Part I: Documentation

preCICE

The coupling library for partitioned multi-physics simulations

Documentation version 3.3.1

Generated: March 13, 2026

preCICE is free/open-source software, using the GNU LGPL3 license. The code is publicly available and actively developed on Github at https://github.com/precice/precice.

This pdf document is a snapshot of the preCICE documentation hosted at precice.org as of March 13, 2026. The HTML/CSS version of the documentation is available on Github at https://github.com/precice/precice.github.io and can also be built locally with Jekyll. For more information consult the README in this repository.

Table of Contents

Documentation

Fundamentals

Installation

Configuration

The preCICE documentation

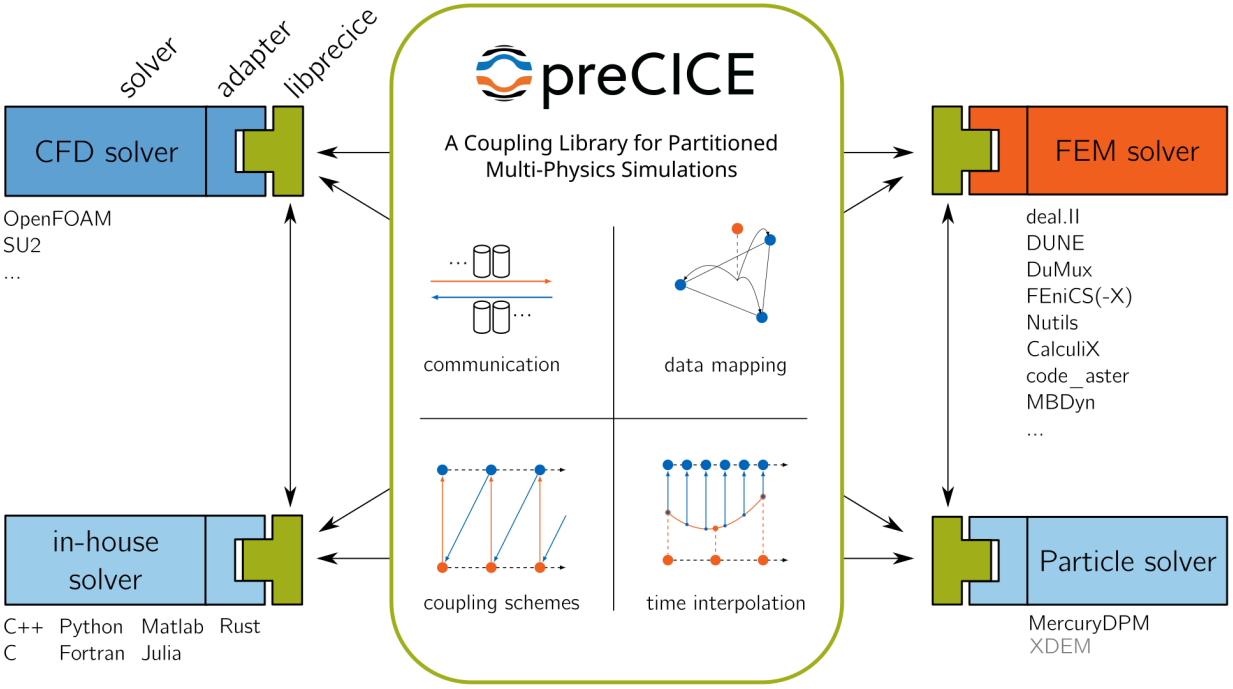
Summary: This page gives an overview of the complete preCICE documentation, including building, configuration, literature, the API, and much more.

The big picture

preCICE stands for Precise Code Interaction Coupling Environment. Its main component is a library that can be used for partitioned multi-physics simulations, including, but not restricted to fluid-structure interaction and conjugate heat transfer simulations. Partitioned (as opposite to monolithic) means that preCICE couples existing programs (solvers) which simulate a subpart of the complete physics involved in a simulation. This allows for the high flexibility that is needed to keep a decent time-to-solution for complex multi-physics scenarios, reusing existing components. preCICE runs efficiently on a wide spectrum of systems, from low-end laptops up to complete compute clusters and has proven scalability (page 14) on 10000s of MPI Ranks.

