



Web/Front-end Developer for Scientific Computing Software in Biomedical Applications

The Porous and Biological Media group (MPB) of the Fluid Mechanics Institute of Toulouse is hiring a high-level web developer with solid experience in software engineering, UI/UX design and front-end development. The developer main goal will be to develop the front-end for a high-performance computing engine dedicated to biomedical applications, and make its use possible through a Software-as-a-Service (SaaS) solution.

Academic context: In recent years, MPB has developed a strong expertise in the modeling of blood flow and blood / tissue exchanges in the brain microcirculation. The applications concern neurodegenerative diseases (from understanding the basic mechanisms, to diagnosis, monitoring or evaluation of therapeutic strategies), with a strong potential for innovation.

In particular, within the framework of the ERC Consolidator BrainMicroFlow, the MPB group developed a high-performance computing engine, the BMF code (see below), which, thanks to a sparse representation of the vascular network as a graph, solves flow and transfer problems at the level of the entire brain with high spatial resolution. Based on this code, and with the support of a CNRS Prematuration fund, we now want to develop a Software-as-a-Service solution based on this computing engine, that will be interactive, easy to use, reliable and efficient, for the needs of biomedical research, *i.e.* that users with minimal or no programming skills (e.g. biomedical engineers or biologists) could use remotely.

BMF: this software is a high quality C++17 simulation engine, fully tested and with High-Performance Computing capabilities based on MPI domain decomposition. It uses a number of external libraries, notably PETSc for linear and non-linear algebra, PARMETIS and PT-Scotch for unstructured network partitioning, GoogleTest for unit and functional testing, GPROF and GCOV for profiling and test coverage, DOXYGEN for automatized documentation generation, and CMake compilation and packaging management. Code quality is ensured through pre-commit hooks (linting, clang-tidy, ...) and a Gitlab-runner based CI/CD pipeline. All layers of the application can be tuned through JSON configuration file and I/O operations make use of HDF5 formatted data to enable fast parallel I/O operations. The code runs on Linux platforms (Ubuntu 20.04, 22.04 and standardized Docker environments), on macOS as-well-as on supercomputers (e.g. Olympe at CALMIP regional HPC mesocenter).

Missions:

The main mission will be to develop a prototype web-site/front-end to allow the remote use of our software. For this purpose, the developer will:

1. Familiarize themselves with the core BMF simulation engine, its features, workflow and might integrate research-quality Python or C++ prototypes into this engine to better understand the engine components. The developer will improve both the developer and user documentations based on their external point-of-view on this code.
2. Define with the project team the functional specifications of the front-end. These specifications should distinguish the feature set that must be implemented by the end of the project in a Minimal Viable Product (MVP); and supplementary optional features that might be implemented between the MVP release and the end of the project.
3. Propose a technology they already master to translate the functional specifications into technical specifications and formalize a protocol/API for the back-end/front-end communications.
4. Effectively implement the front-end and participate in the development of the back-end to at least lead to the delivery of a MVP.

The developer will have to document their work, use state-of-the-art development techniques (in terms of documentation, testing, continuous-integration, security, ...) and propose and use well adopted languages and technologies for the front-end to ensure the application maintainability.

Activities:

The developer will:

- Interact weekly with the team members composed of Researchers who are the project leads (funding, main orientations), PhD students (application users and model/solver developers), and a research engineer who is the technical lead (HPC performances, code quality, back-end developer).
- Define the functional specifications of the front-end
- Co-define with the backend developer the back-end/front-end communication API
- Design a User Interface based on the core set of functional specifications defining the MVP
- Implement the UI with a modern framework of their choice
- Document all steps of their work on suited support (reports, meeting minutes, sketches, slides, code, ...)

Profile:

Technical skills: high-level in a web development framework (React, Angular, Vue, other...) and languages (HTML, CSS, JS). UI/UX Design. Ideally C++ programming, or other low-level language (C, Fortran, Rust) or OOP language (Java). Use and developments of Docker applications, and knowledge of HPC programming and MPI will be highly appreciated.

Other skills: project management, proficiency in English, ability to adapt and anticipate, autonomy and rigor. Demonstrated interest for subjects at the interface between disciplines. Team spirit.

Academic supervisors: Sylvie Lorthois, Directeur de Recherches CNRS (IMFT), in collaboration with Maxime Pigou, Ingénieur de Recherches CNRS (IMFT).

Administrative aspects: This position is funded for 17 to 18 months, starting as early as possible, by the CNRS Prematuration Program. The employer is the *Centre National de la Recherche Scientifique* (National Center for Scientific Research, www.cnrs.fr), the largest fundamental research organization in Europe. For candidates with a PhD: Gross salary, including social security: ~ 3200 to 3960 €/month, depending on experience. For other candidates, depending on diploma and experience: Gross salary, including social security: ~ 2485 et 3270 €/month.

For more information: please send via email your curriculum vitae, a statement of your future career goals, the names and email addresses of two references, with " Web/Front-end Developer" in the subject line, to: Sylvie Lorthois.

To apply: Candidates with a PhD should apply online following <https://emploi.cnrs.fr/Offres/CDD/UMR5502-SYLLOR-008/Default.aspx>. Other candidates should apply following <https://emploi.cnrs.fr/Offres/CDD/UMR5502-SYLLOR-009/Default.aspx>