

# FreeFem++ project update: GitHub, new documentation, new website, module repository, and a lot more

Who? Simon Garnotel  
From? Airthium  
When? FreeFem++ days 2018 - December 12

## Introduction

### GitHub

Why

Git - GitHub

Repository architecture

The FreeFem-sources repository

Open an issue

Open a pull request

CI/CD

## Documentation

Website

PDF

## Website

Home

Other pages

## Modules

Code architecture

Website

## What's more ?

more ?

again ?

## Conclusion

Polytechnique - Paris (Bâtiment 404)

**A really big multinational company:** 3 people + 1 trainee



We make a thermodynamic energy storage system

- Most simulations done using FreeFem++
- First «thèse CIFRE» in January 2019 in partnership with LJLL - Frédéric Hecht  
*«Multi-part contact in fluid-structure interaction algorithm»,*  
*Houssam Houssein*

## Introduction

### GitHub

Why

Git - GitHub

Repository architecture

The FreeFem-sources repository

Open an issue

Open a pull request

CI/CD

## Documentation

Website

PDF

### Website

Home

Other pages

### Modules

Code architecture

Website

## What's more ?

more ?

again ?

## Conclusion

# FreeFem++ is now on GitHub

Why ?

## Thank you for 100 million repositories

Nov 08, 2018

jasoncwarner

Announcements



Today we reached a major milestone: 100 million repositories now live on GitHub. Powering this number is an incredible community. Together, you're **31 million developers** from nearly every country and territory in the world, collaborating across **1.1 billion contributions**.

Credit <https://blog.github.com>

- Who knows git ?
- Who knows github ?
- Who knows **how to use** git & github ?

Small git tutorial:

<http://rogerdudler.github.io/git-guide/>

Github guides:

<https://guides.github.com/activities/hello-world/>

An alternative: Gitlab

- We migrated before Github acquisition by Microsoft
- Less popular and fragmented
- But open-source

# All in one place

<https://github.com/FreeFem>



## FreeFem++

<http://www.freefem.org/>

Repositories 21    People 16    Teams 5    Projects 2    Settings

Pinned repositories

Customize pinned repositories

FreeFem-sources

FreeFem++ source code

C++ ★ 34 13 issues

FreeFem-doc

FreeFem++ user documentation

Python ★ 14 5 issues

FreeFem-modules

FreeFem++ modules

CSS ★ 2 issues

FreeFem-website

FreeFem++ website

HTML ★ 1 issue

Find a repository... Type: All Language: All New

**FreeFem-sources**

FreeFem++ source code

simulation-framework finite-elements finite-element-analysis

C++ ★ 34 13 issues 3 issues need help Updated an hour ago

**FreeFem-doc**

FreeFem++ user documentation

simulation-framework finite-elements finite-element-analysis

Top languages

- PostScript
- Python
- JavaScript
- HTML
- Shell

Most used topics

freefem

finite-element-methods

finite-elements

simulation-framework

# Source repository

<https://github.com/FreeFem/FreeFem-sources>

Everyone can see the source code, and submit changes.

Help us, star the project!

Several branches:

- **master**: always compile
- **develop**: current development, often compile
- **hotfix**: used to rapidly fix a bug
- **feature-XXX**: feature development, sometimes compile

The screenshot shows the GitHub repository page for 'FreeFem / FreeFem-sources'. The page includes navigation links for Code, Issues (38), Pull requests (1), Projects (1), Wiki, Insights, and Settings. It also shows statistics: 4,286 commits, 28 releases, and 5 contributors. A prominent red button at the top right encourages users to 'Help us, star the project!'. Below the stats, there's a list of recent commits, each with a small icon, the author's name, the commit message, the file path, and the time it was made. The commits are as follows:

Author	Commit Message	File Path	Time Ago
gargamet	Merge pull request #34 from freefem/hotfixes	(empty)	Latest commit official on 25 Jul
	FreeFem++-appContents	copy file for version 4278 to 4297	9 months ago
	build	copy file for version 4278 to 4297	9 months ago
	debian	copy file for version 4278 to 4297	9 months ago
	download	Code refactoring + macros for PETSc partitioning.	5 months ago
	examples++-3d	copy file for version 4278 to 4297	9 months ago
	examples++-bug	copy file for version 4278 to 4297	9 months ago
	examples++-chap3	add missing file in distrib	8 months ago
	examples++-eigen	copy file for version 4278 to 4297	9 months ago
	examples++-fdm	Code refactoring + macros for PETSc partitioning.	5 months ago
	examples++-load	Fixes issue #21 (compilation error in debug mode).	5 months ago
	examples++-mpi	correct Coventry et Codacy (#44) directly	8 months ago
	examples++-other	copy file for version 4278 to 4297	9 months ago
	examples++-tutorial	change type of kernel data of dissection solver.	6 months ago
	examples++-e	copy file for version 4278 to 4297	9 months ago
	examples+eig	copy file for version 4278 to 4297	9 months ago
	ffdf.xcodeproj	add init arry of string and print	6 months ago
	script	correct memory leak in case of throw in 2d mesh generation	6 months ago

# Open an issue: as simple as a forum!

All open issues are listed in the «Issues» tab, just click on «New issue» to add one.

The image shows two side-by-side screenshots of a GitHub repository page. The left screenshot displays the 'Issues' tab, showing a list of 10 open issues. The right screenshot shows the 'New issue' creation dialog, which includes fields for Title, Description, Labels, Assignees, and Milestones, along with a file upload section and a 'Submit new issue' button.

**Issues Tab (Left):**

- 10 Open, 18 Closed
- MUMPS error** - #11 opened on 25 Oct by **opened**
- P1nc in 3D enforcement** - #43 opened on 20 Oct by **opened**
- Problems compiling on Arch** - #45 opened on 20 Sep by **opened**
- Using a path when loading a mesh file (DSL)?** - #28 opened on 30 Jul by **closed**
- Changing behavior of include directive (DSL)?** - #29 opened on 30 Jul by **closed**
- Coverage enhancement** - #10 opened on 20 Jul by **opened**
- Meaning of assertion (!=+MscCfEnd())** - #26 opened on 20 Jul by **closed**
- Multiple copies of mortar-msh.lib** - #27 opened on 20 Jul by **closed**
- mesh errorarnings** - #25 opened on 20 Jul by **closed**

**New Issue Dialog (Right):**

- Title:** [Empty input field]
- Description:** [Empty text area]
- Labels:** [None yet]
- Assignees:** [None—assign yourself]
- Projects:** [None yet]
- Milestones:** [No milestones]
- Attach files by dragging & dropping, selecting them, or pasting from the clipboard.**
- Submitting via Markdown is supported.**
- Submit new issue** [Green button]

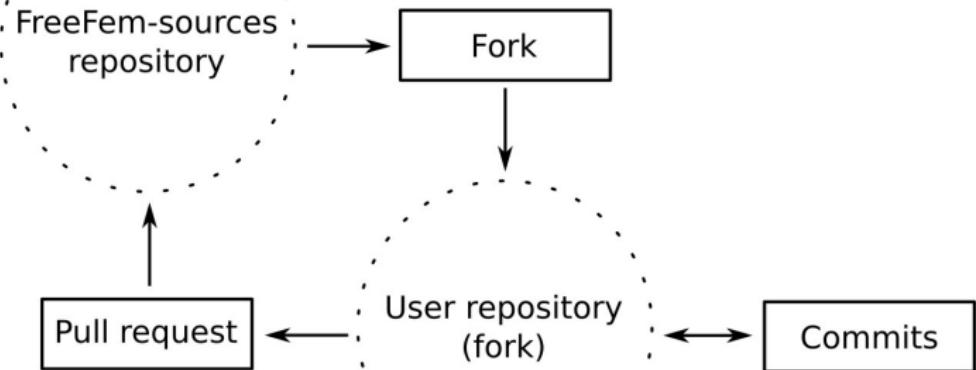
GitHub uses Markdown language

<https://guides.github.com/features/mastering-markdown/>

Remark

*Issues in the FreeFem-sources repository only concern core and plugins, not usage.*