The preCICE library offers parallel communication means, data mapping schemes, and methods for transient equation coupling. Additionally, we are actively developing methods for time interpolation and more features (see our roadmap (page 16)). preCICE is written in C++ and offers additional bindings (page 335) for C, Fortran, Python, Rust, Julia and Matlab. Coupling your own solver is very easy, due to the minimally-invasive approach of preCICE. Once you add the (very few) calls to the preCICE library in your code, you can couple it with any other code at runtime. For well-known solvers such as OpenFOAM, deal.II, FEniCS, Nutils, CalculiX, or SU2, you can use one of our official adapters.

preCICE is free/open-source software, using the GNU LGPL3 license. This license ensures the open future of the project, while allowing you to use the library also in closed-source solvers. The code is publicly available and actively developed on GitHub. See more license information (page 10).



Writing about preCICE? Get this image and more material.

Where to find what

This documentation explains how to use preCICE. We do not detail the numerical methods and HPC algorithms in the preCICE docs, but we refer to existing publications on preCICE for these topics. The literature guide (page 12) gives an overview of the most important preCICE literature.

The preCICE docs are organized in several sections:

- Installation (page 20): How to get and install preCICE on various systems.
- Configuration (page 81): At runtime, preCICE needs to be configured with an xml file. Here you learn how to do that.
- Tooling (page 194): Several helpful (but completely optional) tools around preCICE: tools for setting up your simulation, post-processing the results, and much more.
- Provided adapters (page 246): The preCICE community maintains ready-to-use adapters for many popular solvers. Here, you find the documentation of these adapters.
- Running simulations (page 401): Learing how to run preCICE simulations on various types of machines.
- Couple your code (page 334): Getting familiar with the preCICE API.
- Dev docs (page 414): References that developers use. Are you maybe also thinking of contributing (page 0)?

Before you start reading: there are just some preCICE-specific technical terms (page 8) that every user should read first.

☑ **Tip:** Interested in training? We have developed a training course (page 0) on preCICE. Come to the yearly preCICE workshops (page 0) or book a private training through the support program (page 0).

Terminology

Summary: We often refer to the following terms, but they may not already be clear.

Partitioned approach

As already mentioned in the overview:

> Partitioned (as opposed to monolithic) means that preCICE couples existing programs (solvers) which simulate a subpart of the complete physics involved in a simulation.

The direct opposite is the (numerically) monolithic approach, in which the same software has to construct and solve a global system of equations for the complete domain.

There are several advantages and disadvantages in both approaches. The partitioned approach allows to reuse existing components, reducing the time from deciding to simulate a multi-physics scenario to getting accurate results (the real time to solution). It also allows to study different combinations of components that are already "experts" in each subdomain. The monolithic approach can have robustness and performance advantages in some cases, but with the current advanced partitioned coupling algorithms, the significance of any such difference should not always be taken for granted (see our literature guide (page 12)).

Solver and participant

By *solver*, we refer to a complete simulation code, which we want to couple. We do not mean a linear algebra solver. With *participant*, we refer to a solver in the context of a coupled simulation (e.g. "Fluid participant"). This term is also used in the preCICE configuration (page 81).

Library approach

preCICE follows a *library* approach. This basically means that preCICE is a library: each solver needs to call preCICE. This also means that preCICE runs in the same threads that the solvers run in. The opposite coupling approach is the *framework* approach. In that approach, the coupling tool calls all solvers, which need to implement a certain programming interface. The advantage of a library approach is that it is minimally invasive to the coupled codes. They do not need to be rewritten. Instead, you just need to insert the preCICE calls at the right places.

Peer-to-peer approach

preCICE also follows a peer-to-peer approach. If you already tried preCICE, you may have noticed that you only need to start all coupled solvers individually, in the same way you would start them to run each single-physics simulation. There is no other starting mechanism involved: no server-like coupling executable or anything similar.

Adapter

To call preCICE from your code, you need to call functions of the application programming interface of preCICE. You can directly do this in your code. In this case, you develop an adapted solver. The little software engineering purist in you prefers, however, to collect all calls to preCICE into one place. This could be a separate class or module in your code. This could also be a separate library, which you call from pre-defined callback hooks. We call this one place an *adapter*. Depending on the perspective, you would call it *preCICE adapter*, *MyCode adapter*, or *MyCode-preCICE adapter*; assuming that you want to couple a code named MyCode. preCICE comes with a few ready-to-use adapters (page 246). If you want to couple your own code, you basically want to develop an adapter for this code. Read more on adapter software engineering approaches (page 0).