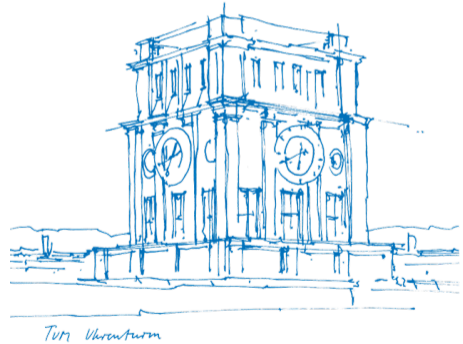


# Growing preCICE from an as-is coupling library to a widely-used, batteries-included ecosystem

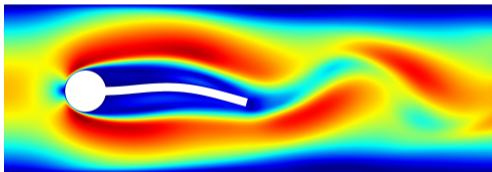
ESCO 2022 – software workshop

Gerasimos Chourdakis  
Technical University of Munich

June 15, 2022

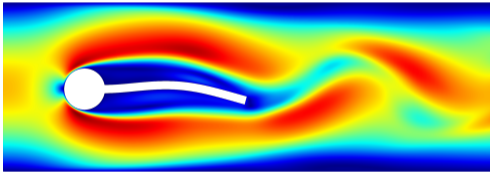


## Partitioned multi-physics simulations

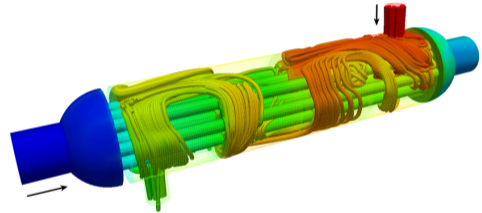


Fluid-Structure Interaction:  
Turek-Hron FSI3 benchmark

# Partitioned multi-physics simulations

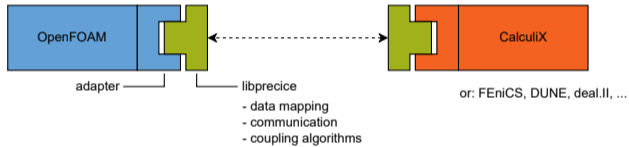


Fluid-Structure Interaction:  
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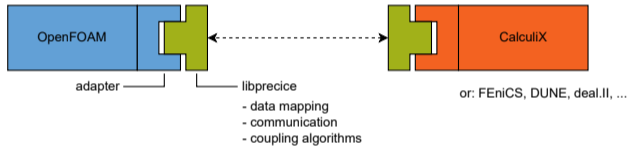


Conjugate Heat Transfer:  
heat exchanger

# preCICE in a nutshell

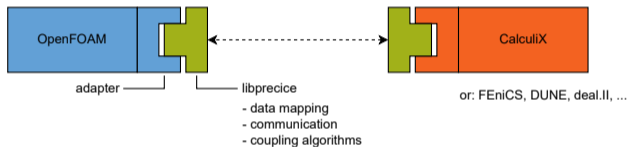


## preCICE in a nutshell



```
while (t < t_end){
  solve(dt);
  precice.write_data(force);
  max_dt = precice.advance(dt);
  precice.read_data(displacement);
}
```

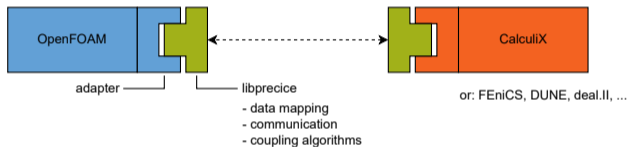
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Adapters and examples for: OpenFOAM, SU2, CalculiX, deal.II, FEniCS, DUNE, Nutils, ...

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Adapters and examples for: OpenFOAM, SU2, CalculiX, deal.II, FEniCS, DUNE, Nutils, ...

API in C++, C, Fortran, Python, Matlab, Julia

# Walking around the website (1)



## Welcome to preCICE

The coupling library for partitioned multi-physics simulations.



preCICE is an **open-source coupling library** for partitioned multi-physics simulations, including, but not restricted to fluid-structure interaction and conjugate heat transfer simulations.

Partitioned means that **preCICE couples existing programs/solvers** capable of simulating 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.

The software offers convenient methods for transient equation coupling, communication, and data mapping.



- Available adapters
- Tutorials
- Quickstart

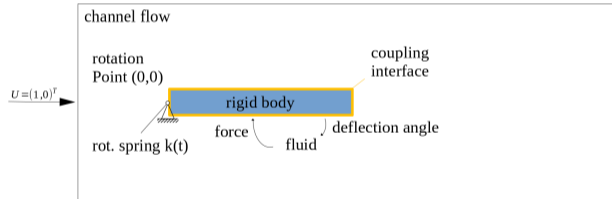


## Live demo

Quickstart tutorial:  
[precice.org/quickstart.html](https://precice.org/quickstart.html)

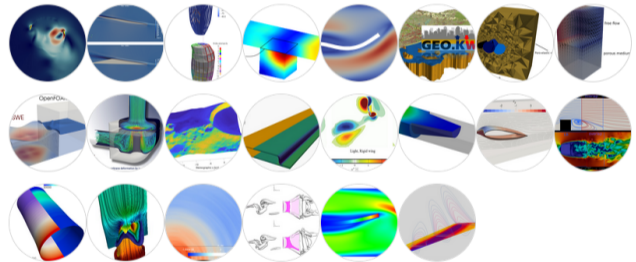
Running on the preCICE demo VM:  
[precice.org/installation-vm.html](https://precice.org/installation-vm.html)

**Homework:** Run it yourself! :-)



## Walking around the website (2)

- Couple your code
- User stories
- Who uses preCICE



## Achievements unlocked: Usability & Reachability

*You don't need to talk to us to successfully use preCICE,*

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*You don't need to talk to us to successfully use preCICE,  
but if you want, you can reach us very easily.*

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*You don't need to talk to us to successfully use preCICE,  
but if you want, you can reach us very easily.*

*"After the amount of support I received from this community, I am switching to  
opensource for every one of my needs."*

*(@nithinadidela on the preCICE forum)*

## But why all this effort?

We are not the target users of preCICE:  
we research and develop methods and software, not applications.

