

# Data-driven modelling, simulation, and optimization of nonlinear/hybrid systems (DaMSONoS)

ideas for an ITN-EID proposal 2021



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RG 8

- next EU program: Horizon Europe 2021-2027
- precise deadlines (etc.) are not available yet (estimate: March, April 2021)
- probably: EID ( $\leq 15$  ESRs), ETN ( $\leq 10$  ESRs)
- probably: new rules for resubmission after rejection

- Data science revolution
- Strong growth in numerical complexity
- Hybrid and nonlinear coupled systems  
(systems involving data-based and physically modelled terms)
- Industry and academic sector: shortage of candidates with experience in data-related research

# Challenges

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## **Mathematical challenges**

- Data-driven modelling, hybrid systems
- Data management and reduction
- Learning and optimization algorithms
- Simulation
- Validation
- Data-dependent convergence rates in optimization and simulation

## **Industrial challenges**

- Resource and energy efficient production
- Customer needs driven manufacturing and flexibility (temporal/spatial)
- Production assistants (human - machine collaboration)
- Data-driven decision making (e.g. energy networks)
- Real-time feedback

# Experience at WIAS with European projects

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## ITNs at WIAS

- ROMSOC - Reduced Order Modelling, Simulation and Optimization of Coupled Systems, 2018-2021
- MIMESIS - Mathematics and Materials Science for Steel Production and Manufacturing, Coordinator: D. Hömberg, WIAS, 2015 - 2019
- PROPHET - Photonics as an Enabling Technology, Sub-project Head: M. Radziunas, A. Vladimirov, 2011 - 2014

## ERC Starting Grants

- Elliptic Partial Differential Equations and Symmetry of Interfaces and Layers for Odd Nonlinearities, Project Head: E. Valdinoci, 2013 - 2016
- Entropy Formulation of Evolutionary Phase Transitions, Project Head: E. Rocca 2013 - 2016
- Rough path theory, differential equations and stochastic analysis, Project Head: P. Friz 2010 - 2016

## ERC Consolidator Grant

- Geometric aspects in pathwise stochastic analysis and related topics, Project head: P. Friz, 2016-2021.

## ERC Advanced Grant

- Analysis of multiscale systems driven by functionals, Project head: A. Mielke, 2016-2021.

## Forschungsverbund Berlin (FVP)

- completed: Within all eight institutes of FVB 82 projects were completed within the program FP7 and Horizon 2020 (thereof 16 ITNs).
- ongoing: 29 ongoing Horizon 2020 projects (thereof 8 ITNs).

- **M. Hintermüller**, Nonsmooth Variational Problems and Operator Equations
- **D. Hömberg**, Nonlinear Optimization and Inverse Problems (ITN: MIMESIS)
- **V. John**, Numerical Mathematics and Scientific Computing
- **V. Spokoiny**, Stochastic Algorithms and Nonparametric Statistics (ERC grant: P. Friz)

## Potential members:

- Members of Romsoc
- Simula, Oslo
- Sebastian Pokutta, FU Berlin / Vice-Head Zuse Institute Berlin  
Optimization and Machine Learning
- potential industrial partner: Bosch, Denso (Japan)
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# Roadmap

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- **until Oct. 15:** confirmation of participation of Romsoc members
- **Oct. 16:** ZOOM Meeting: Discussion: [additional members \(aim: 15 ESRs\)](#)
- **until Oct. 30:** each beneficiary sends preliminary abstract/keywords about mathematical challenges to be addressed
- **Nov. 7:** summary of proposed challenges will be send to all beneficiaries
- **Nov. 14:** ZOOM Meeting: Discussion: [mathematical challenges and milestones](#)
- **until Dez. 15:** industrial partner organizations for each project
- **Dez. 16:** ZOOM Meeting: Discussion: [training units](#)
- **until Jan 15:** finalizing description of individual projects
- **until Feb 5:** finalizing the proposal
- **until Feb 15:** internal reviewing of the proposal and corrections
- approximately 3-4 weeks as backup.