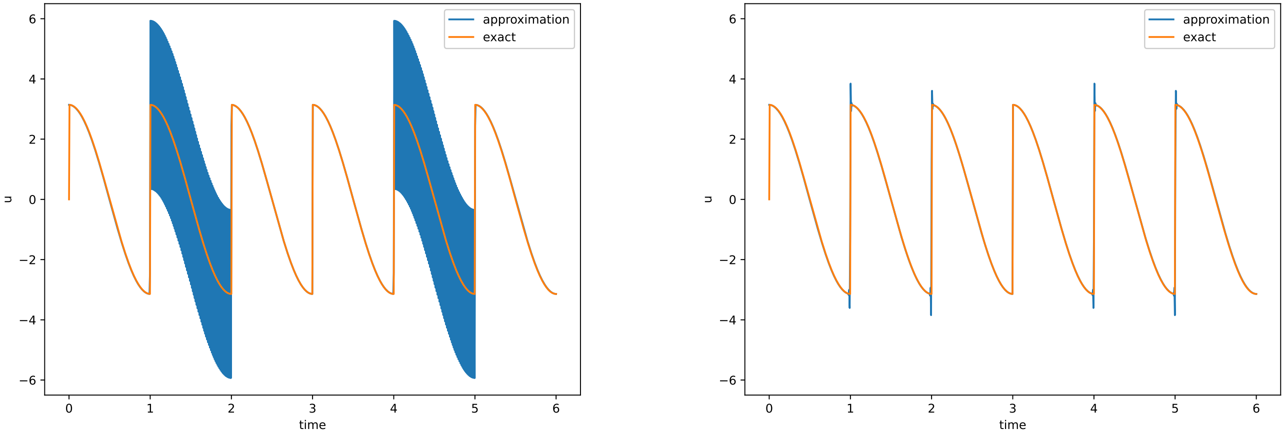
47th Woudschoten conference 2023

One-minute poster session

14:00-15:00 Line up from 01 till 24

DUTCH-FLEMISH
SCIENTIFIC
COMPUTING SOCIETY

Stable adaptive least-squares space-time boundary element methods for the wave equation.



(a) Standard approach (b) Least-squares approach

By:

D. M. Hoonhout, MSc.

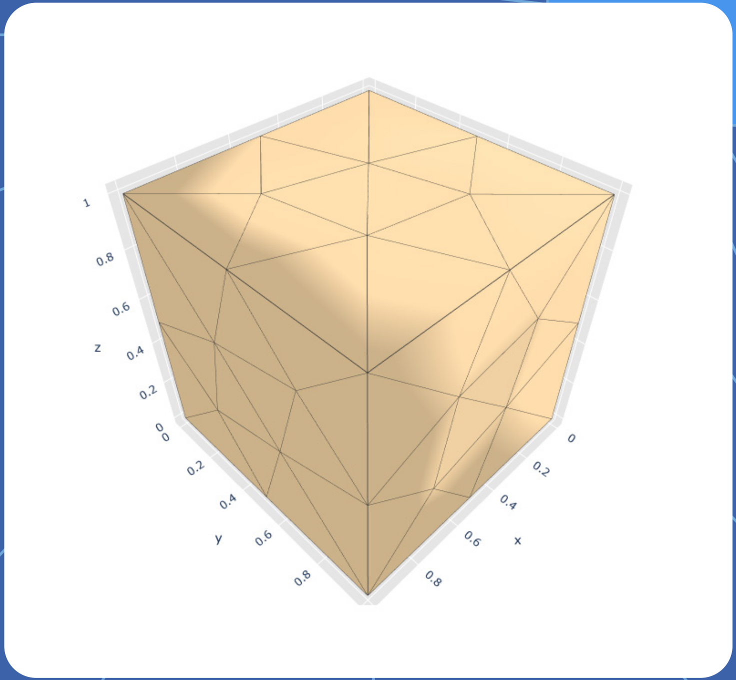
DELFT UNIVERSITY OF TECHNOLOGY

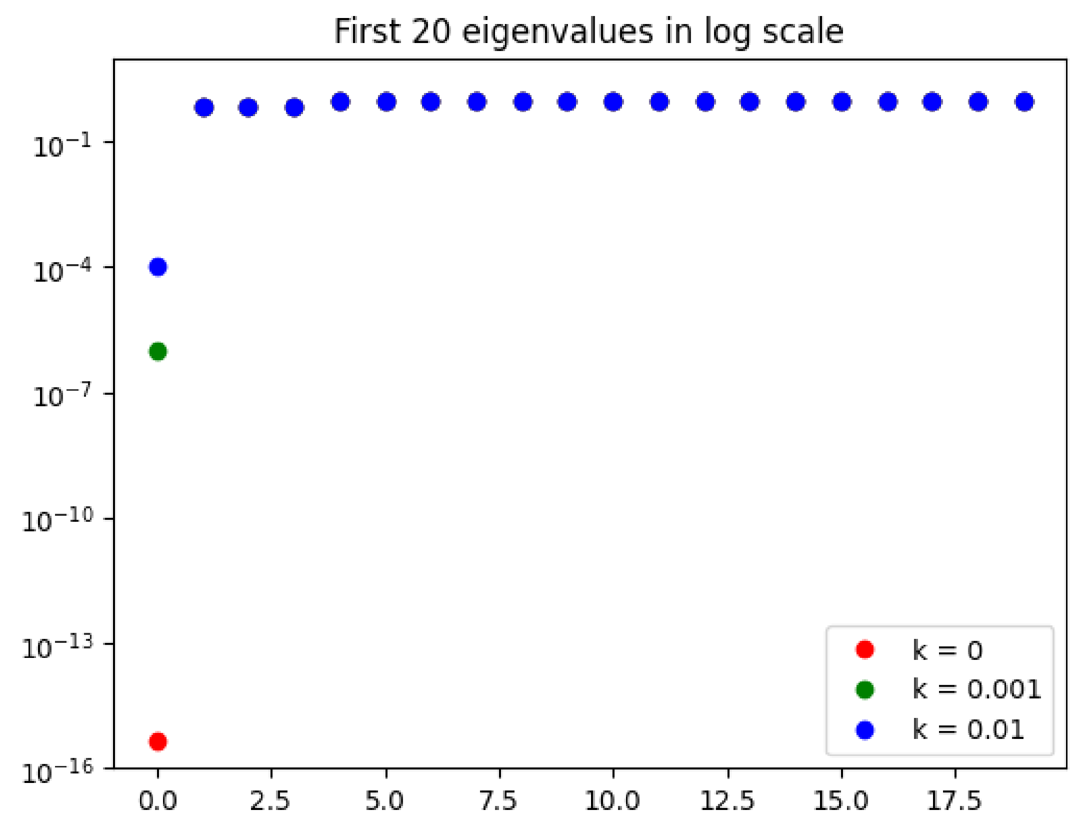
FACULTY OF NUMERICAL ANALYSIS

First-kind Galerkin BEM for the single layer operator of the Hodge-Helmholtz equation

Ralf Hiptmair[a], Carolina Urzúa-Torres[b], Anouk Wisse[b]
[a] Seminar for Applied Mathematics, ETH Zürich, Switzerland
[b] Delft Institute of Applied Mathematics, Delft University of Technology, Netherlands

$$\mathbf{curl}\ \mathbf{curl}\ \mathbf{A} - \eta\nabla\mathrm{div}\mathbf{A} - \kappa^2\mathbf{A} = 0$$





Novel Reduced Basis Sampling Method for problems with high-dimensional parameters

Evie Nielen, Oliver Tse, Karen Veroy

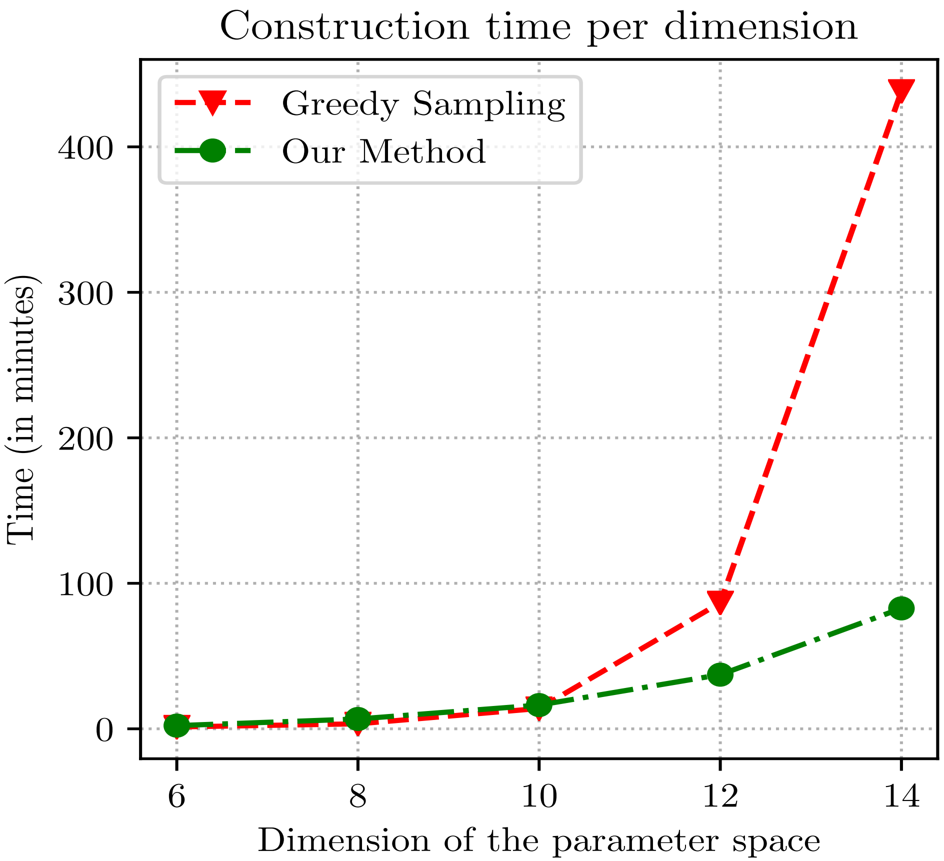
Set-up: Bilinear, coercive, linear form:

