Friedrich-Alexander-Universität
Research Center for
Mathematics of Data | MoD

Hosted by our FAU MoD, the #MLPDES25 workshop is an international event that brings together researchers from Europe and the United States to explore the deepening connection between Machine Learning (ML) and Partial Differential Equations (PDEs). With participants from diverse backgrounds, this event aims to establish a collaborative platform for experts to network, share insights, and drive progress in these exciting fields.

We will dive into recent theoretical advancements and applications, while also discussing ongoing challenges in areas such as:
- Control and PDE methods for universal approximation and data classification
- Mean field analysis of Neural Networks
- ML applications in traffic flow modeling and autonomous driving
- ML and numerical simulation in bio-mechanics and micro-fluidics

Polimi	Poliba	AFOSR	FAU	Inria Sorbonne	Inria Sophia-Antipolis	Uni Rostock	FAU	UC San Diego	Surrey
Paola Antonietti	Alessandro Coclite	Fariba Fahroo	Giovanni Fantuzzi	Borjan Geshkovski	Paola Goatin	Alexander Keimer	Anne Koelewijn	Miroslav Krstic	Camilla Nobili

Machine Learning and PDEs

#MLPDES25 WORKSHOP

April 28 - 30, 2025

ERLANGEN - BAVARIA, GERMANY

Gianluca Orlando	Michele Palladino	Gabriel Peyré	Alessio Porretta	Francesco Regazzoni	Domènec Ruiz-Balet	Daniel Tenbrinck	Daniela Tonon	Yaoyu Zhang	Wei Zhu
Poliba	UAQ	CNRS ENS-PSL	UNIROMA2	Polimi	Imperial	FAU	UNIPD	SJTU	Georgia Tech

WHEN

Mon.-Wed. **April 28 - 30, 2025**
09:00H - 17:00H

WHERE

Onsite. FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg
Senatssaal (Senate Hall) im Kollegienhaus
Universitätsstraße 15, 91054 Erlangen - Bavaria, Germany

Online (live streaming): https://www.fau.tv/fau-mod-livestream-2025

REGISTRATION

Free but mandatory.
Registration form: www.dcn.nat.fau.eu/mlpdes25-registration

www.mod.fau.eu/mlpdes25

SCIENTIFIC COMMITTEE

- **Giuseppe Maria Coclite.** Politecnico di Bari
- **Enrique Zuazua.** FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg

ORGANIZING COMMITTEE

- **Darlis Bracho Tudares.** FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg
- **Nicola De Nitti.** EPFL, École Polytechnique Fédérale de Lausanne
- **Lorenzo Liverani.** FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg

AUDIENCE

This international workshop is open to: Public, Students, Postdocs, Professors, Faculty, Alumni and the scientific community all around the world.

UNTERSTÜTZT VON / SUPPORTED BY
Alexander von HUMBOLDT STIFTUNG
Friedrich-Alexander-Universität DYNAMICS, CONTROL, MACHINE LEARNING AND NUMERICS
Politecnico di Bari

Friedrich-Alexander-Universität
Research Center for
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www.mod.fau.eu/mlpdes25

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#MLPDES25 Schedule • Time table

