TOFU'S BENCHMARKING
AWP18-EEG-CEA-MENDOZA

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1. Starting Point

ToFu's versioning is set automatically with each `git` tag. We will set as a reference point the version number `1.3.22-6-g45cb446`, which also corresponds to the `git` tag.

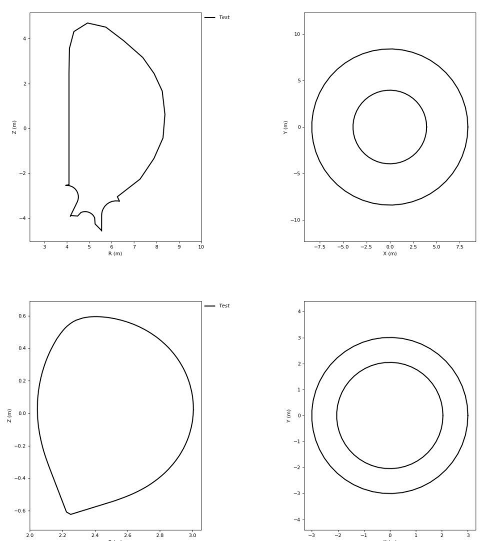
1.1. **Geometry definitions.** In order to have an extensive benchmarking, we need to set a series of tests configurations that will encompass the maximum scenarios, as well as allow us to test the speed-up of simple yet essential methods. Let us first define the different geometries:

- Tests with only a vessel:
  - Config A1:
    - WEST – V1 (realistic) : 63 points
  - Config A2:
    - TER – Test (artificial) : 551 points
  - Config A3:
    - WESTSep – Test (artificial, inspired by the separatrix of an experimental shock of WEST) : 1001 points

- Tests with a vessel and structural elements:
  - Config B1: 'min' (only axisymmetric structures)
    - Ves: WEST V0
    - Struct:
      - Baffle : Baffle-V0
      - Upper divertor : UpDiv-V1
      - Lower divertor : LowDiv-V1
  - Config B2: 'light' (same as B1 + some toroidal structures)
    - Ves: WEST V0
    - Struct:
      - Baffle: Baffle-V1
      - Upper divertor: UpDiv-V2
      - Lower divertor: LowDiv-V2
      - Inner Bumpers: InnerBumpers-V1
      - Outer Bumper: OuterBumper-V1

        · IC antennas: IC1-V1 + IC2-V1 + IC3-V1
- Config B3: 'full'
    * Ves: WEST-V0
    * Struct:
        · Baffle: Baffle-V2
        · Upper divertor: UpDiv-V3
        · Lower divertor: LowDiv-V3
        · Inner Bumpers: InnerBumpers-V3
        · Outer Bumper: OuterBumper-V3
        · IC antennas: IC1-V1 + IC2-V1 + IC3-V1
        · LH antennas : LH-V1, LH2-V1
        · Ripple : Ripple-V1
        · VDE : VDE-V0

Figure 1. Examples of geometry configurations: A2 and A3



The camera is defined as following. The point of convergence in (X, Y, Z) coordinates is $P = [1.5, 3.2, 0.]$ it is pointed towards the device with direction $\vec{n}_{In} = [-0.5, -1., 0.]$ (normalized) of magnitude $F = 0.1$. The camera is dicretized in a set of LOS, which have a director vector of $D_{12} = [0.3, 0.1]$. We will vary the number of lines of sights in a camera, $N_i = 10^i$, with $i = 0, \cdots, 6$.

2. Set of tests and initial times

As a baseline, we use the set of ToFu's unit-tests for the geometry part. There are a total of 13 tests testing the most low-level functions, we will exclude for this part the 13th. The table 1 shows the execution time needed for each test on different machines.

Table 1. Execution time of unit tests 1 to 13, time computed as the mean of 5 runs

Machine	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Ubuntu	3.13×10^{-4}	4.47×10^{-4}	1.55×10^{-4}	3.01×10^{-4}	4.82×10^{-4}	5.26×10^{-3}
Sirrah	8.62×10^{-3}	3.95×10^{-4}	1.66×10^{-4}	3.20×10^{-4}	5.79×10^{-4}	8.11×10^{-3}
Atlas	0.00	0.00	0.00	0.00	0.00	0.00
Machine	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12
Ubuntu	4.77×10^{-2}	5.90×10^{-3}	3.51×10^{-2}	4.79×10^{-2}	1.11×10^{-1}	2.84×10^{-2}
Sirrah	5.16×10^{-2}	6.86×10^{-3}	4.69×10^{-2}	5.91×10^{-2}	1.32×10^{-1}	3.63×10^{-2}
Atlas	0.00	0.00	0.00	0.00	0.00	0.00

In addition we tested the different combination of geometries configurations with the camera defined in Section 1.1 and the different number of LOS, on the method from the `geometry` module, `LOS_Calc_PInOut_VesStruct`. This method will be the focus of our optimization. The inital times are summed up in table ADDTABLEREF.

Table 2. Execution time of the method on different configurations on Sirrah

config	A1	A2	A3	B1	B2	B3
V1	2.83×10^{-4}	2.89×10^{-4}	2.67×10^{-4}	4.69×10^{-4}	1.76×10^{-3}	1.03×10^{-1}
V10	2.26×10^{-4}	3.68×10^{-4}	4.20×10^{-4}	6.20×10^{-4}	4.92×10^{-3}	3.62×10^{-1}
$V10^2$	4.07×10^{-4}	1.02×10^{-3}	1.48×10^{-3}	8.22×10^{-4}	3.44×10^{-2}	2.87
$V10^3$	1.90×10^{-3}	8.64×10^{-3}	1.44×10^{-2}	3.32×10^{-3}	3.28×10^{-1}	2.85×10^{1}
$V10^4$	1.46×10^{-2}	8.31×10^{-2}	1.41×10^{-1}	2.72×10^{-2}	3.23	2.83×10^{2}
$V10^5$	1.44×10^{-1}	8.37×10^{-1}	1.39	2.62×10^{-1}	3.35×10^{1}	2.85×10^{3}
$V10^6$	1.56	8.45	1.39×10^{1}	2.78	3.29×10^{2}	2.90×10^{4}

Table 3. Execution time of the method on different configurations on Ubuntu

config	A1	A2	A3	B1	B2	B3
V1	2.84×10^{-4}	2.25×10^{-4}	2.52×10^{-4}	3.70×10^{-4}	1.57×10^{-3}	0
V10	2.73×10^{-4}	2.83×10^{-4}	3.32×10^{-4}	4.34×10^{-4}	4.91×10^{-3}	0
V10^2	5.50×10^{-4}	7.91×10^{-4}	1.15×10^{-3}	6.23×10^{-4}	2.87×10^{-2}	0
V10^3	2.01×10^{-3}	7.19×10^{-3}	1.25×10^{-2}	3.67×10^{-3}	2.64×10^{-1}	0
V10^4	1.54×10^{-2}	6.92×10^{-2}	1.13×10^{-1}	2.31×10^{-2}	2.57	0
V10^5	1.19×10^{-1}	6.77×10^{-1}	1.13	2.07×10^{-1}	2.59×10^{1}	0
V10^6	1.16	6.79	1.13×10^{1}	2.09	2.59×10^{2}	0