$a(u, v; \mu) = f(v; \mu)$

Goal: Construct a reduced basis

The catch: parameter μ is high-dimensional

Greedy Sampling asks for a lot of patience



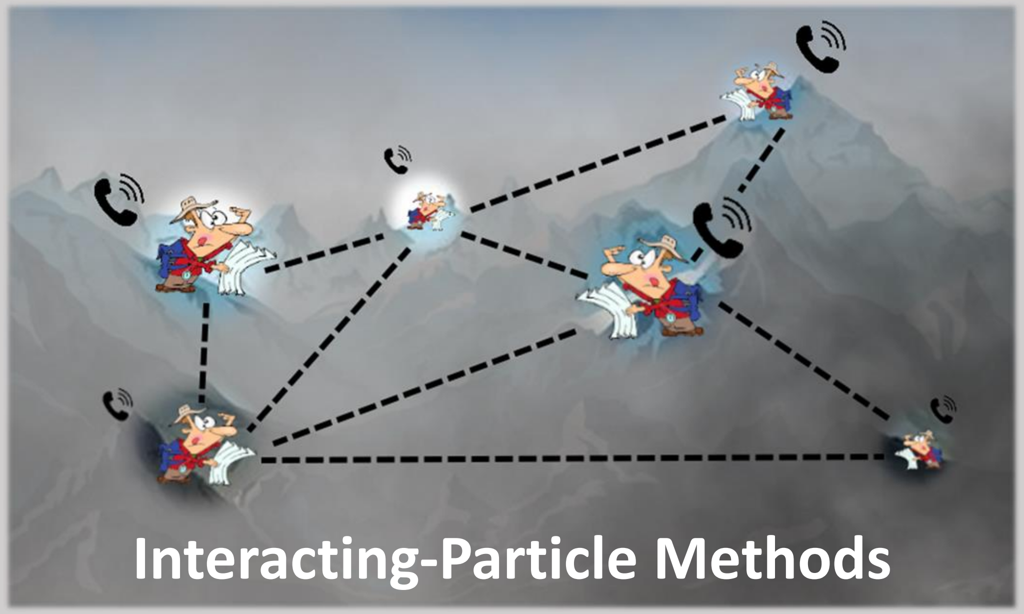
Fast calculation of Potential Future Exposure and XVA sensitivities using Fourier series expansion

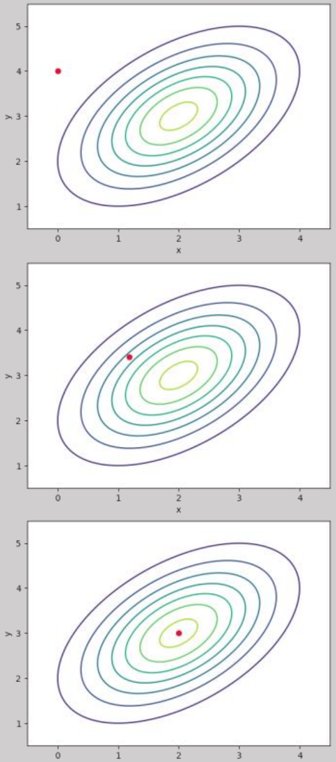
Gijs Mast   Xiaoyu Shen   Fang Fang

Delft University of Technology, The Netherlands
FF Quant Advisory B.V., The Netherlands

September 27, 2023

Single-Ensemble Multilevel Monte Carlo for Interacting-Particle Methods

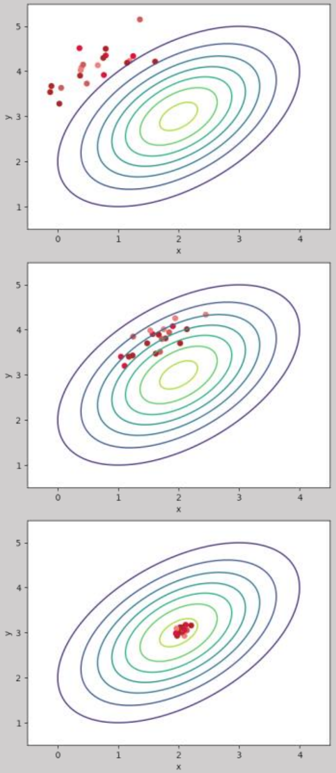




Pros +	Cons -
Greater **exploration**	**Expensive** evaluation at every particle, at every timestep
Trivially **parallelizable**	
Often **gradient-free**	

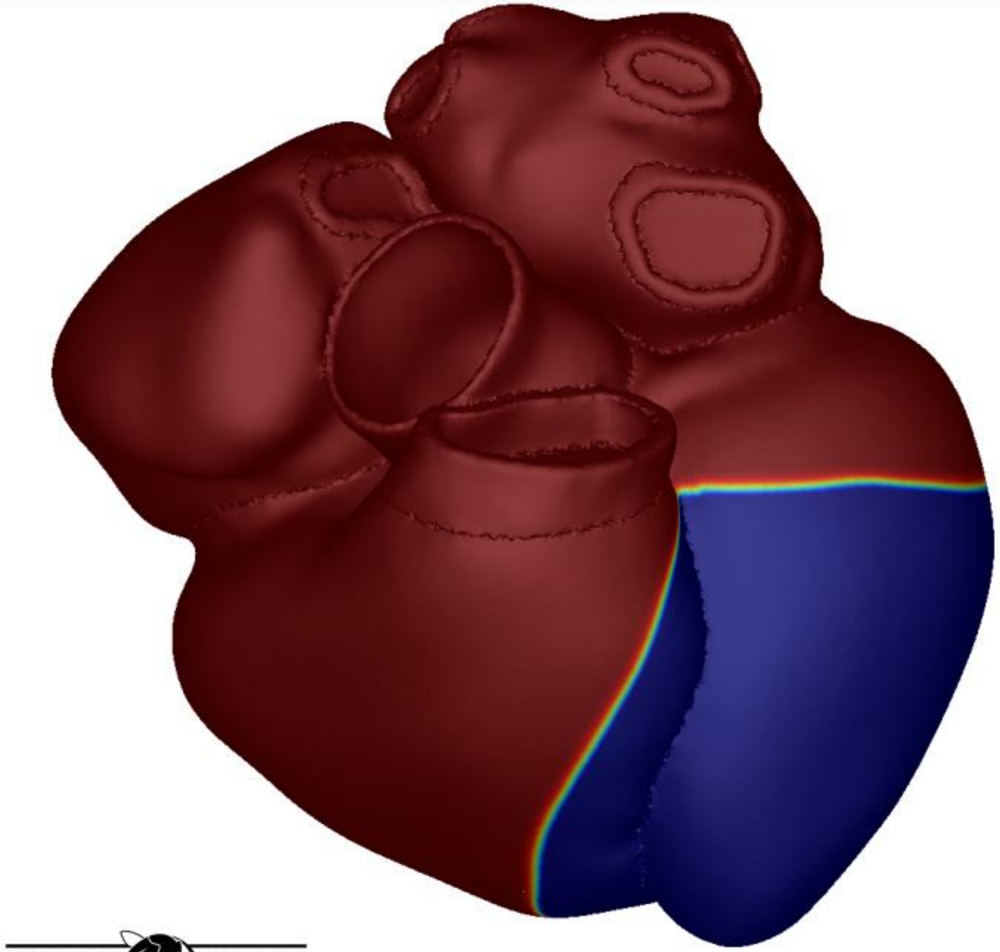
Solution

Leverage **cheap** approximations
with multilevel Monte Carlo



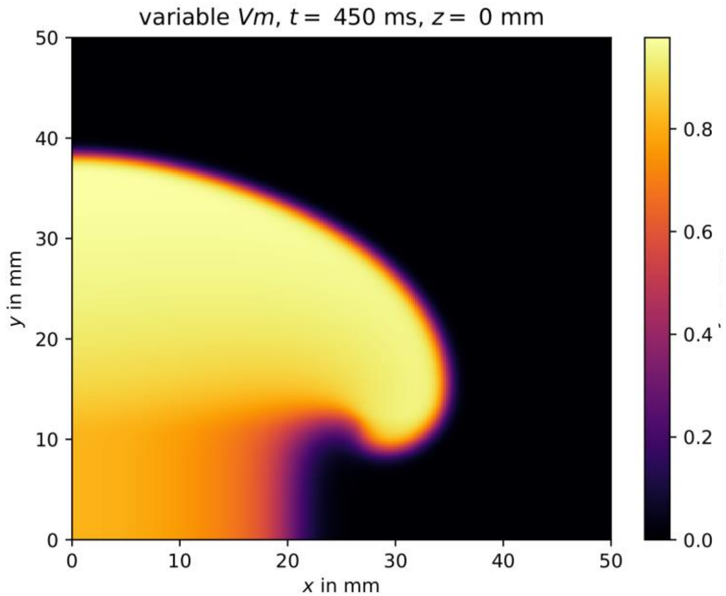
A. Bouillon, T. Ingelaere & G. Samaey

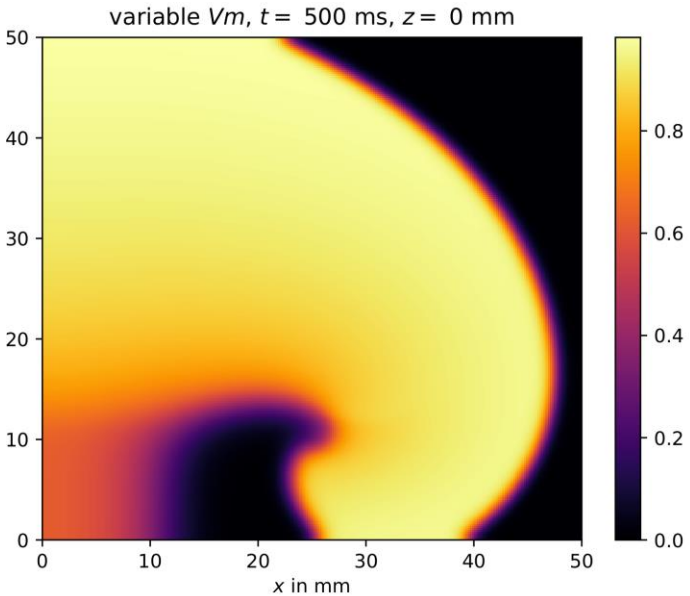
Markov Chain Monte Carlo methods for electrical conductivity estimation in the heart



