COST Action InterCoML: Working Group 2 – Kickoff Meeting

ML for CT

<u>Working Group Leaders</u>: Hendrik Kleikamp and Francisco Periago

5 December 2025

This meeting will be recorded!

If you do not want to be visible on the record, please turn off your camera.

Schedule for today

Schedule for today – Morning session

- 9:00–9:15: Welcome
- *T2.1: Breaking the curse of dimensionality in some control and parametric problems for PDEs*
    - 9:15–9:45: Presentation by Francisco Periago
    - 9:45–10:00: Round table discussion
- 10:00–10:20: Coffee break
- *T2.2: Solving parameterised optimal control problems using machine learning*
    - 10:20–10:50: Presentation by Hendrik Kleikamp
    - 10:50–11:05: Round table discussion
- 11:05–11:15: Short break
- *T2.3: Computing control Lyapunov functions with neural networks*
    - 11:15–11:45: Presentation by Lars Grüne
    - 11:45–12:00: Round table discussion
- 12:00–13:30: Lunch break

- *T2.4: On the life-cycle-optimisation problems in materials and the deep neural network approach*
    - 13:30–14:00: Presentation by Peter Kogut
    - 14:00–14:15: Round table discussion
- 14:15–14:25: Short break
- *T2.5: Exploiting PINNs for solving complex free boundary problems*
    - 14:25–14:55: Presentation by Cristina Trombetti
    - 14:55–15:10: Round table discussion
- 15:10–15:30: Closing

Introduction to the COST Action

The COST Action InterCoML (CA24136) aims to …

1 strengthen the control-theoretical foundations of ML methods,

2 *leverage modern ML tools to tackle complex and high-dimensional CT problems,*

3 develop hybrid and data-driven models for highly complex application scenarios,

4 transform theoretical results into software solutions and practical implementations in industry and society,

5 disseminate insights and findings generated within the Action to the research community and the general public.

The COST Action InterCoML (CA24136) aims to …

1. strengthen the control-theoretical foundations of ML methods,
2. *leverage modern ML tools to tackle complex and high-dimensional CT problems,*
3. develop hybrid and data-driven models for highly complex application scenarios,
4. transform theoretical results into software solutions and practical implementations in industry and society,
5. disseminate insights and findings generated within the Action to the research community and the general public.

> The Action will combine different approaches, creating synergies that will benefit both sides, and leading to progress in both theoretical investigations and applications.

Introduction to Working Group 2

Applications of machine learning to solve problems in control theory

> Applications of machine learning to
> solve problems in control theory

(Current) Tasks within Working Group 2:

- Addressing the curse of dimensionality with ML tools
- Solving parameterised optimal control problems
- Construction of control Lyapunov functions using ML methods
- Developing ML-based approaches for the life-cycle-optimisation in materials
- Exploiting PINNs for solving complex free boundary problems

Activities planned by Working Group 2

First year of the COST Action:

- Dedicated session related to our Working Group at a joint meeting by the Action (information on this is soon to be published!)
- Initiation of smaller subgroups tackling specific problems
- Short Term Scientific Missions – STSMs (see also the next slide)
- Preparation of a benchmark collection for control problems
- Creation of lists of open problems and questions related to WG2

First year of the COST Action:

- Dedicated session related to our Working Group at a joint meeting by the Action (information on this is soon to be published!)
- Initiation of smaller subgroups tackling specific problems
- Short Term Scientific Missions – STSMs (see also the next slide)
- Preparation of a benchmark collection for control problems
- Creation of lists of open problems and questions related to WG2

In the long run of the COST Action:

- Organization of dedicated events and minisymposia at conferences related to WG2
- Implementation of training schools for students
- Dissemination activities (for instance in the context of the European Researchers' Night)

Short term scientific missions – STSMs

Goals and format:

- Short term visit (one to two weeks) financed by the COST Action
- Joint work on a project which benefits substantially from working together in person
- **Important:** STSMs are **not** restricted to the topics T2.1–T2.5 presented today
  $\longrightarrow$ If you have an idea for an interesting project, please apply!
- **Important:** Visiting and hosting researcher should dedicate most of the time during the STSM on the joint research project

Goals and format:

- Short term visit (one to two weeks) financed by the COST Action
- Joint work on a project which benefits substantially from working together in person
- **Important:** STSMs are **not** restricted to the topics T2.1–T2.5 presented today
  $\longrightarrow$ If you have an idea for an interesting project, please apply!
- **Important:** Visiting and hosting researcher should dedicate most of the time during the STSM on the joint research project

Requirements for application:

- <u>Before the application:</u> Contact a potential host for the STSM and develop a working plan together indicating milestones and goals
- <u>Before the application:</u> Receive a confirmation by the hosting/supervising researcher
- <u>After the STSM:</u> Present the outcomes of the STSM to WG2 (or even to the whole COST Action)

Presentations of tasks related to Working Group 2

Presentation T2.1 – Francisco Periago

Breaking the curse of dimensionality in some control and parametric problems for PDEs

Round table discussion on T2.1

Breaking the curse of dimensionality in some control and parametric problems for PDEs

Coffee break until 10:20

Presentation T2.2 – Hendrik Kleikamp

Solving parameterised optimal control problems using machine learning

Round table discussion on T2.2

Solving parameterised optimal control problems using machine learning

Short break until 11:15

Presentation T2.3 – Lars Grüne

Computing control Lyapunov functions with neural networks

Round table discussion on T2.3

Computing control Lyapunov functions with neural networks

Lunch break until 13:30

Presentation T2.4 – Peter Kogut

On the life-cycle-optimisation problems in materials and the deep neural network approach

Round table discussion on T2.4

On the life-cycle-optimisation problems in materials and the deep neural network approach

Short break until 14:25

Presentation T2.5 – Cristina Trombetti

Exploiting PINNs for solving complex free boundary problems

Round table discussion on T2.5

Exploiting PINNs for solving complex free boundary problems

Closing remarks

- **Working group 2 – we are officially up and running!**
- If not already done: *Apply to become part of the WG!*
- Call for STSMs will be published soon via mail and on our webpage!
- Please start connecting to a potential STSM host in the near future.
- If you are interested in working on one of the tasks for WG2, do not hesitate to contact Hendrik (`hendrik.kleikamp@uni-graz.at`) or Francisco (`f.periago@upct.es`)!
- There will be a joint conference of the Action at the end of April 2026 in Prague, Czech Republic, stay tuned!

Closing remarks

- **Working group 2 – we are officially up and running!**
- If not already done: *Apply to become part of the WG!*
- Call for STSMs will be published soon via mail and on our webpage!
- Please start connecting to a potential STSM host in the near future.
- If you are interested in working on one of the tasks for WG2, do not hesitate to contact Hendrik (`hendrik.kleikamp@uni-graz.at`) or Francisco (`f.periago@upct.es`)!
- There will be a joint conference of the Action at the end of April 2026 in Prague, Czech Republic, stay tuned!

Thanks for participating!