\zeta = 0.942478$
$\zeta = 1.256637$
$\zeta = 1.570796$
R
Z


$\zeta = 2.199115$
$\zeta = 2.513274$
$\zeta = 2.827433$
$\zeta = 1.884956$
R
Z