## Pull request, for (external) developers



Remark *All pull requests must point to the **develop** branch!*

# Continuous Integration / Delivery



Computers (MacOS, Windows and Linux) that compile the code each time it is modified!  
→ Checks if everything works fine on «all» platforms

In the future, FreeFem++ binaries will be automatically published in GitHub releases:

- dmg, for MacOS
- exe, for Windows
- deb, rpm, for Linux (others ?)  
→ Always up-to-date packages

## Introduction

### GitHub

Why  
Git - GitHub  
Repository architecture  
The FreeFem-sources repository  
Open an issue  
Open a pull request  
CI/CD

## Documentation

[Website](#)  
[PDF](#)

### Website

[Home](#)  
[Other pages](#)

### Modules

[Code architecture](#)  
[Website](#)

## What's more ?

[more ?](#)  
[again ?](#)

## Conclusion

# Documentation website

<https://doc.freefem.org/>

The screenshot shows the top navigation bar of the FreeFem++ documentation website. The bar includes the FreeFem++ logo, a search icon, a search input field labeled "Search", and a GitHub icon with the text "FreeFem++ on Github 14 Stars · 5 Forks". Below the search bar is a horizontal menu with links: Introduction, Documentation, Language References, Tutorials, Examples, and Models.

## Documentation

[Home](#)

[Some Notations](#)

[Mesh Generation](#)

[Finite Element](#)

[Visualization](#)

[Algorithms & Optimization](#)

[Parallelization](#)

[Plugins](#)

[Developers](#)

[TODO](#)

## Finite Element

As stated in [tutorials](#), FEM approximates all functions  $w$  as

$$w(x, y) \simeq w_0 \phi_0(x, y) + w_1 \phi_1(x, y) + \cdots + w_{M-1} \phi_{M-1}(x, y)$$

with finite element basis functions  $\phi_k(x, y)$  and numbers  $w_k$  ( $k = 0, \dots, M - 1$ ). The functions  $\phi_k(x, y)$  are constructed from the triangle  $T_{i_k}$ , and called *shape functions*.

In FreeFem++ the finite element space

$$V_h = \{w \mid w_0 \phi_0 + w_1 \phi_1 + \cdots + w_{M-1} \phi_{M-1}, w_i \in \mathbb{R}\}$$

is easily created by :

```
1 fespace IDspace(1Dmesh,<IDFE>);
```

or with  $\ell$  pairs of periodic boundary conditions in 2D :

```
1 fespace IDspace(1Dmesh,<IDFE>,
2   periodic=[[la1, sa1], [lb1, sb1],
3             ...,
4             [lak, sak], [lbk, sbk]]);
```

and in 3D :

```
1 fespace IDspace(1Dmesh,<IDFE>,
2   periodic=[[la1, sa1, ta1], [lb1, sb1, tb1],
3             ...,
4             [lak, sak, tak], [lbk, sbk, tbk]]);
```

where `IDspace` is the name of the space (e.g. `Vh`), `1Dmesh` is the name of the associated mesh

## Table of contents

[Use of fespace in 2D](#)

[Use of fespace in 3D](#)

[Lagrangian Finite Elements](#)

[P0-element](#)

[P1-element](#)

[P2-element](#)

[P1 Nonconforming Element](#)

[Other FE-space](#)

[Vector Valued FE-function](#)

[Raviart-Thomas Element](#)

[A Fast Finite Element Interpolator](#)

[Keywords: Problem and Solve](#)

[Weak Form and Boundary Condition](#)

[Parameters affecting solve and problem](#)

[Problem definition](#)

[Numerical Integration](#)

[Variational Form, Sparse Matrix, PDE Data Vector](#)

[Interpolation matrix](#)

[Finite elements connectivity](#)

[References](#)

## Pros:

- Search bar
  - Direct edition (via a Pull Request on GitHub). All the documentation is written in Markdown and L<sup>A</sup>T<sub>E</sub>X
  - Direct copy/paste of code
  - New language reference tab

