Show message in browser

STADIUS
Center for Dynamical Systems, Signal Processing and Data Analytics

STADIUS Newsletter

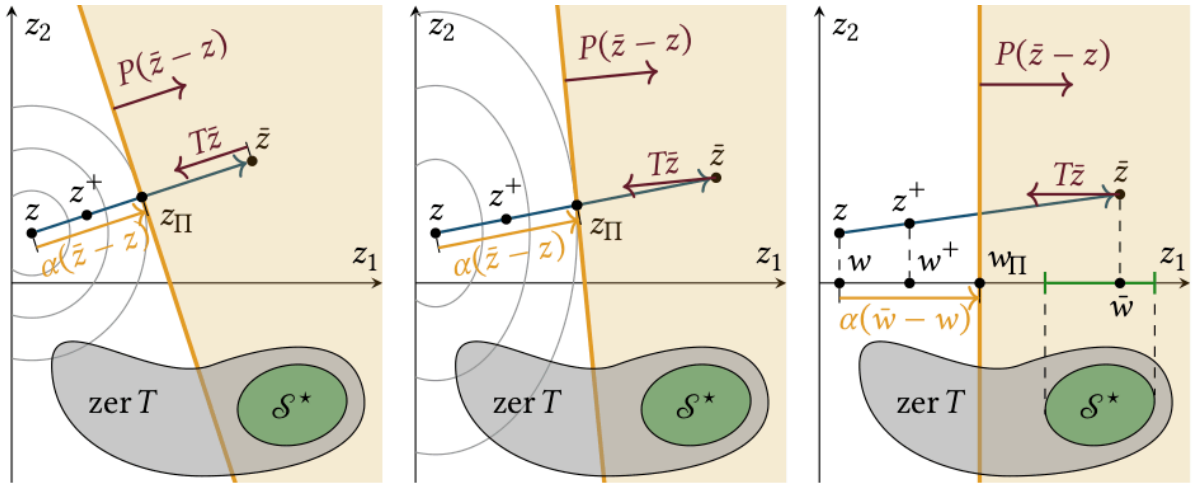
March 2026

Research of the month by Brecht Evens

"Splitting Methods for Nonmonotone Inclusion Problems"

Work under the supervision of Puya Latafat and Panos Patrinos

Due to their simplicity and ability to exploit structure, splitting methods are the standard choice for solving large-scale, structured inclusion problems. In this project we consider splitting methods designed to handle problems without smoothness requirements, such as Douglas–Rachford splitting (DRS) and Chambolle–Pock (CP), which involve only resolvent evaluations and simple arithmetic operations. A common feature of these methods is that they can be viewed as particular instances of the preconditioned proximal point algorithm (PPPA), which generalizes the classic proximal point algorithm (PPA) by replacing the scalar stepsize with a symmetric positive semidefinite preconditioner. Despite their widespread use, the convergence theory of the PPPA and its special cases remains largely confined to the monotone setting. This significantly limits their applicability, as many inclusion problems of practical interest are nonmonotone. Moreover, this limitation is rather surprising, since the classic PPA has been shown to converge for certain nonmonotone operators, such as cohypomonotone ones, but corresponding results in the preconditioned setting are missing.



Projective interpretation of the PPPA

To address this gap in the literature, this project aims to develop novel convergence results for the PPPA beyond the monotone setting, and as a consequence, tighten the convergence analysis of its special cases such as DRS and CP. To this end, we rely upon a projective

interpretation of the PPPA, in which each iteration is viewed as a (relaxed) projection onto a certain halfspace. This geometric insight allows us to identify precise conditions under which convergence can be guaranteed for nonmonotone inclusion problems.

In particular, this project advances the understanding of splitting methods through the following main contributions.

1. We provide **a comprehensive study of the relaxed PPPA** for nonmonotone inclusion problems that admit oblique weak Minty solutions.
2. We introduce and study **a general class of semimonotone operators**, as a natural extension of (hypo)monotone and co(hypo)monotone operators.
3. We study **convergence conditions for DRS and CP** involving semimonotone operators, revealing novel stepsize and relaxation parameter ranges.
4. We develop **a novel splitting method** tailored to nonmonotone inclusion problems with linear subspace constraints.

For more detailed reading:
PhD thesis:
Splitting Methods for Nonmonotone Inclusion Problems
👉 https://lirias.kuleuven.be/4257881
Research articles:
Convergence of the preconditioned proximal point method and Douglas–Rachford splitting in the absence of monotonicity
👉 https://link.springer.com/article/10.1007/s10107-024-02182-0
Convergence of the Chambolle–Pock algorithm in the absence of monotonicity
👉 https://link.springer.com/article/10.1007/s10957-025-02680-x

---

Awards



SOCN Best Thesis Award for Brecht Evens

We are delighted to announce that our STADIUS colleague **Brecht Evens** has been selected as the laureate of the **inaugural SOCN PhD Thesis Award 2026.** His dissertation, *Splitting Methods for Nonmonotone Inclusion Problems*, was completed in December 2025 under the supervision of Prof. Panos Patrinos and Prof. Puya Latafat.

