

# ALIEN: Homogeneous Access to Linear Algebra Libraries

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Industrial software simulation codes must handle several use cases that might need different approaches to solve their linear systems. In practice, this implies that codes use several linear algebra libraries. For example, one may use Hypré for some multi-grid solvers, and PETSc for other computations. Mostly often, these libraries do not use compatible data structures, so do not interact very well.

At CEA and IFPEN, we have developed ALIEN, a C++ linear algebra wrapper that is designed to:

1. provide a common interface to linear algebra operations;
2. manage most of the difficulty to use distributed memory objects;
3. allow using different linear algebra libraries at the same time, and how to make them interact;
4. extend underlying linear algebra libraries by adding high level functionalities.

In this presentation, we will present the software architecture we have designed, describing how it answers each of the previous four wishes. Then we will illustrate some benefits of using this intermediate wrapper, for the application developers, and for the end-users. In particular, we will present results for a cpu-based simulation that can leverage both cpu- and gpu-based linear solvers, thanks to ALIEN.

We will also discuss future extensions we plan to implement to improve application developer productivity and application optimization, such as expression templates.

This is a joint work between Cédric Chevalier from CEA and Sylvain Desroziers and Xavier Tunc from IFPEN.

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