**Remark** *All contributions are welcomed!*

**Remark** *Issues in the FreeFem-doc repository should concern documentation errors, improvements ...*

<b>Tutorials</b>	<a href="#">Table of contents</a>
<a href="#">Getting started</a>	<a href="#">Solving Poisson's equation</a>
<a href="#">Poisson's equation</a>	
<a href="#">Classification of the equations</a>	
<a href="#">MonteCarlo</a>	
<a href="#">Heat Exchanger</a>	
<a href="#">Acoustics</a>	
<a href="#">Thermal Conduction</a>	
<a href="#">Incompressible Fluid Flow and Thermal effects</a>	
<a href="#">Pure convection, The rotating hill</a>	
<a href="#">The system of elasticity</a>	
<a href="#">The system of Stokes for fluids</a>	
<a href="#">A projection algorithm for the Navier-Stokes equations</a>	
<a href="#">Runge-Kutta method for the steady Navier-Stokes equations</a>	
<a href="#">A large fluid problem</a>	
<a href="#">A fluid problem with complex numbers</a>	
<a href="#">Optimal control</a>	
<a href="#">A flow with shocks</a>	
<a href="#">Time dependent schemes</a>	
<a href="#">optimization for heat equations</a>	
<a href="#">A transient Stokes solver in main menu</a>	
<a href="#">WIL-Presto</a>	
<a href="#">Matlab / Octave Scripts</a>	
<a href="#">TDB</a>	
<a href="#">Poisson's equation</a>	
<a href="#">Solving Poisson's equation</a>	
<a href="#">For a given function <math>f(x, y)</math>, find a function <math>u(x, y)</math> satisfying</a>	
$-\Delta u(x, y) = f(x, y) \quad \text{for all } (x, y) \in \Omega \quad (1)$	
$u(x, y) = 0 \quad \text{for all } (x, y) \in \partial\Omega \quad (2)$	
<a href="#">Here <math>\partial\Omega</math> is the boundary of the bounded open set <math>\Omega \subset \mathbb{R}^2</math> and <math>\Delta u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}</math>.</a>	
<a href="#">We will compute <math>u</math> with <math>f(x, y) = -xy</math> and <math>\Omega</math> the unit disk. The boundary <math>C = \partial\Omega</math> is defined as:</a>	
$C = \{(x, y)   x = \cos(t), y = \sin(t), 0 \leq t \leq 2\pi\}$	
<b>Note</b>	
<a href="#">In FreeFem++, the domain <math>\Omega</math> is assumed to be described by the left side of its boundary.</a>	
<b>The following is the FreeFem++ program which computes <math>u</math>:</b>	
<pre>1 // Define mesh boundary 2 border C={0,2*pi/exact(); yexact();} 3 4 // The triangular domain Th is on the left side of its boundary 5 mesh Th = buildmesh(C(1)); 6 7 // The finite element space defined over Th is called here Vh 8 Fespace Vh(Th, P1); 9 Vh u, v; // Define u and v as piecewise-P1 continuous functions 10 11 // Define a function f</pre>	

# Already some contributions!

## Wifi propagation tutorial

Wifi Propagation

Summary

In this tutorial, we will study the wifi signal power in a flat. An awesome flat is especially designed for the experiment, with 2 walls:

Figure 1 - Flat

Even if the flat seems small enough to be covered by wifi everywhere, it is still interesting to study where the signal's power is the lowest. We will study where to put the hotspot to get the best coverage, and as we're a bit lazy we will only put it next to the left wall.

Physics

## Matlab interface tutorial + documentation

Link with Matlab® and Octave

In order to create plots from FreeFem++ simulations in Octave and Matlab the FEM mesh and the FE function must be exported to text files:

```
mesh Th = square(10, 10, [2*x-1, 2*y-1]);
fespace Vh(Th, P1);
uh = sin(x-y)*x;

savemesh(Th, "export.mesh.msh");
ofstream file("export_data.txt");
for (int j=0; j<10; ++j)
    file << uh(j) << endl;

```

Within Matlab or Octave the files can be processed with the `ffmatlab` library:

```
akgridpath(path_to_freefem());
[phi,b,t]=ffreadmesh("export.mesh.msh");
ffreaddata(phi,"export_data.txt");
ffplot3d(phi,b,t, "FFplot",4, "ZStyle","Continuous", "Mesh", "on");
grid;
```

Fig 9 Matlab / Octave plot

Navigation icons: back, forward, search, etc.