# Lessons learned

## Lessons learned: Technical

1. Library vs framework
2. Separation of concerns
3. Few, common dependencies
4. Packages for common platforms
5. Standard practices (e.g., xSDK, OpenSSF Best Practices, code quality checkers)



### Project Status

release v2.4.0    doi 10.18419/darus-2613    Build and Test passing    system tests check

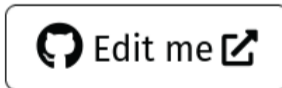
### Project Quality

openssf best practices passing    codefactor A    lgtm:C++ A+    codecov 89%



## Lessons learned: Documentation

1. Content from multiple sources, rendered at one place
  - website + a wiki for each repository + dev docs → website
  - content next to code
  - content available offline
  - export to one PDF
2. Very easy to contribute (“edit me” button + review)



## Lessons learned: Documentation (2)

Q&A strategy: add to the documentation, send link as answer

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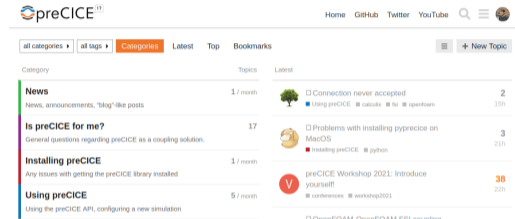
Lufthansa

Home > [Timetable & flight status](#)

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# Lessons learned: Communication

1. Mailing list + chatroom → Discourse forum
  - Threaded, great search, tags, categories, answers, ...
  - Also used as blog, FAQ, conferences
2. Too many requests → Support program
3. preCICE Workshops (+ feedback, training)
4. Some marketing is essential.



## Not discussed (feel free to ask)

- Features, numerics, performance
- Testing and CI
- Collaboration & project management
- Publication and release strategy
- ...

# Key reference (fresh!)


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SOFTWARE TOOL ARTICLE

## preCICE v2: A sustainable and user-friendly coupling library [version 1; peer review: awaiting peer review]

Gerasimos Chourdakis , Kyle Davis , Benjamin Rodenberg , Miriam Schulte , Frédéric Simonis , Benjamin Uekermann [✉](#)   
 Georg Abrams, Hans-Joachim Bungartz, Lucia Cheung Yau, Ishaan Desai , Konrad Eder, Richard Hertrich, Florian Lindner ,  
 Alexander Rusch , Dmytro Sashko, David Schneider , Amin Totounferoush , Dominik Volland, Peter Vollmer , Oguz Ziya Koseomur

This article is included in [Excellent Science gateway](#)



### Open Peer Review

#### Approval Status

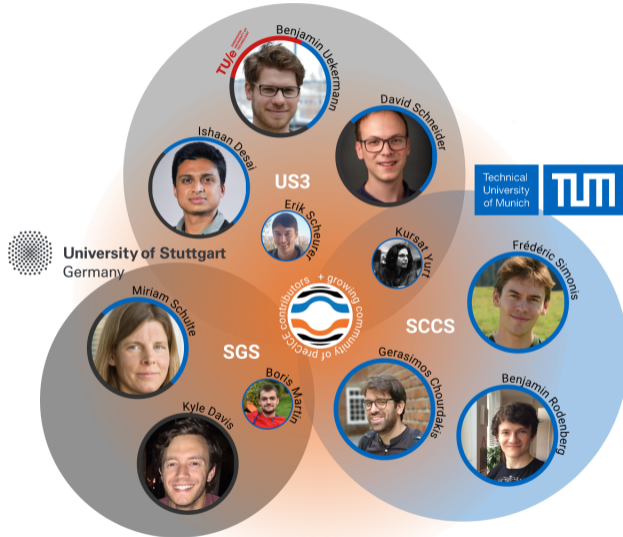
AWAITING PEER REVIEW

#### Comments on this article

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# People



# Funding

Supported by:



Federal Ministry  
for the Environment, Nature Conservation,  
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based on a decision of  
the German Bundestag



# DFG

- Research Software Sustainability  
- EXC 2075 SimTech



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754462





## Advertisements



The logo for the preCICE Workshop #4 2023. It features the preCICE logo (a stylized 'C' with blue and orange waves) followed by the text 'preCICE'. Above this, an orange banner contains the text 'Workshop #4' and another orange banner contains '2023'. Below the main text, there are two stacked rectangular boxes: the top one is blue with white text 'Technical University of Munich' and the bottom one is dark grey with white text 'February 13 - 16'. The word 'Germany' is written in white on a blue background, positioned between the two boxes.

Technical University of Munich February  
Germany 13 - 16

**Talk tomorrow (David Schneider):**  
*“Towards Large-Scale Data Mappings for Scattered Data”*

DT session, after lunch

## Summary

**Main message:** always think of the user, it may be highly beneficial (in the long run).

Gerasimos Chourdakis (@MakisH)  
gerasimos.chourdakis@tum.de  
(and many more)



Slides & feedback: [go.tum.de/200137](https://go.tum.de/200137)