Maarten Volkaerts
KU Leuven
Department of Computer Science

$$\frac{\partial V_m}{\partial t} = \underbrace{\nabla \cdot D \nabla V_m}_{\text{wave propagation}} + \underbrace{R(V_m, u)}_{\text{ion currents}} \qquad \frac{\partial u}{\partial t} = f(V_m, u)$$





Utrecht University

Deltares

Adaptive moving meshes for space-fractional PDE models in 1D using the L2(NU)-method

Pu Yuan, Paul Zegeling, Ailbhe Mitchell

MMPDE: $$\frac{\partial x}{\partial t} = \frac{1}{\tau}\frac{\partial}{\partial \xi}\left(M\frac{\partial x}{\partial \xi}\right)$$

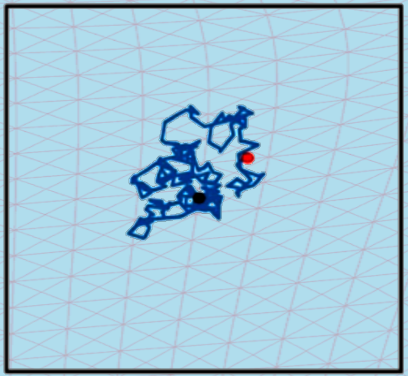
$${}_{C}D^{\alpha}_{a,x}u(x) = \frac{1}{\Gamma(2-\alpha)}\sum_{k=0}^{n-1}\int_{x_k}^{x_{k+1}}(x-s)^{1-\alpha}\frac{\partial^2 u}{\partial s^2}ds$$

Apply to

$$-(-\Delta)^{\frac{\alpha}{2}}u(x) = -\frac{1}{2\cos(\alpha\pi/2)}\left({}_{C}D^{\alpha}_{x,R}u(x) + {}_{C}D^{\alpha}_{x,L}u(x)\right)$$

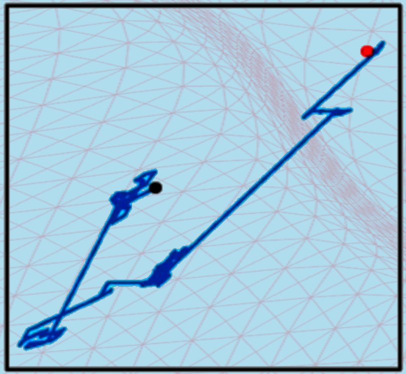
Solves

$$u_t = -(-\Delta)^{\frac{\alpha}{2}}u(x) + f(u)$$



Brownian(random) walk

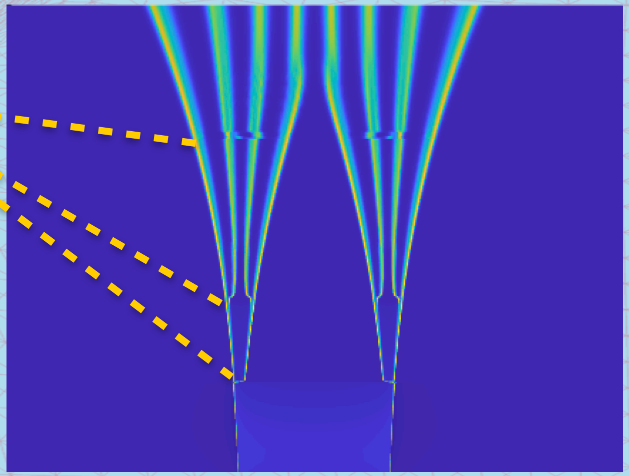
α=2



Levy flights

1<α<2

Detecting the bifurcations in the space-fractional Gray-Scott model



Mortgage prepayment: What is the "right price" of people's behavior?

Leonardo Perotti
l.perotti@uu.nl

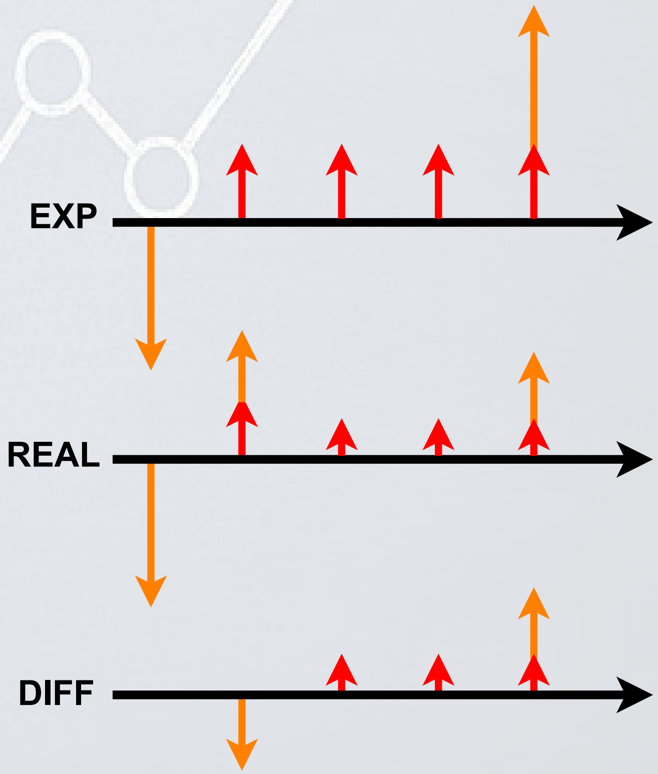
Utrecht University

Mathematical Institute @ **Utrecht University**
Treasury Modelling @ **Rabobank**

Rabobank

Buying a house and winning the lottery…

- Contractual **expected** repayments
- **Behavioral uncertainty** of prepayment
- What is the **"fair price"**?

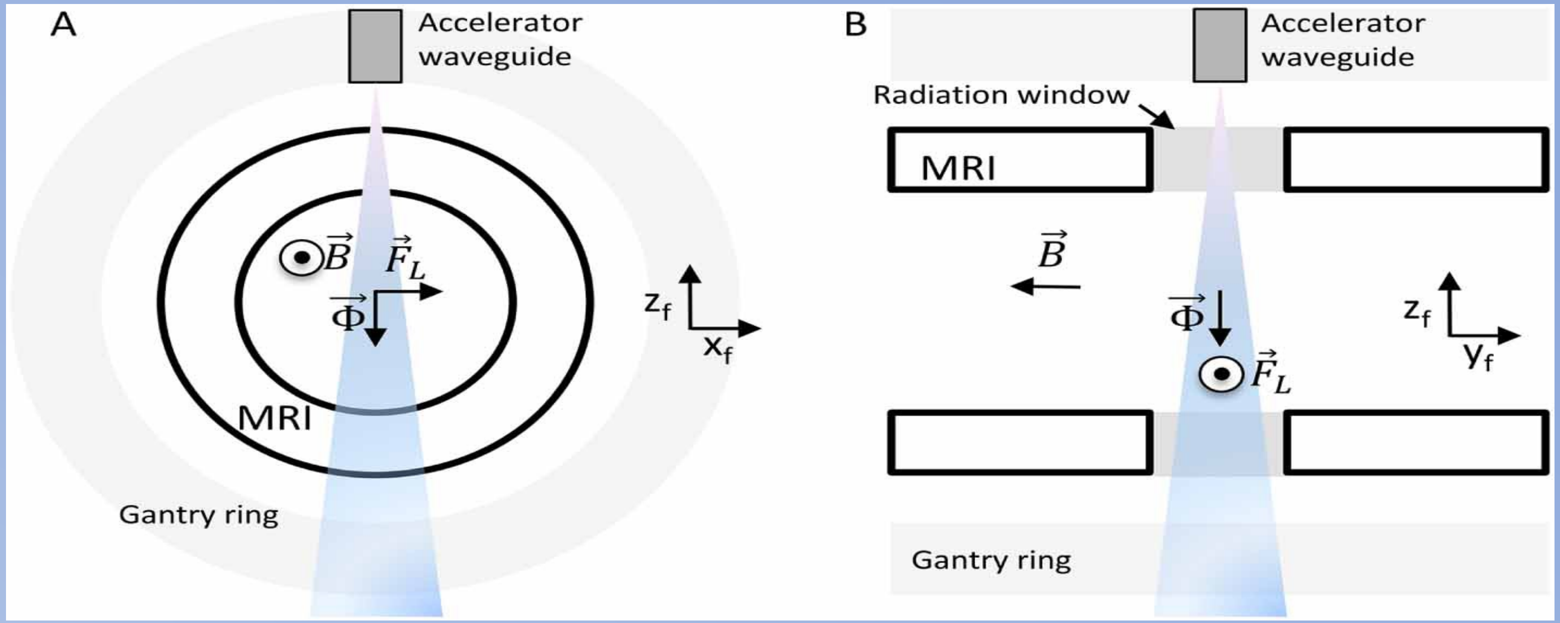


…with some math

- Stochastic optimal **control problem**
- **Measure change** (Girsanov's Theorem)
- (**Deep**) machine **learning** application

Analysis and systematic discretization of a Fokker-Planck equation with Lorentz force

UNIVERSITY OF TWENTE.