+ some typo fix

Only one thing to say: **Thank you!**

# PDF/Book – Offline version

From the website to  $\text{\LaTeX}$

Work in progress, hopefully available next year



## Introduction

### GitHub

Why  
Git - GitHub  
Repository architecture  
The FreeFem-sources repository  
Open an issue  
Open a pull request  
CI/CD

## Documentation

Website  
PDF

## Website

[Home](#)  
[Other pages](#)

## Modules

Code architecture  
Website

## What's more ?

more ?  
again ?

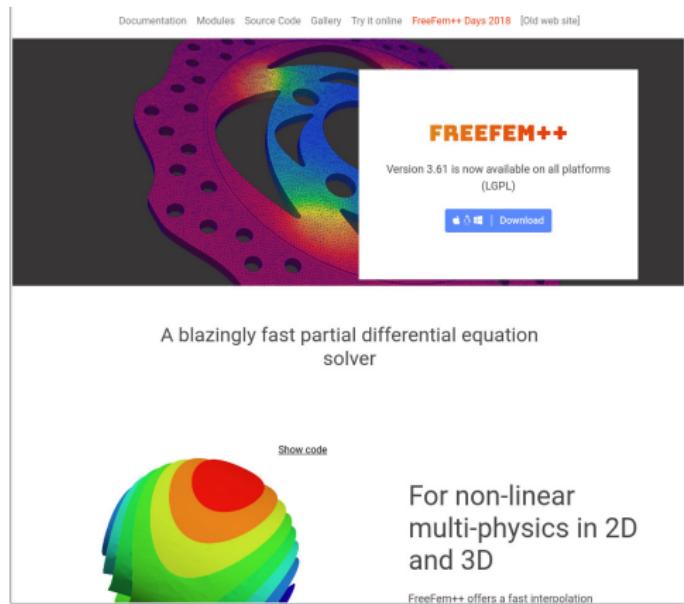
## Conclusion

# New website

<https://freefem.org>

Please update your website, personal page, ...

- Link to:
  - Documentation
  - Modules
  - Sources
  - FreeFem++-js

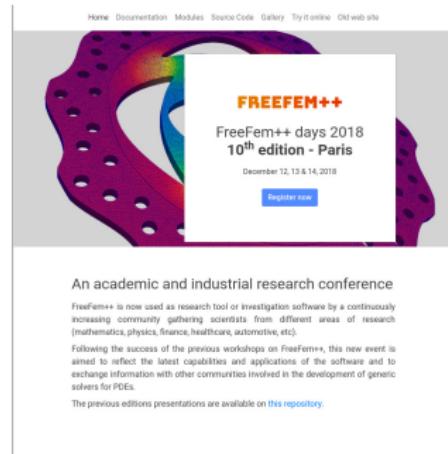
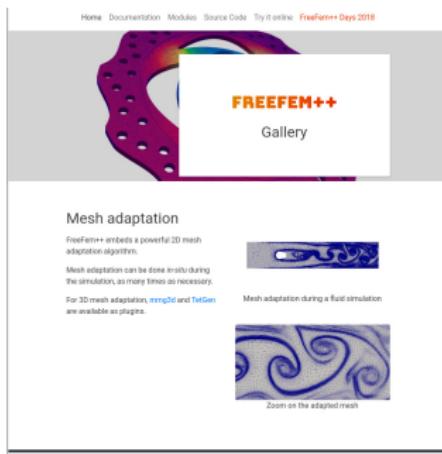


# Gallery / FF-days announcements

Remark

Feel free to add your beautiful images on this page!

