

About

- ▶ Position: **PostDoc**
- ▶ Field: **Numerical Mathematics**
- ▶ Specialty: **Model Reduction**
- ▶ Group: **AG Ohlberger**
- ▶ Office: **Orleans-Ring 10 (120.021)**



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Projects

- ▶ Since 2021-11: Westfälische Wilhelms Universität Münster
Algorithm Knowledge Graph & Open Interfaces (MaRDI)
<https://mardi4nfdi.de>
- ▶ 2016–2021: Max Planck Institute Magdeburg
Model Order Reduction for Gas and Energy Networks (MathEnergy)
<https://mathenergy.de>
- ▶ 2011–2016: Westfälische Wilhelms Universität Münster
Combined State and Parameter Reduction (PhD Project)
<https://gramian.de>

Combined State and Parameter Reduction

Input-Output System:

$$\begin{aligned} \dot{x}(t) &= f(x(t), u(t), p) & \dim(x(t)) &\gg 1 \\ y(t) &= g(x(t), u(t), p) & \dim(p) &\gg 1 \end{aligned}$$

Input: $u(t)$

Parameter: p

State: $x(t)$

Vector Field: f

Output: $y(t)$

Output Function: g

Reduced Order Model:

$$\begin{aligned} \dot{x}_r(t) &= f_r(x_r(t), u(t), p_r) & \dim(x_r(t)) &\ll \dim(x(t)) \\ \tilde{y}(t) &= g_r(x_r(t), u(t), p_r) & \dim(p_r) &\ll \dim(p) \end{aligned}$$

$$\|y(p) - \tilde{y}(p_r)\| \ll 1$$

Model Order Reduction for Gas and Energy Networks

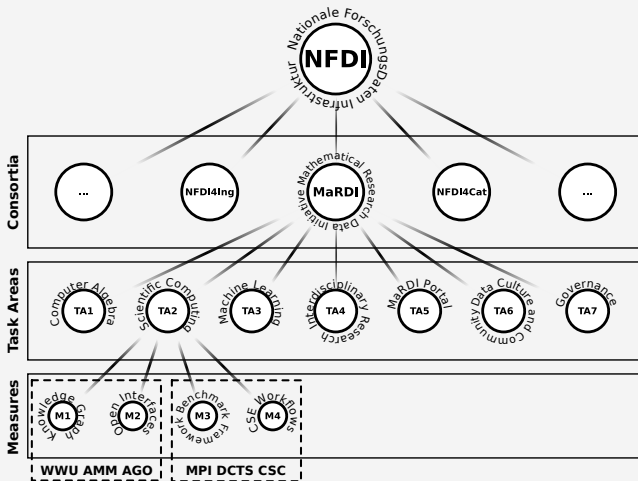
Gas Pipeline Model (Isothermal Euler Equations) :

$$\frac{1}{\gamma_0 z_0} \partial_t p = -\frac{1}{S} \partial_x q$$

$$\partial_t q = -S \partial_x p - \underbrace{\left(\frac{S g h_x}{\gamma_0 z_0} p \right)}_{\text{Gravity}} + \underbrace{\left(\frac{\gamma_0 z_0 \lambda_0 |q| q}{2 d S p} \right)}_{\text{Friction}}$$

Pressure:	$p(x, t)$	Pipe Diameter:	d	Friction Factor:	λ_0
Mass-Flux:	$q(x, t)$	Pipe Cross-Section:	S	Compressibility:	z_0
Pipe Incline:	h_x	Gravity Acceleration:	g	Gas State:	γ_0

Mathematical Research Data Initiative



Furthermore

- ▶ Mathematical Software and Reproducibility
- ▶ Model Reduction for Hyperbolic Input-Output Systems
- ▶ Runge-Kutta Methods for Hyperbolic Systems
- ▶ Time-Domain Nonlinear System Identification
- ▶ Properties of the Empirical Cross Gramian

Knowledgeable

- ▶ System Theory
 - ▶ Model Reduction
 - ▶ Parameter Identification
 - ▶ System Identification
- ▶ Numerical Mathematics
 - ▶ Scientific Computing
 - ▶ Unsupervised Learning
 - ▶ Dynamic Mode Decomposition
- ▶ Computer Programming
 - ▶ MATLAB / Octave
 - ▶ Reproducibility
 - ▶ Research Software Engineering

Me and Mathematics Münster

▶ **Structure:**

The algorithm knowledge graph will help structural understanding.

▶ **C. Models and Approximation:**

My model reduction research fits into this project.



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Why I Applied

- ▶ MaRDI bundles and heads FAIR practices in mathematics.
- ▶ New Challenge: Knowledge graphs.
- ▶ Fantastic conditions.

Curious

- ▶ How do you do your research for algorithms?
- ▶ How do you interface with other software?
- ▶ Are you handling high-dimensional dynamic input-output systems?



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Cluster Events?

▶ Having a beer with everybody. Maybe in summer?



Extracurricular

- ▶ I was a saxophonist in **muMPitz**, the MPI Magdeburg's jazz combo. I am looking for a new jazz band in Münster ...
- ▶ I would consider myself a **Scheme** enthusiast. Is there a something like a Lisp/Scheme/Clojure user group?

Summary

- ▶ MaRDI – Mathematical Research Data Initiative
- ▶ Replicability, Reproducibility, Reusability, Sustainability
- ▶ Model Reduction, System Theory, Scientific Computing

<https://himpe.science>