NWO

Vincent Bosboom
Herbert Egger
Matthias Schlottbom

Multilevel MCMC with high-resolution observations

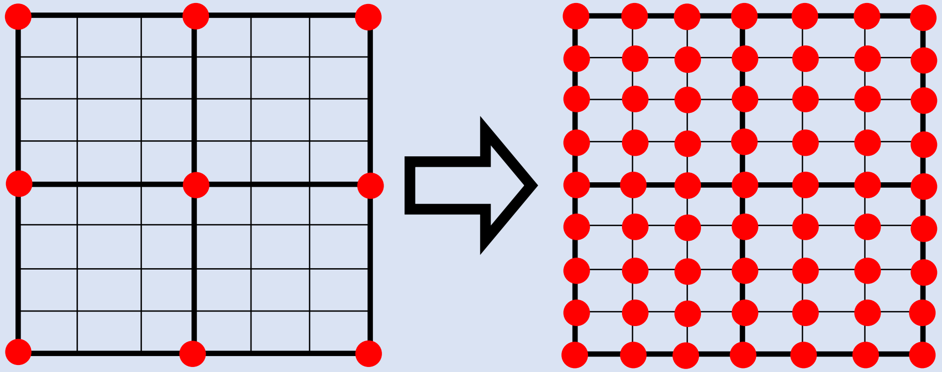
Pieter Vanmechelen, Geert Lombaert & Giovanni Samaey

ALGORITHMIC DEVELOPMENT

Extend MCMC sampling to use resolution-dependent data

APPLICATION ORIENTED

Focus on real-life applications in structural health monitoring



KU LEUVEN

fwo

Structure-preserving Model Reduction on Manifolds

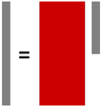
How well can classical model reduction methods, e.g., POD, perform?

Benchmark: Kolmogorov N-width

$$d_n((\mathcal{P})) := \inf_{V_n;\dim(V_n)=n} \sup_{\boldsymbol{\mu}\in\mathcal{P}} \inf_{\mathbf{v}_n\in V_n} \|\mathbf{x}_N(\boldsymbol{\mu}) - \mathbf{v}_n\|$$

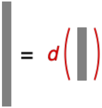
① Model Reduction on Manifolds

- Extend linear-subspace approximation, $\mathbf{V} \in \mathbb{R}^{2N\times 2n}$
- To nonlinear approximations, $d : \mathbb{R}^{2n} \to \mathbb{R}^{2N}$
- Focus on: polynomial embeddings, autoencoders



② Structure-preserving MOR

- Preserve given structure in reduced model, e.g.,
- Hamiltonian system: symplectic model reduction

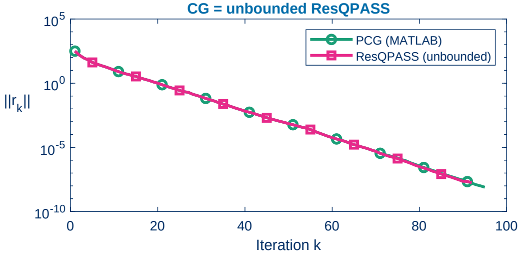


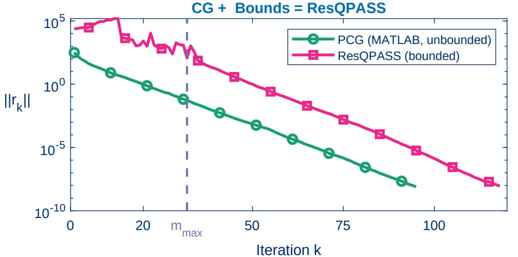
$$\frac{d}{dt}\mathbf{x}(t;\boldsymbol{\mu}) = \mathbb{J}_{2N}\nabla_{\mathbf{x}}\mathcal{H}(\mathbf{x}(t;\boldsymbol{\mu});\boldsymbol{\mu})$$

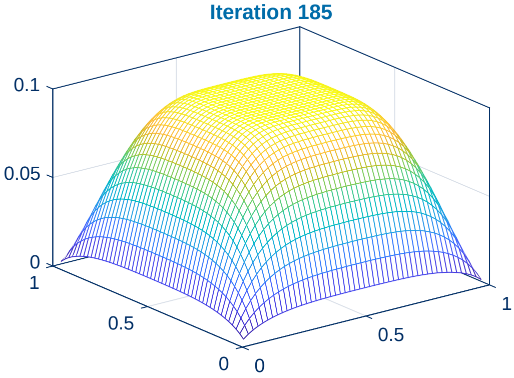
UNIVERSITY
OF TWENTE.

CG + bounded variables = ResQPASS

Bas Symoens


CG = unbounded ResQPASS


CG + Bounds = ResQPASS


Iteration 185

University of Antwerp

Applied Mathematics

Uncertainty Quantification for Neural Field equations with random data

Francesca Cavallini

Vrije Universiteit Amsterdam

Amsterdam Center for Dynamics and Computation

Woudschoten conference , Sept 27 2023

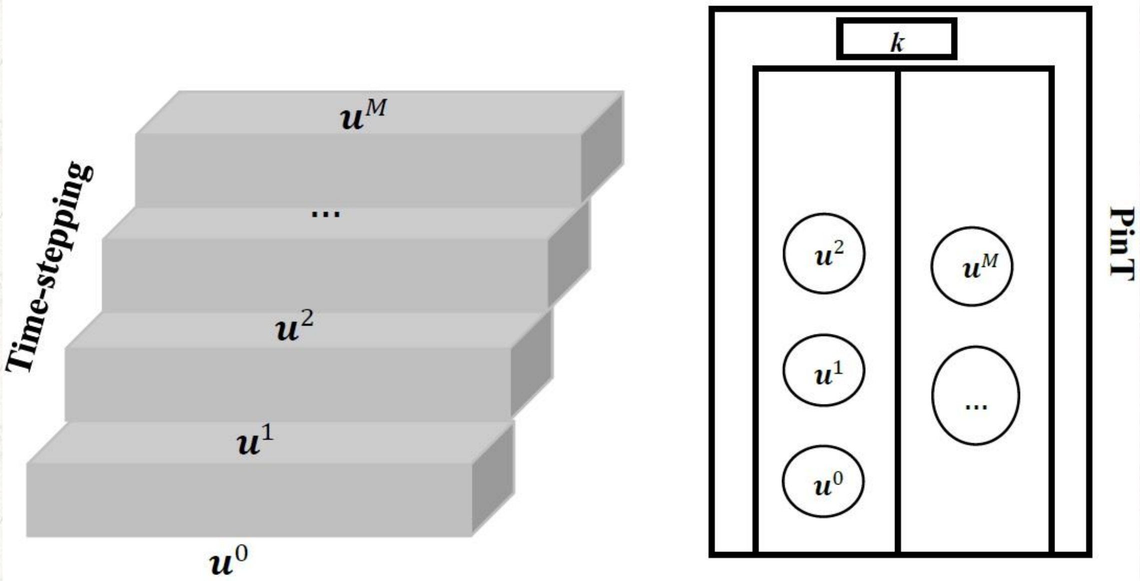
Variational multiscale stabilization of the magnetohydrodynamics equations

Kevin Dijkstra

Parallel-in-time iterative methods with Crank-Nicolson scheme for European option pricing PDEs