	MON. APRIL 28, 2025	TUE. APRIL 29, 2025	WED. APRIL 30, 2025
09:30H 10:00H	Registration **Opening ceremony**	**Wei Zhu. Georgia Tech** Structure-Preserving Machine Learning and Data-Driven structure discovery	**Fariba Fahroo. AFOSR** TBA
10:00H 10:30H	**Daniel Tenbrinck. FAU** Eigenvalue problems on graphs and hypergraphs	**Gabriel Peyré. CNRS, ENS-PSL** Transformers are universal in-context learners	**Borjan Geshkovski. Inria S.** Many-particle systems perspective on Transformers
10:30H	COFFEE / TEA BREAK		
11:00H 11:30H	**Gianluca Orlando. Poliba** A comparison between peridynamic and classical waves	**Yaoyu Zhang. SJTU** The condensation phenomenon of Deep Neural Networks	**Daniela Tonon. UNIPD** Hamilton-Jacobi equations on infinite dimensional spaces
11:30H 12:00H	**Camilla Nobili. Surrey** Quantification of enhanced dissipation and mixing for time-dependent shear flows	**Paola Antonietti. Polimi** Machine Learning enhanced polytopal finite element methods	**Alessio Porretta. UNIROMA2** Diffusion effects in optimal transport and mean-field planning models
12:00H	LUNCH BREAK		
14:30H 15:00H	**Alexander Keimer. Rostock** Optimal control of nonlocal conservation laws and the singular limit	**Francesco Regazzoni. Polimi** Replicator dynamics as the large-population limit of a multi-strategy discrete moran process	**Anne Koelewijn. FAU** SSPINNpose: Self-supervised learning of biomechanical variables without ground truth
15:00H 15:30H	**Michele Palladino. UAQ** Handling uncertainty in optimal control	**Giovanni Fantuzzi. FAU** Data-driven system analysis: Polynomial optimization meets Koopman	**Miroslav Krstic. UC San Diego** Neural Operators: Implementation enablers for PDE control
15:30H	COFFEE / TEA BREAK		**Alessandro Coclite. Poliba** Replicator dynamics on a network
16:00H 16:30H	**Paola Goatin. Inria S.A.** Data-driven simulation, uncertainty quantification and optimization for hyperbolic and kinetic models	**Domènec Ruiz-Balet. Imperial** Some remarks on matching measures with Machine Learning architectures	**Closing ceremony**
20:00H		**Social dinner**	

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- **Enrique Zuazua**. FAU MoD/DCN-AvH, Friedrich-Alexander-Universität Erlangen-Nürnberg

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- **Lorenzo Liverani**. FAU DCN-AvH, Friedrich-Alexander-Universität Erlangen-Nürnberg

07.03.2025

Machine Learning and PDEs

#MLPDES25 WORKSHOP

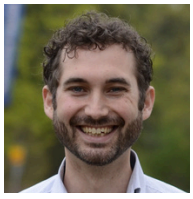
April 28 - 30, 2025

ERLANGEN - BAVARIA
GERMANY

DAY 1 • Mon. April 28, 2025

09:30H
10:00H
Registration
Opening ceremony

10:00H
10:30H



Daniel Tenbrinck
FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg
Eigenvalue problems on graphs and hypergraphs

10:30H
COFFEE / TEA BREAK

11:00H
11:30H

Gianluca Orlando
Politecnico di Bari
Replicator dynamics as the large-population limit of a multi-strategy discrete moran process

11:30H
12:00H

Camilla Nobili
University of Surrey
Quantification of enhanced dissipation and mixing for time-dependent shear flows

12:00H
LUNCH BREAK

14:30H
15:00H

Alexander Keimer
Universität Rostock
Optimal control of nonlocal conservation laws and the singular limit

15:00H
15:30H

Michele Palladino
Università degli Studi dell'Aquila
Handling uncertainty in optimal control

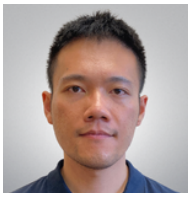
15:30H
COFFEE / TEA BREAK

16:00H
16:30H

Paola Goatin
Inria Sophia-Antipolis
Data-driven simulation, uncertainty quantification and optimization for hyperbolic and kinetic models

DAY 2 • Tue. April 29, 2025

09:30H
10:00H



Wei Zhu
Georgia Institute of Technology
Structure-Preserving Machine Learning and Data-Driven structure discovery

10:00H
10:30H

Gabriel Peyré
CNRS, ENS-PSL
Transformers are universal in-context learners

10:30H **COFFEE / TEA BREAK**

11:00H
11:30H

Yaoyu Zhang
Shanghai Jiao Tong University
The condensation phenomenon of Deep Neural Networks

