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EUROfusion

EUROfusion Engineering Grant (EEG)

INTERIM REPORT[1]

For calendar year	**2019**
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Beneficiary	CEA
TA ref.	AWP18-EEG-CEA/MENDOZA
Name of Coordinating Project Leader/Task Force Leader	Michele Romanelli
Date	**11/12/19**

1. **Abstract** – please summarise the main achievements in the respective reporting year

The ToFu (*To*mography for *Fu*sion) library aims at providing the fusion and plasma community with a fast, object-oriented, transparent and documented tool for designing tomography diagnostics, computing synthetic signal (direct problem) as well as tomographic inversions (inverse problem).

The integration module is an important piece in both solving the direct and the inverse problem. Thus, the first months of this year were dedicated to the optimization and improvement of the integration module and more generally the geometry module (mainly the sampling part). This allowed to optimize the algorithm that computes the signal received by a camera (or diagnostic) using a synthetic emissivity function given by a user.

Furthermore, for the project longevity and its usability it was important to improve the documentation of the library. A great effort was made towards **tofu**'s user documentation: a new website was created with tutorials, installation instructions, a gallery of results, and the code documentation. The documentation for developers was also created: a document how to contribute to the project was added, as well as how to install the library from sources, and the API documentation.

Having a better documentation allowed us to have more contributors in the library, with mainly two additional new developers and more activity from two contributors that found the code easier to read and better documented.

[1] In line with section 4 of the Task Agreement, due at end of each calendar year, maximum 3 pages (excluding publications)

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ToFu was successfully installed in different Linux distributions, as well as in OSX and Windows machines, and the latest version is available on the ITER clusters, where it is compatible with the version of IMAS currently installed and Eurofusion Gateway. The library is now easier to install, and the packaging is more robust. The unitary tests run automatically in a wider range of machines to ensure the stability of the code.

One of the new contributors was helped to add a new geometry definition for ITER's configuration.

2. Objectives

- Optimize spatial integration module
- Create plugins for IMAS and ITER
- Update online documentation
- Improve continuous version control
- Release stable version

3. Principal achievements during the reporting period (deliverables, milestones)

- Optimization and parallelization of the geometry module: better compilation flags, parallelization of existing functions and loops.
- Optimization of the spatial integration module:
  - Computing time optimization: up to 5 times faster;
  - Memory optimization: a slower algorithm available that will not cause « out of memory » errors for bigger test cases;
  - Optional integration methods: sum, simpson or romberg;

LOS	10	10^2	10^3	10^4
original	0.46	2.24	18.1	x
memory	0.9	8.9	96	945 (6Gb)
calls	0.207	0.53	4.32	x
hybrid	0.08	0.44	4.2	40.3 (32Gb)

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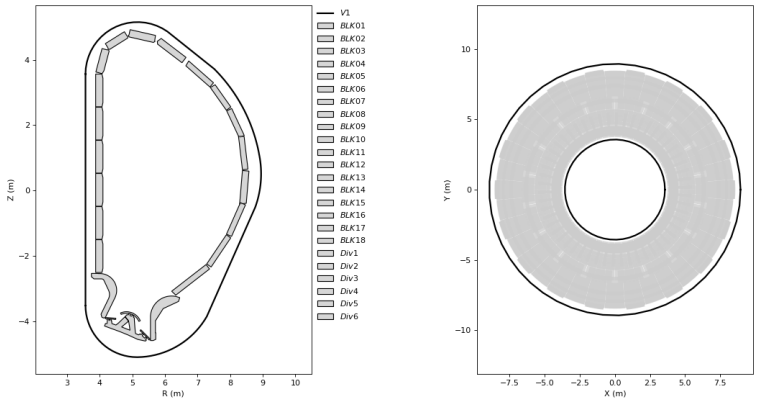
- Compatibility with IMAS and ITER:
  - Installation of latest version of **tofu** on the ITER clusters, where IMAS is installed;
  - Addition of ITER's configuration (with Koyo Munechika);



- Update of online documentation :
  - New website tofuproject.github.io/tofu/ with the following main menus: Installation, Contributing, Gallery (tutorials), API documentation, etc.
  - New README files for developers: https://github.com/ToFuProject/tofu/blob/devel/README.md
- Continuous integration, packaging and portability improved by:
  - Stopping the use of deprecated or complex packages;
  - More complete set of automatic tests platforms (trusty, xenial, Mac OS X);
  - Better packaging (using pip, and conda) on different platforms (Linux, Windows, Mac OSX);
- Two stable releases of **tofu** (versions 1.4.1 and 1.4.2-alpha)

4. Description of deviations, if any, from the original work programme

5. **Scientific publications** – please add the five-digit EUROfusion pinboard ID for each publication[2]

Conference contributions

- ICIAM
- EuroScipy
- PyConFr (ID 23564)

[2] This information is mandatory. For details on the EUROfusion publications procedure please see the publications section in the ERG/EEG guideline.

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6. Participation in conferences, patents, teaching and knowledge transfer

Participation to trainings:

- IMAS codecamp in ITER

Knowledge transfer:

- Helped new developers to **tofu:** Koyo Munechika, Florian Le Bourdais, Riccardo Ragona