Brecht's thesis overcomes the decades-long monotonicity barrier that has shaped splitting methods since their original conception by interpreting each iteration as a projection onto a carefully chosen halfspace. This geometric perspective allows him to **establish tight convergence results for widely used algorithms** such as Douglas–Rachford and Chambolle–Pock, applied to a novel class of nonmonotone operators.
Both the SOCN PhD Thesis Award jury and his examination committee praised the distinct originality, exceptional mathematical rigor, and depth of the work.

The **SOCN PhD Thesis Award** recognizes outstanding scientific quality, originality, and impact within the doctoral school and is presented for the first time this year.
The award was formally presented at the Benelux Meeting on Systems and Control on 26 March 2026.

To find more about Brecht's research, read the "research of the month section" or click here to access his PhD thesis.

Congratulations to Brecht on this well-deserved recognition.

News



Rodolphe Sepulchre on Brains and Machines

In the latest episode of Brains and Machines, STADIUS Professor Rodolphe Sepulchre, a control theorist, talks to Dr. Sunny Bains of the University College London. They discuss the inspiration he took from studying biological neurons, why both discrete and continuous behaviors are inherent to how they work, and why building neurons is often easier than simulating them.

👉 We encourage readers to explore the full interview here

Events @ STADIUS

07/04/2026 – A Control-Theoretical Approach to the Free Energy Principle
When: 07/04/2026, 14:00 - 15:00
Where: Aula R, ESAT
Speaker: Giovanni Russo

For more information about STADIUS events please visit the STADIUS Event webpages.

Don't forget to check the website of VAIA for a wide choice of courses on (aspects of) AI: www.vaia.be

STADIUS Colloquium Series

Tensors and Temporal Networks in Neuroscience
When: 22/04/2026; 10:00 - 11:00
Speaker: Borbala Hunyadi
Location: Aula R
Abstract: Our brain a complex network of interconnected regions which function in a coordinated manner to execute various functions and process information. Mapping the organization of this network in space and time is a major challenge in computational neuroscience and related fields. Consequently, there is a large body of literature describing the brain as a network. However, there are major differences in terms of what is meant by "network" in these works.



Therefore, in this talk, I first present different abstractions of brain networks. Subsequently, I explain how these different abstractions lead to – via matrix factorizations of simpler versions of the models – different tensor decompositions. More specifically, I will discuss blind source separation of functional neuroimaging data, as well as community detection in static and dynamic networks, using spectral clustering, CPD and BTD. I will illustrate the use and benefits of these techniques in EEG data recorded during cognitive tasks to characterize the electrophysiological signatures of various steps of task execution, and, ultimately, to reveal differences in such signatures in health and pathology.

Bayesian inference with physics-informed deep generative models: Applications to computational imaging
When: 17/06/2026; 15:00 - 16:00
Speaker: Marcelo Pereyra
Location: Aula C
Abstract: This talk introduces a novel mathematical and computational framework for constructing high-dimensional Bayesian inversion methods that leverage state-of-the-art generative denoising diffusion models as statistical priors.



A central innovation is the use of Langevin diffusion processes and Markov chain Monte Carlo sampling techniques to create stochastic neural network architectures that perform nearly-perfect sampling. The obtained networks are modular and composed of interpretable layers that are directly related to statistical priors and data likelihoods. The layers encoding the data likelihood function are designed for flexibility, enabling observation model parameters to be specified at inference time and seamlessly integrated with pre-trained foundational generative priors.

For more information go to STADIUS Colloquium Website

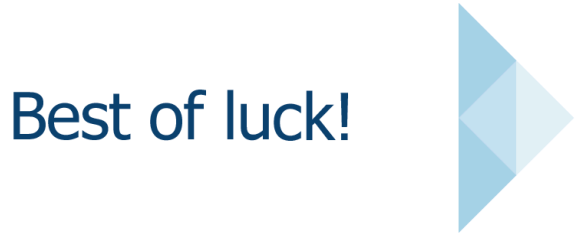


Current and planned visitors

- **Andrea Costanzo** - in group of Alexander Bertrand (since February)
- **Anna Fuzari -** in group of Toon van Waterschoot (since February)
- **Stefano Giacomelli** - in group of Toon van Waterschoot (since March)
- **Francesco Cordiano** - in group of Johan Suykens (arriving in April)
- **Jiande Chen** - in group of Maarten De Vos (arriving in April)

Enjoy your research visit at STADIUS !!!

We wish the best of luck to the researchers who are leaving STADIUS



This month, several colleagues will finish their appointment at STADIUS.

- **Raphaël Widdershoven,** a postdoctoral researcher supervised by Lieven De Lathauwer
- **Thomas Burger** and **Tihol Ivanov Donchev,** postdoctoral researchers from the group of Rodolphe Sepulchre
- **Lukas Vanpoucke,** Phd researcher supervised by Bart De Moor

We warmly thank them all for their contributions and wish them every success in the next steps of their careers.