11:30H
12:00H

Paola Antonietti
Politecnico di Milano
Machine Learning enhanced polytopal finite element methods

12:00H **LUNCH BREAK**

14:30H
15:00H

Francesco Regazzoni
Politecnico di Milano
Discovering the hidden low-dimensional dynamics of time-dependent PDEs with latent dynamics networks

15:00H
15:30H

Giovanni Fantuzzi
FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg
Data-driven system analysis: Polynomial optimization meets Koopman

15:30H **COFFEE / TEA BREAK**

16:00H
16:30H

Domènec Ruiz-Balet
Imperial College London
Some remarks on matching measures with Machine Learning architectures

20:00H **Social dinner**

DAY 3 • Wed. April 30, 2025

09:30H
10:00H

Fariba Fahroo
AFOSR, Air Force Office of Scientific Research
TBA

10:00H
10:30H

Borjan Geshkovski
Inria, Sorbonne Université
Many-particle systems perspective on Transformers

10:30H **COFFEE / TEA BREAK**

11:00H
11:30H

Daniela Tonon
Università di Padova
Hamilton-Jacobi equations on infinite dimensional spaces

11:30H
12:00H

Alessio Porretta
Università di Roma Tor Vergata
Diffusion effects in optimal transport and mean-field planning models

12:00H **LUNCH BREAK**

14:30H
15:00H

Anne Koelewijn
FAU, Friedrich-Alexander-Universität Erlangen-Nürnberg
SSPINNpose: Self-supervised learning of biomechanical variables without ground truth

15:00H
15:30H

Miroslav Krstic
University of California San Diego
Neural Operators: Implementation enablers for PDE control

15:30H
16:00H

Alessandro Coclite
Politecnico di Bari
Replicator dynamics on a network

16:00H **Closing ceremony**

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FAU. Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)
FAU MoD, Research Center for Mathematics of Data
www.mod.fau.eu

Quick-info

Cauerstraße 11, 91058 Erlangen
Felix Klein building. 3rd. floor
+49 9131 85-67133
dcn-avh@fau.de
+49 174 198-9775 (urgencies)

#MLPDES25 website

www.mod.fau.eu/events/mlpdes25

Registration #MLPDES25

www.dcn.nat.fau.eu/mlpdes25-registration

How to get to Erlangen?

By taxi. The best choice. Expect to pay: 35 EUR – 40 EUR approx. for one trip (Duration: 15 mins.)

By bus. Take Bus Nº 30. Frequency: 20-30 mins. Expect to pay: 02 EUR – 04 EUR (Duration: 30 mins.)
Tickets for local public transportation can be purchased at the Customer Service Offices of the transportation companies or from ticket machines at major stops.

How to get to our FAU DCN-AvH Chair office?

From the main train station (in the center of Erlangen) you can get to our office at Cauerstrasse:

By taxi. 15EUR–20EUR approx. (one trip, from center to the FAU's Department Mathematik
Duration: 10-15 mins.)

By bike/car. Coming by bike/car? In front of the building you will find a huge parking lot available! (gMaps directions)

By foot. Distance: 4Kms. approx. from the downtown to our building. Expect to walk: 45 mins.

By bus. Please take **bus Nº 20** at the Erlangen Arcaden center (3 mins by walk from the main train station).
Go off the bus at "Technische Fakultät" stop. (11 stops later)
Frequency: 20 mins. Expect to pay: 02 EUR – 02.50 EUR (Duration: 15mins)
Other options (bus): Taking Nº 287 or Nº 293 from the main bus station (Bahnhofsplatz 1, city center).
Frequency: 20 – 30 mins (Duration: 25 – 30mins.)

Hotels

- Hotel Altmanns Stube
- A.B. Hotel
- NIU Cure

Apartments

- Zeitwohnhaus
- NIU Cure – Hipster Studio
- Hotel Kral – Wohnen auf Zeit

Restaurants

- Steinbachbräu (Brewhouse)
- Alter Simpl (Franconian)
- Spezerei (Franconian)

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