*Previous editions abstracts, slides, scripts are available in a GitHub repository  
(<https://github.com/FreeFem/FreeFem-days>)*



Information about the (current) next FreeFem++ days

## Introduction

### GitHub

Why  
Git - GitHub  
Repository architecture  
The FreeFem-sources repository  
Open an issue  
Open a pull request  
CI/CD

## Documentation

Website  
PDF

## Website

Home  
Other pages

## Modules

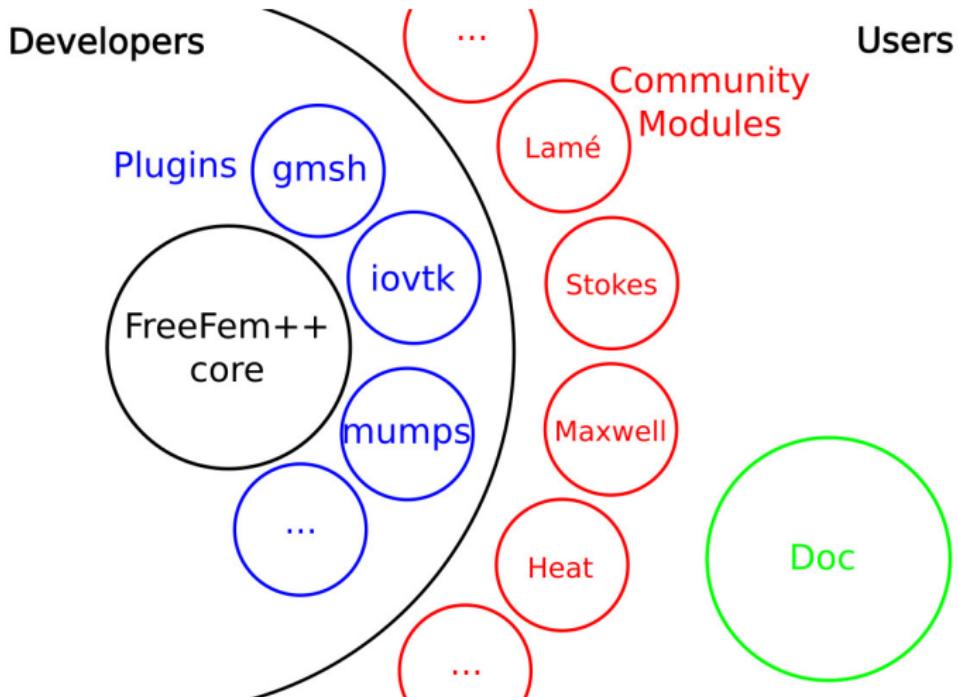
Code architecture  
Website

## What's more ?

more ?  
again ?

## Conclusion

# Schematic code architecture



Modules (.edp) are physical problems algorithms, ready to use  
and ideally **validated**

# Module website

<https://modules.freefem.org/>

List of modules with tag selection and search bar

The screenshot shows the homepage of the FreeFem++ modules website. At the top, there is a navigation bar with tabs for "solid", "electromagnetism", "academic", "validated", and "fast". Below the navigation bar is a search bar with the placeholder "Search". A sidebar on the left lists various modules: Elasticity, Helmholtz, Magnetostatic, Poisson, Stokes, and Wentzel. Each module name is followed by a color-coded tag: solid (blue), electromagnetism (orange), academic (green), validated (red), and fast (purple). To the right of the search bar, there is a detailed description of the Poisson module. The description includes the title "Poisson", a brief description of the algorithm for solving the 2D and 3D Poisson's equation, and a mathematical formulation involving the variation form, Green's formula, and algorithms for Poisson's equation on a square. At the bottom of the page, there is a call to action "We need your help!" encouraging users to contribute to the repository on GitHub.