Recently defended PhDs

Congratulations to the new PhD graduate!

- **6/03/2026 - Christof Baeriswyl** *"Hardware-Efficient Algorithms for Multi-Dimensional State-Space Filtering with Application in Bioelectrical Sensor Arrays"* **Thesis**
  Promotor: Alexander Bertrand

- **17/03/2026 - Vincent Scheltjens** *"Federated Learning in Healthcare: Towards privacy-enhancing, AI-driven decision support systems; Federated Learning in Healthcare: Towards privacy-enhancing, AI-driven decision support systems"* **Thesis**
  Promotor: Bart De Moor

New projects starting in March

A Multicenter RCT - A Multicenter RCT on the impact of Wearable EEG and AI-Based Seizure Detection in absence seizure management
📌 KU Leuven - C3
🎓 Maarten De Vos & Wim Van Paesschen

Publications

Here's the monthly STADIUS Publications Digest, including new reports that have been added to the publications database. Please remember to have your own reports added in the publications database and make sure your entries are kept up to date (status submitted/accepted/published) at all times.

Contact Ida for new additions and updates; do not add/update database content yourself.

26-56
Liu Z., Bono M., Flisar A., Decloedt R., Van Den Bossche M., De Vos M., ``Dissociating the Nocturnal Physiological Drivers of Agitation Occurrence and Severity in Dementia: An Explanatory Study Using Contactless Sleep Sensing", Technical Report 26-56, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2026.
26-57
Bruneel R., Patrinos P., ``Multi-stage scenario reduction for optimal energy storage operation in real-time markets", in *Proc. of the 2025 IEEE Innovative Smart Grid Technologies Conference Europe (ISGT Europe)*, Valletta, Malta, Oct. 2025, pp. 1-5.
Lirias number: 4406118.
26-58
Angelou A., Moonen M., ``Master-Assisted Channel Estimation for Cell-Free Massive MIMO Networks", Technical Report 26-58, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2026.
26-59
Pas P., Lowenstein K. F., Bernardini D., Patrinos P., ``Exploiting Parallelism in a QPALM-based Solver for Optimal Control", *Robotics: Science and Systems 2024 Workshop: Frontiers of optimization for robotics (RSS 2024)*, Delft, the Netherlands, Jul. 2024.
Lirias number: 4210541.
26-60
Ranjbar V., Beerten R., Moonen M., Pollin S., ``Sequential processing strategies in fronthaul constrained cell-free massive MIMO networks", *IEEE Wireless Communications Letters*, vol. 15, 2026, pp. 1797-1801.
Lirias number: 4405991.

26-61
Friesacher H.R., *Uncertainty quantification for trustworthy drug-target interaction predictions*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Feb. 2026, 236 p.
Lirias number: 4395248.

26-62
Rotaru T., *Exact performance analysis of fundamental first-order optimization methods*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Feb. 2026
Lirias number: 4280924.

26-63
Baeriswyl C., *Hardware-efficient algorithms for multi-dimensional state-space filtering with application in bioelectrical sensor arrays*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Mar. 2026
Lirias number: 4397021.

26-64
Scheltjens V., *Federated learning in healthcare : Towards privacy-enhanding, AI-driven decision support systems*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Mar. 2026, 214 p.
Lirias number: 4407449.

26-66
Green Rasmus W.; Heremans R., FischerovÃi D., Yan J., Eriksson L., Mascilini F., Testa A., Franchi D., Sladkevicius P., Valentin L., OpolskienÄ— G., Haak L. A., Fruscio R., Chiappa V., Alcazar J. L., Cibula D., Guerriero S., FrÃ¼hauf F., Carlson J., Mestdagh W., Bourne T., Timmerman D., Van den Bosch T., Epstein E., ``Development and internal validation of competing risks models that combine demographic and ultrasound features with the ESMO-ESGO-ESTRO or ESGO/ESTRO/ESP risk classifications to predict recurrence or progression in endometrial cancer: results from the IETA-4 cohort follow-up study", Technical Report 26-66, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2026. Accepted for publication in *Social Science Research Network*.
Lirias number: 4409407.

26-67
Vermeylen C., Vervliet N., De Lathauwer L., ``LRGEV(-MMP): Left-Right Generalized Eigenvector (Multi-Mode Pencil) Method for Canonical Polyadic Decomposition", Technical Report 26-67, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2026.

26-68
Brunnstrom J., Moller M., Martin B., Ostergaard J., Koyama S., van Waterschoot T., Moonen M., ``Time-Domain Sound Field Estimation Using Kernel Ridge Regression", *IEEE Transactions on Audio Speech and Language Processing*, vol. 34, 2026, pp. 1243-1258.
Lirias number: 4409430.



Update your profile - Unsubscribe