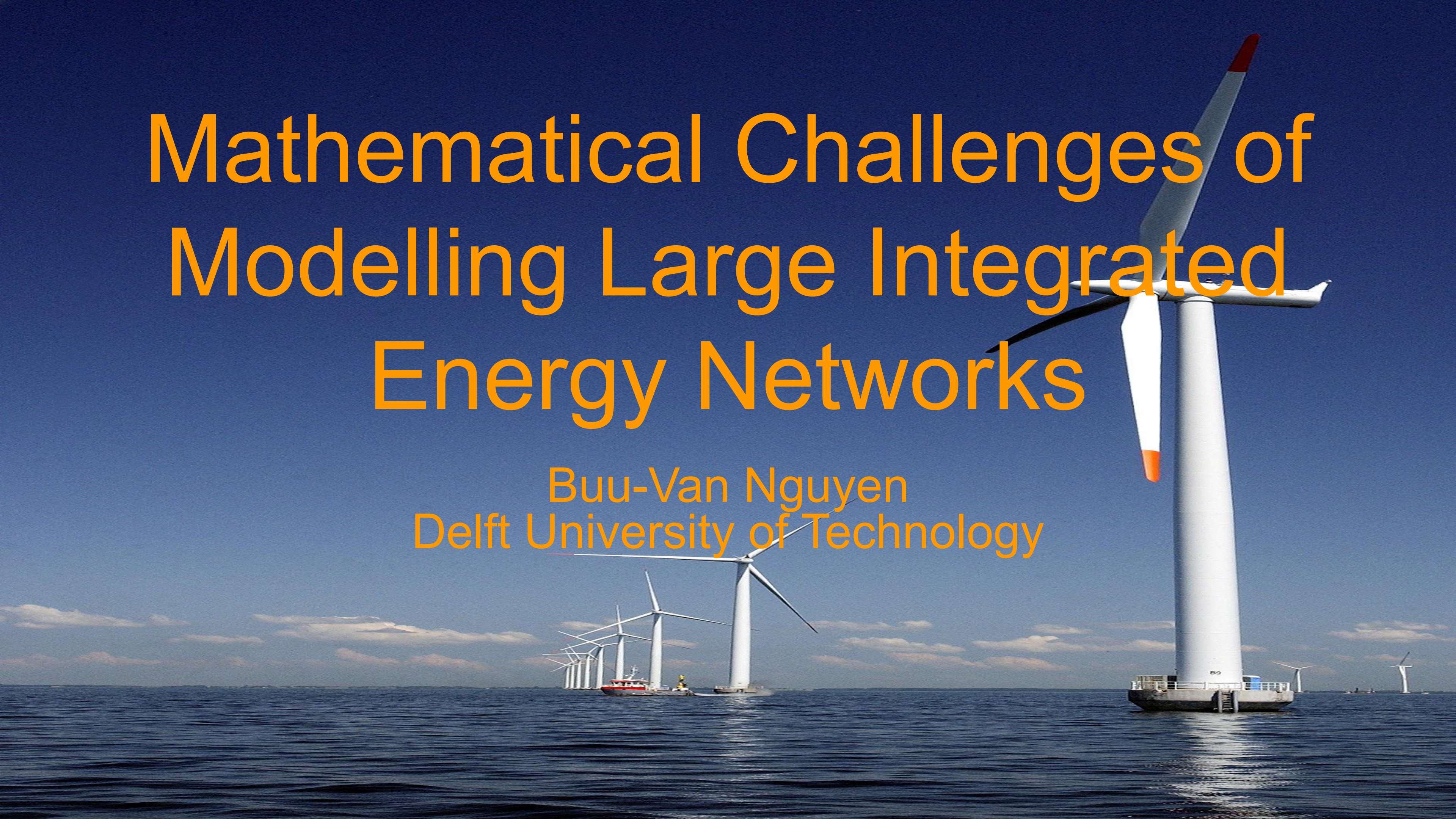
Xian-Ming Gu (SWUFE, China & Utrecht U., Netherlands), Y.-L. Zhao (SICNU, China), C. W. Oosterlee (Utrecht U., Netherlands)

- ✓ Numerical methods of European option pricing PDEs find the solution in each time level one-by-one, namely the time-stepping scheme;
- ✓ Parallel-in-time methods solve the European option pricing PDEs for all the discrete time points simultaneously via matrix diagonalization.



Time-stepping method vs. Parallel-in-time method

Universiteit Utrecht

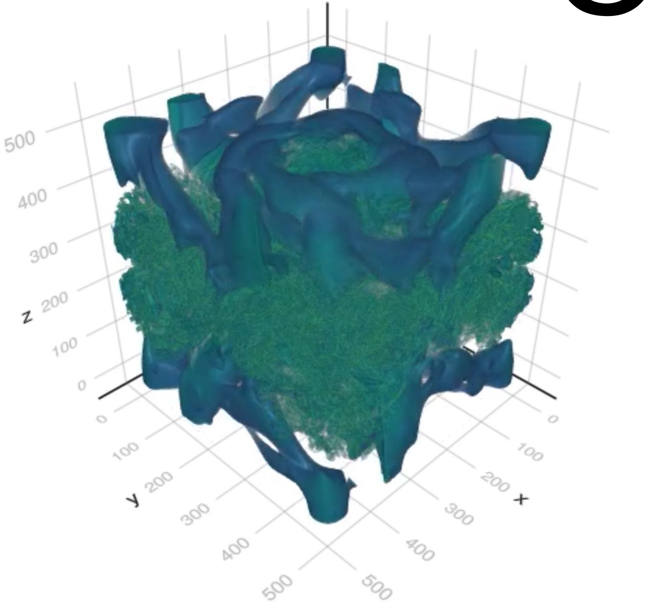


Mathematical Challenges of Modelling Large Integrated Energy Networks

Buu-Van Nguyen
Delft University of Technology

Closing Navier-Stokes

Once and for all



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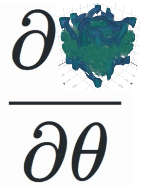

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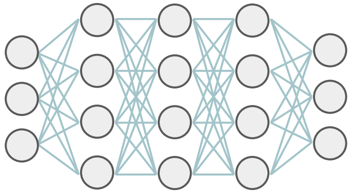

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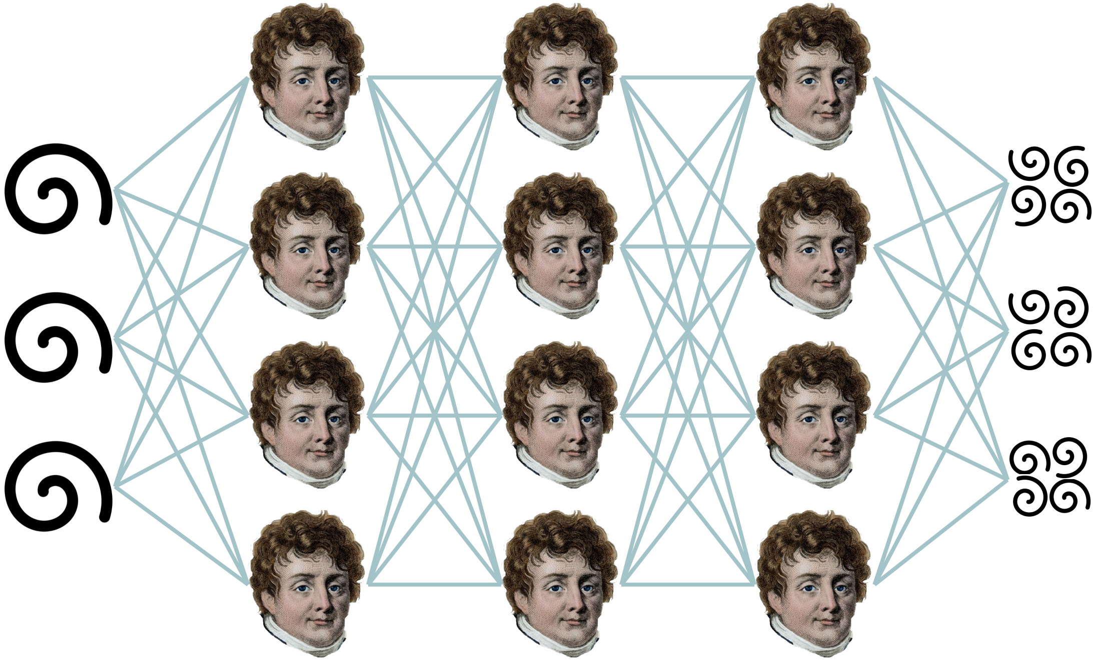