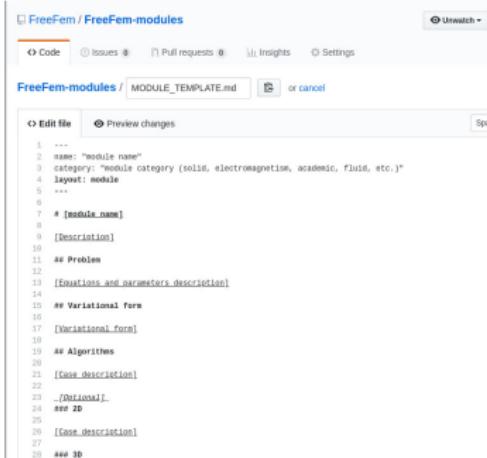
This screenshot shows the detailed description of the Poisson module. It includes the title "Poisson", a brief description of the algorithm for solving the 2D and 3D Poisson's equation, and a mathematical formulation involving the variation form, Green's formula, and algorithms for Poisson's equation on a square. At the bottom of the page, there is a call to action "We need your help!" encouraging users to contribute to the repository on GitHub.

# How does it works ?

Pull requests!

Once again, webpages are in Markdown, with  $\text{\LaTeX}$  support

Modules are automatically added to the list, and tags are processed to appear in the selector



The screenshot shows a GitHub pull request interface for the repository "FreeFem / FreeFem-modules". The file being edited is "MODULE\_TEMPLATE.md". The code in the file is as follows:

```
1 ...
2 name: "module name"
3 category: "module category (solids, electromagnetism, academic, fluid, etc.)"
4 layout: module
5 ...
6
7 # [module_name]
8
9 [Description]
10
11 ## Problem
12
13 [Equations_and_parameters_description]
14
15 ## Variational_form
16
17 [Variational_form]
18
19 ## Algorithms
20
21 [Case_Description]
22
23 [Dimension]
24
25 ## 2D
26
27 [Case_description]
28
29 ## 3D
```

## Introduction

### GitHub

Why  
Git - GitHub  
Repository architecture  
The FreeFem-sources repository  
Open an issue  
Open a pull request  
CI/CD

## Documentation

Website  
PDF

## Website

Home  
Other pages

## Modules

Code architecture  
Website

## What's more ?

more ?  
again ?

## Conclusion

An article from September 2018:

*Use of a Free Software to Solve Internal Boundary Problems of Electrodynamics with a Method of Finite Elements*, V.M. Pomykalov, V.V. Boronina, A.N. Savin, I.A. Nakrap  
(in Russian)

They compared ANSYS to FreeFem++, and:

- (translation) «As can be seen, the resonance frequencies calculated by the finite element method using FreeFem ++ and Ansys HFSS are almost the same.»  
But, they equally say:
  - (translation) ***lack of graphical interface and, as a result, the possibility to manage complex objects;***
  - (translation) *the grid generator built into FreeFem ++ has no possibility forming the finite element space from the graphic models in the format .stl;*
  - (translation) *lack of software-documented algorithm for solving internal boundary value eigenvalue problems.*

Building an open-source (GPL3), web-based, graphical interface for FreeFem++

## Remark

*The goal is to build a tool for (PhD-)students and engineers  
(in small and medium enterprises)*

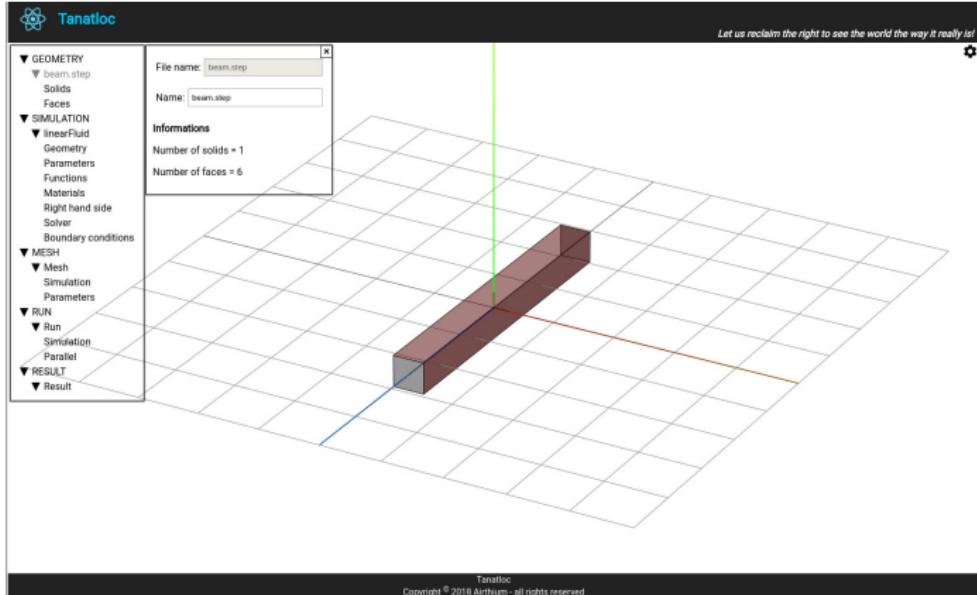
### Advantages:

- «Direct» integration of all modules available on GitHub
- State-of-the-art algorithms
- Deployable locally on your laptop/desktop or on your institution cloud/cluster (mainly Javascript)
- Pre-compiled dockers for Gmsh, FreeFem, Paraview

### Open simulation for people

who do not want to pay an arm and a leg for [introduce proprietary software name here]

# Version $10^{-3}$ pre- $\alpha$



Proof of concept  
Able to run a simulation

# Mailing list or forum

Replace mailing list by Discourse (a modern forum) ?



The screenshot shows a forum page titled "Twitter Developers" on the "Discourse" platform. The page has a blue header with navigation links for "Twitter", "Developers", and "Forums". Below the header, there are sections for "Announcements", "Events", "Partner Tools & SDKs", "Mobile SDK", and "REST API". The "REST API" section is currently active, displaying a list of posts. Posts include topics such as "Accessing additional accounts over REST API - More API Access available", "Pictures not showing programmatically now inst", "Welcome DM's to New Followers", "What are Twitter cards?", "Image not showing when posted in Twitter", "Twitter art gets preserved", "Direct messages started arriving once #3", "Direct messaging now requires authentication", and "How to get replies to a Twitter post". Each post includes a timestamp, a user profile picture, the post title, and a link to the full message.

## Pros:

- Simpler, more convenient
- Searchable
- More visible
- Categories
- We can always reply by email

## Cons:

- ?

## Introduction

### GitHub

- Why
- Git - GitHub
- Repository architecture
- The FreeFem-sources repository
- Open an issue
- Open a pull request
- CI/CD

## Documentation

- Website
- PDF

## Website

- Home
- Other pages

## Modules

- Code architecture
- Website

## What's more ?

- more ?
- again ?

## Conclusion

## In conclusion



- Share your EDP files with us
- Contribute to the core or the doc
- Star the project on GitHub
- Link to the FreeFem++ website on your personal pages

Thank you for your attention!

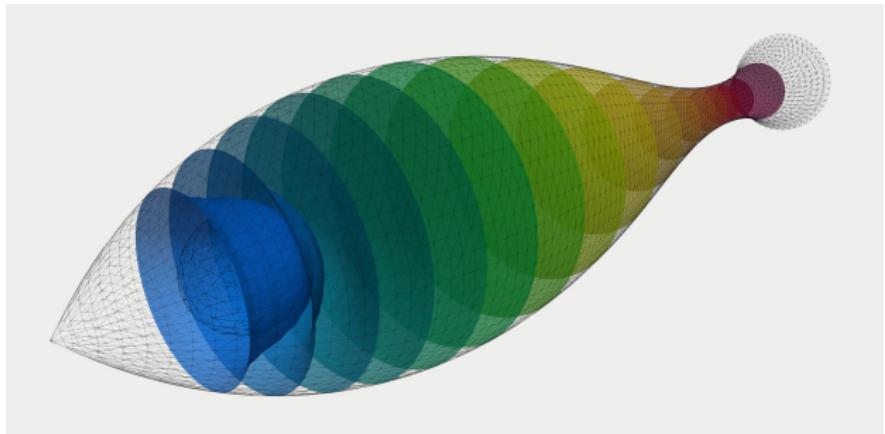


Figure: A Poisson's problem on a «poisson»