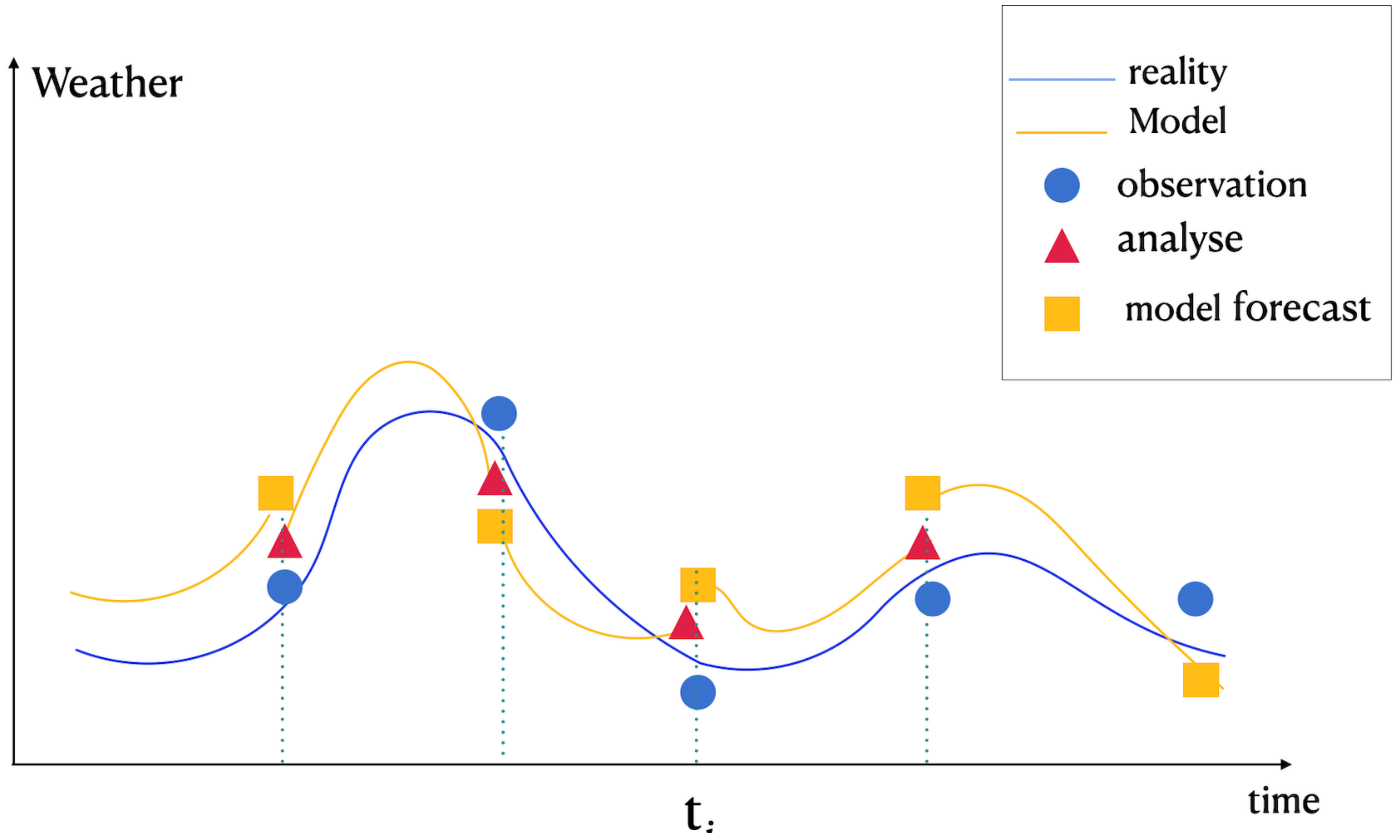
Syver Døving Agdestein

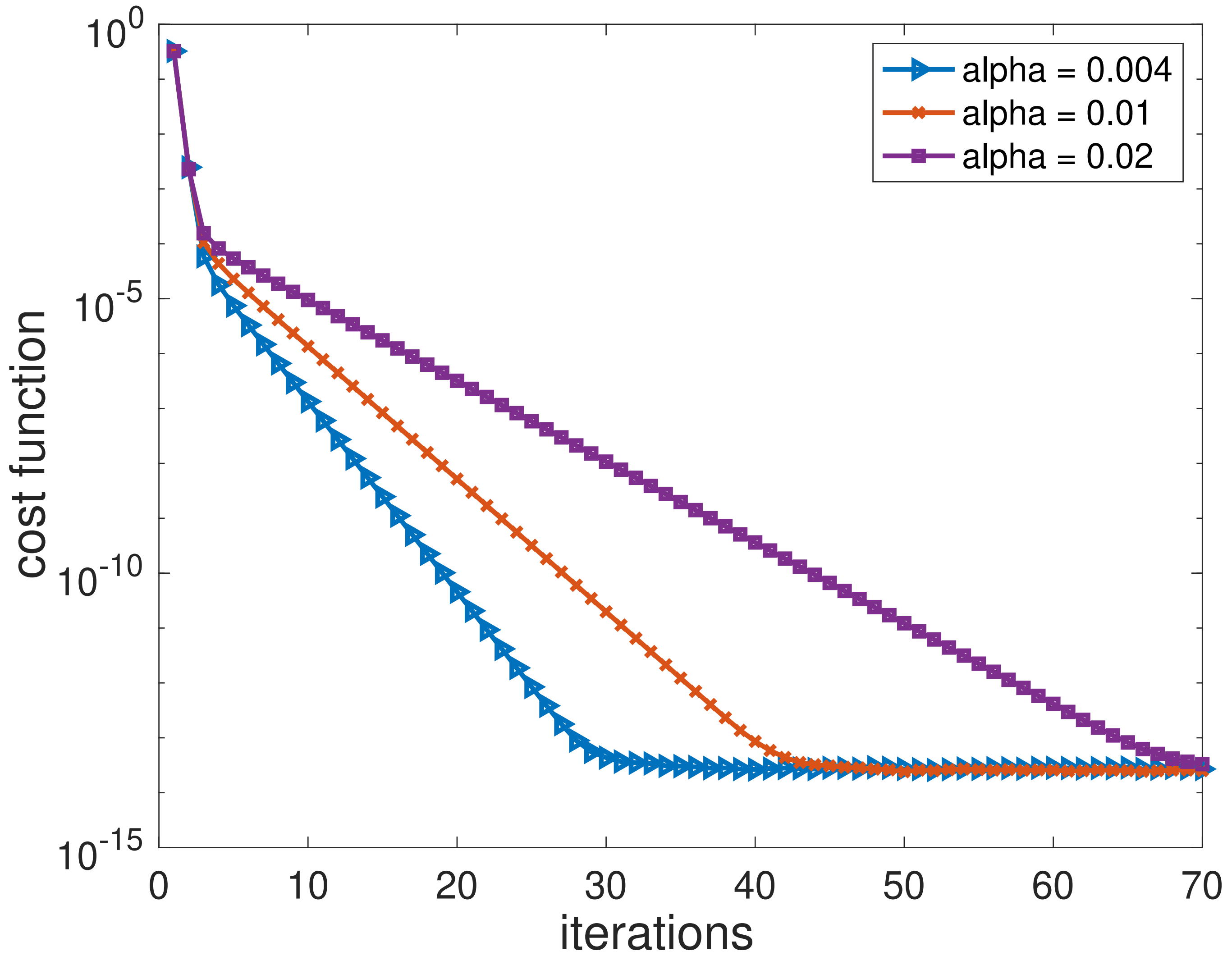
Neural closure models for the incompressible Navier-Stokes equations

Error analysis of a modified form of variational data assimilation

Nazanin Abedini

Vrije Universiteit Amsterdam

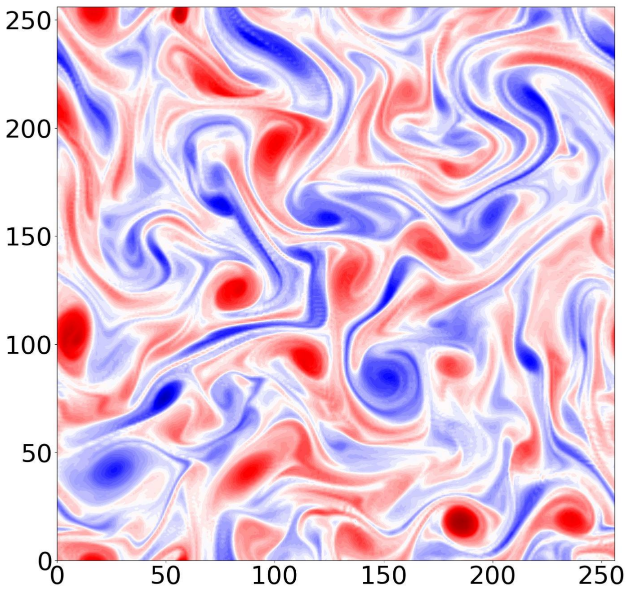




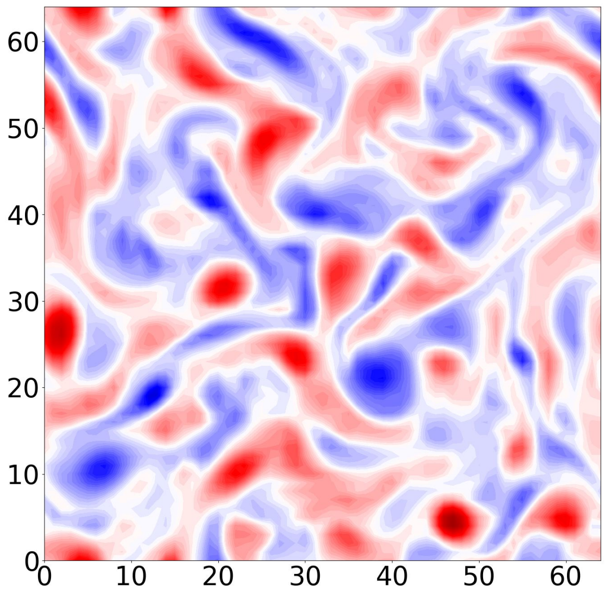
$$\min_{\mathbf{u}\in\mathbb{R}^{nN}} \frac{1}{2}\{\|G(\mathbf{u})\|^2+\alpha\|\mathbf{y}-H\mathbf{u}\|^2\},$$

Low dimensional data-driven LES closures

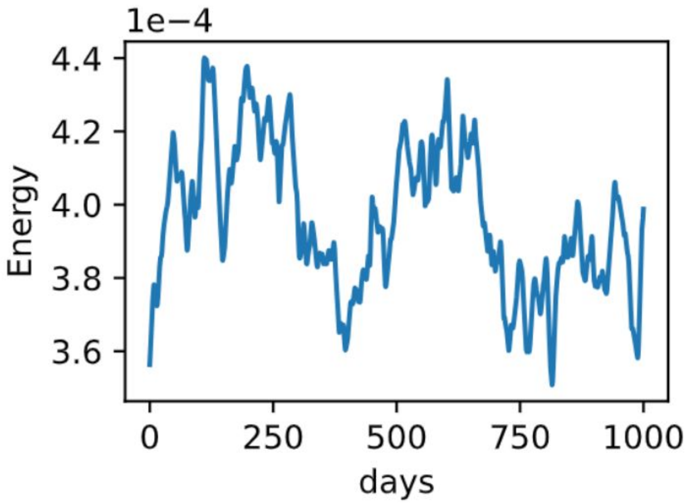
HF



LF



QoI

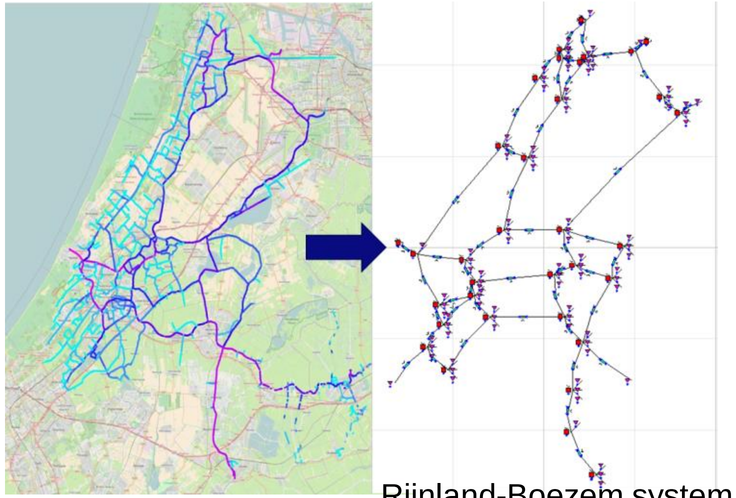


Towards prediction of low dimensional QoIs with data-driven LES closures in 2D turbulence.
Rik Hoekstra

CWI

Techniques applied to non-linear multi-objective optimization problems in water management

Ailbhe Mitchell on behalf of Deltares



Rijnland-Boezem system

Fluid flow:

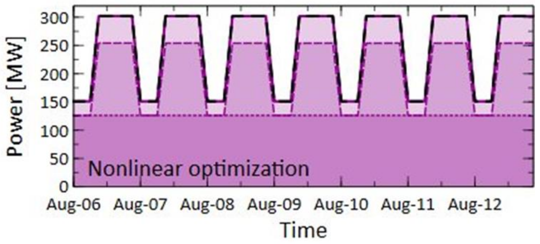
$$F = \frac{\partial Q}{\partial t} + \frac{\partial}{\partial x}\frac{Q^2}{A} + gA\frac{\partial H}{\partial x} + g\frac{Q|Q|}{ARC^2} = 0,$$

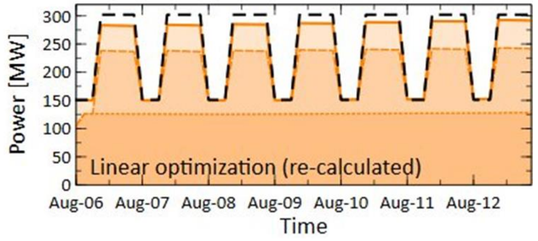
Power equations:

$$P = \eta(Q, H_u, H_d) \cdot \rho \cdot \mathrm{g} \cdot Q \cdot \Delta H,$$
$$\Delta H = H_u - H_d,$$

- Piecewise constant
- Piecewise linear
- Continuation method

- Discrete decisions?





Very large non-linear systems → **Approach** → **Results**

Development and Application of bundle-valued forms in the hybrid mimetic spectral element method

TU/e

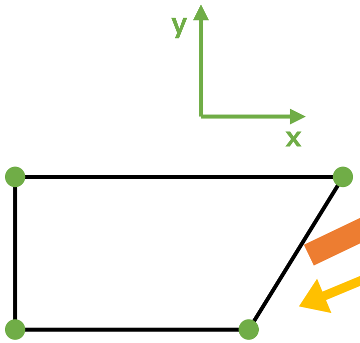
Revanth Sharma, Marc Gerritsma

TU Delft

Physical space

All physical laws and equations are written/or expressed in this domain

Real geometries, may not be easy to model



$\frac{\partial}{\partial x} \otimes a$

$dx \otimes b dy$

Components of physical quantities defined in terms physical (cartesian) coordinates.

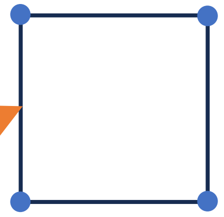
Vector equations written in cartesian coordinate directions

$$\begin{tikzcd}
0 & e_i \otimes \Lambda'^{(2)} \arrow[l, "\mathrm{d}"'] \arrow[d, dashed, leftrightarrow, "\star^b"] & e_i \otimes \Lambda'^{(1)} \arrow[l, "\mathrm{d}"'] \arrow[d, dashed, leftrightarrow, "\star^b"] & e_i \otimes \Lambda'^{(0)} \arrow[l, "\mathrm{d}"'] \arrow[d, dashed, leftrightarrow, "\star^b"] & \mathbb{R} \arrow[l] \\
\mathbb{R} \arrow[r] & e^i \otimes \Lambda^{(0)} \arrow[r, "\mathrm{d}"] & e^i \otimes \Lambda^{(1)} \arrow[r, "\mathrm{d}"] & e^i \otimes \Lambda^{(2)} \arrow[r, "\mathrm{d}"] & 0
\end{tikzcd}$$

Vector-valued forms

Covector-valued forms

Partial transformation (Lagrangian)



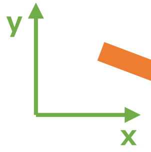
Map given geometry onto a reference domain

Can exploit favourable properties of reference domain

The map used to convert the form parts only

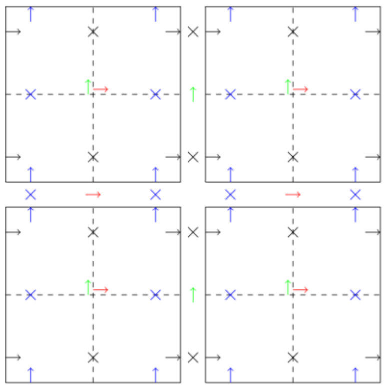
Vector equations written in cartesian (physical) coordinate directions

Equations converted from physical space



$dx \otimes b d\eta$

$\frac{\partial}{\partial x} \otimes a$



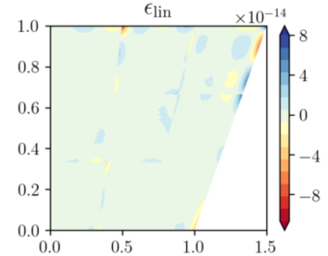
?

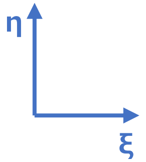
Full transformation

Map given geometry onto a reference domain

Can exploit favourable properties of reference domain

Vector equations written in reference coordinate directions



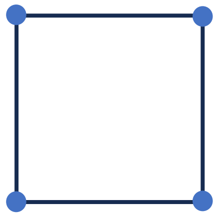


$\frac{\partial}{\partial \xi} \otimes a$

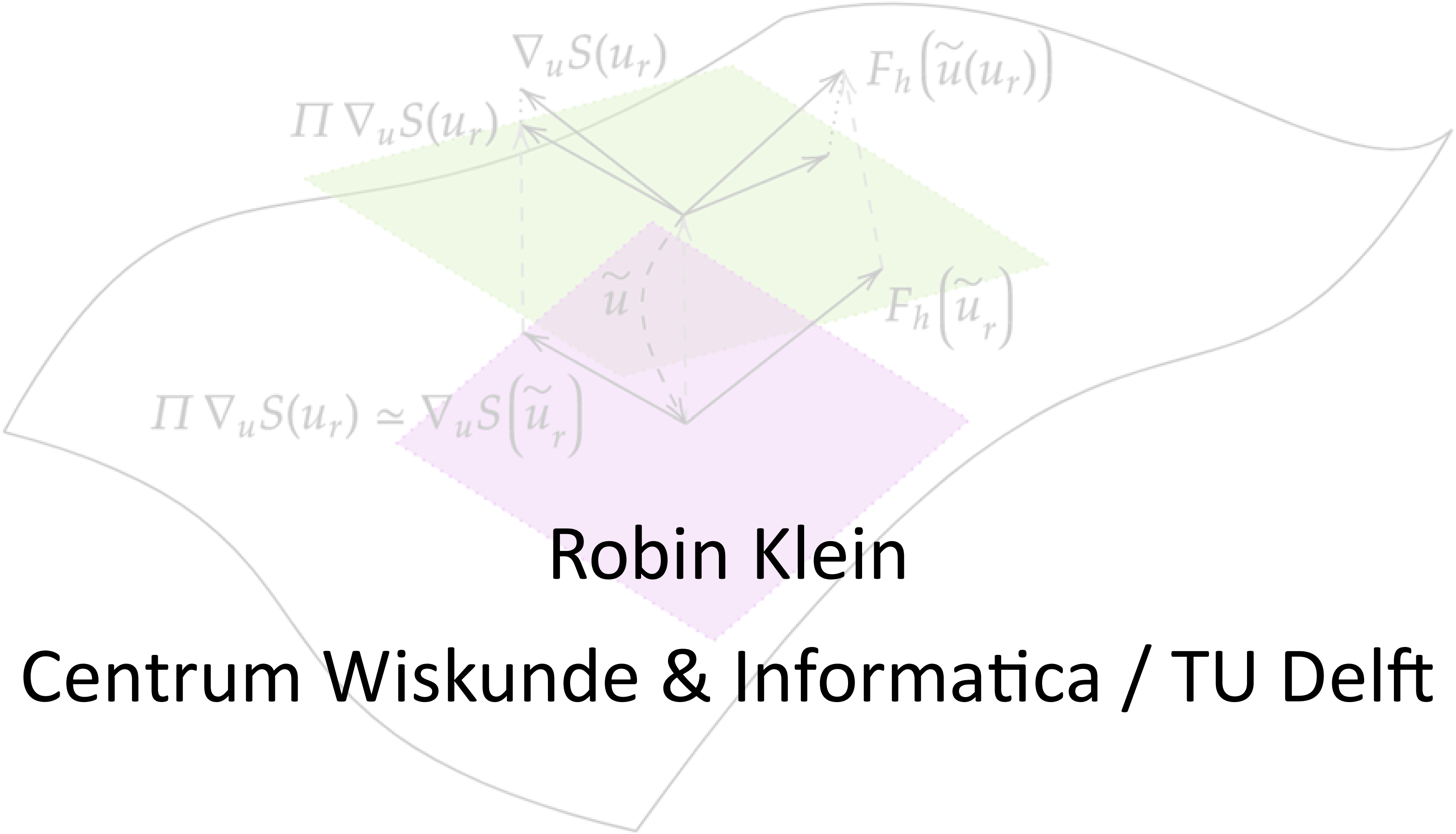
$d\xi \otimes b d\eta$

The map used to convert both the form and the value parts

Equations converted from physical space



Entropy Stable Model Reduction on Nonlinear Manifolds of Hyperbolic Systems



Robin Klein

Centrum Wiskunde & Informatica / TU Delft

One Step Malliavin schemes:
A BSDE approach for Delta Gamma hedging

Balint Negyesi*

model errors — BSDE

regression Monte Carlo

COS

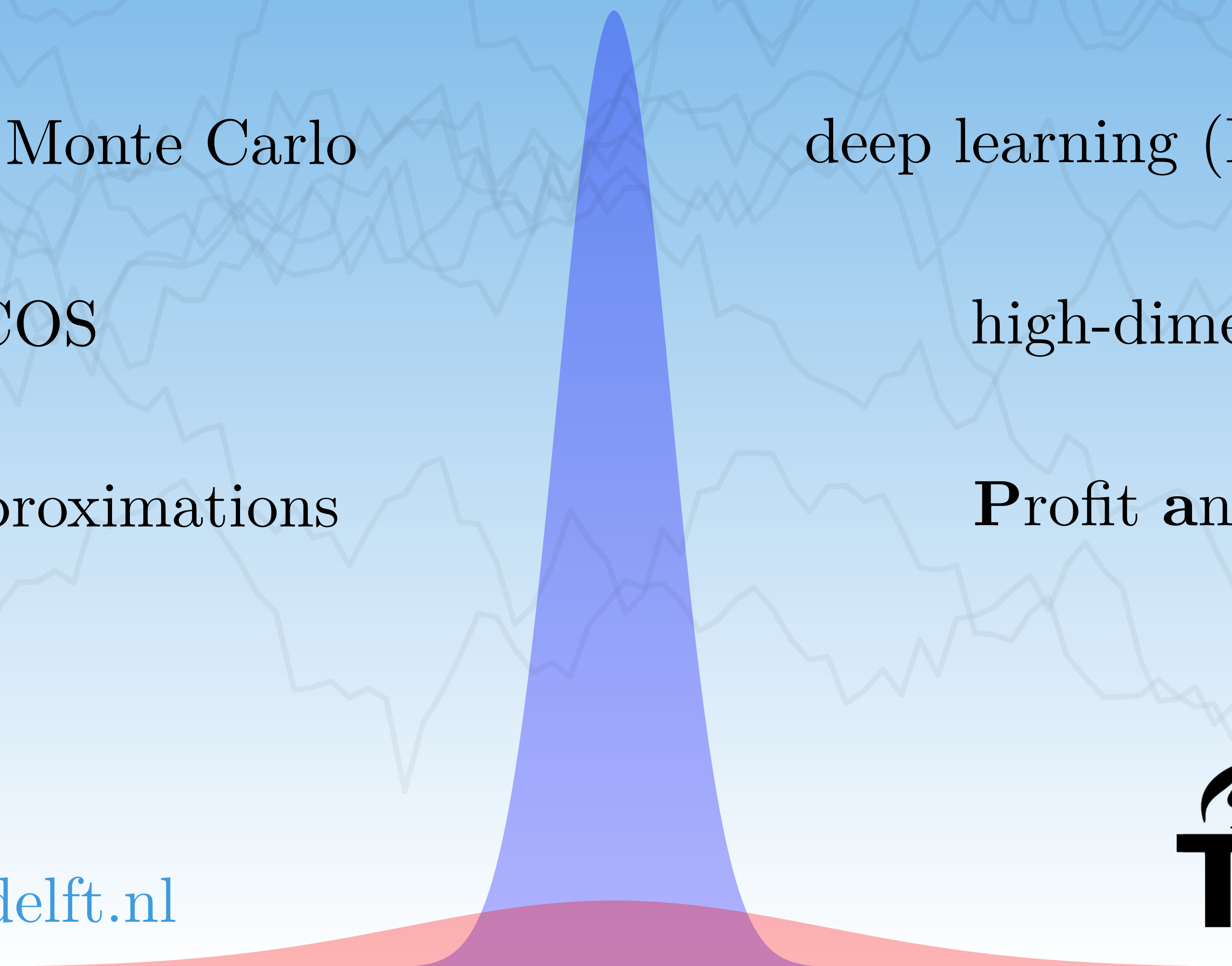
Δ & Γ approximations

European/Bermudan/American

deep learning (Deep BSDE)

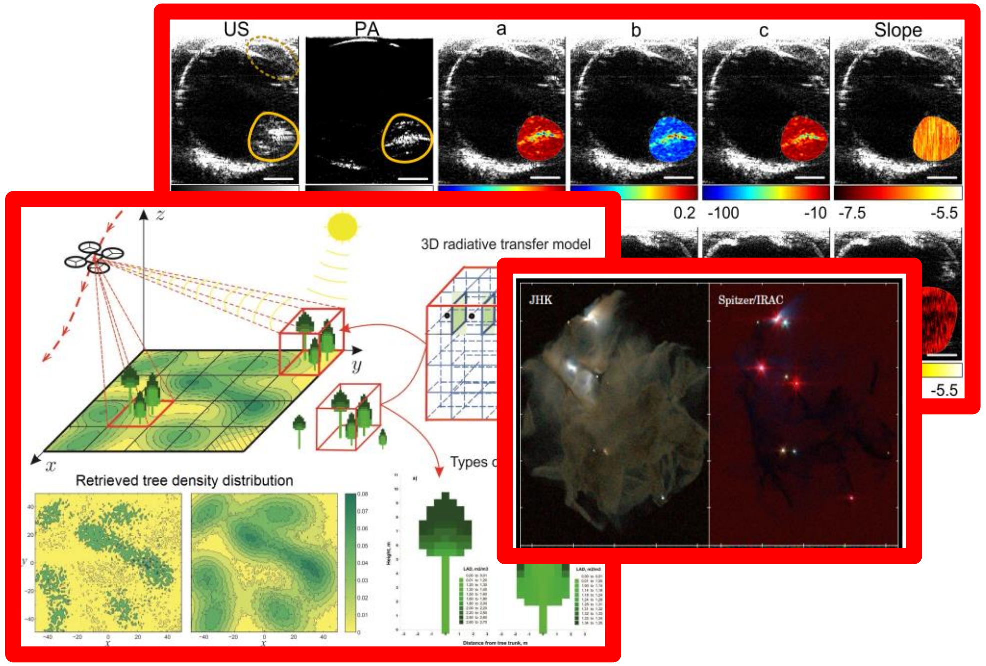
high-dimensions

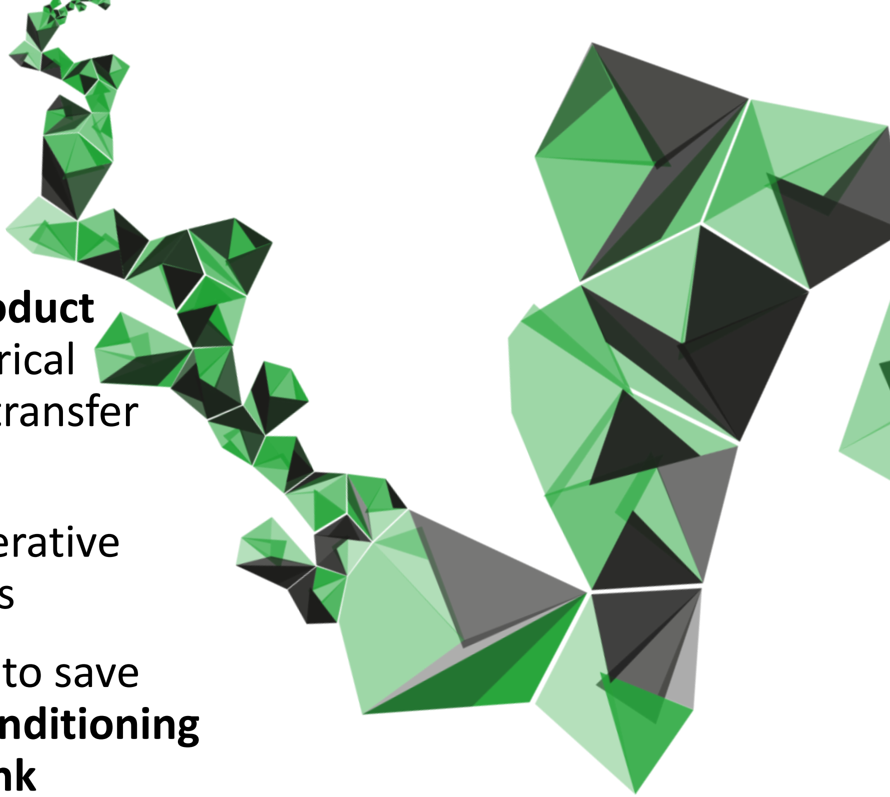
Profit **a**nd **L**oss



*b.negyesi@tudelft.nl

FACULTY OF ELECTRICAL ENGINEERING, MATHEMATICS AND COMPUTER SCIENCE (EEMCS)
MATHEMATICS OF COMPUTATIONAL SCIENCES GROUP (MACS/SACS)





- New **low-rank tensor-product framework** for the numerical solution of the radiative transfer equation
- Full **compatibility** with iterative methods in Hilbert spaces
- Efficient implementation to save memory and time (**preconditioning** and combination with **rank truncation** methods)

A LOW-RANK TENSOR PRODUCT FRAMEWORK FOR RADIATIVE TRANSFER IN PLANE-PARALLEL GEOMETRY

RICCARDO BARDIN[1], MATTHIAS SCHLOTTBOM[1], MARKUS BACHMAYR[2]

1 UNIVERSITY OF TWENTE
2 RWTH AACHEN UNIVERSITY

UNIVERSITY OF TWENTE.

27 SEPTEMBER 2023