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STADIUS
Center for Dynamical Systems, Signal Processing and Data Analytics

STADIUS Newsletter

February 2024

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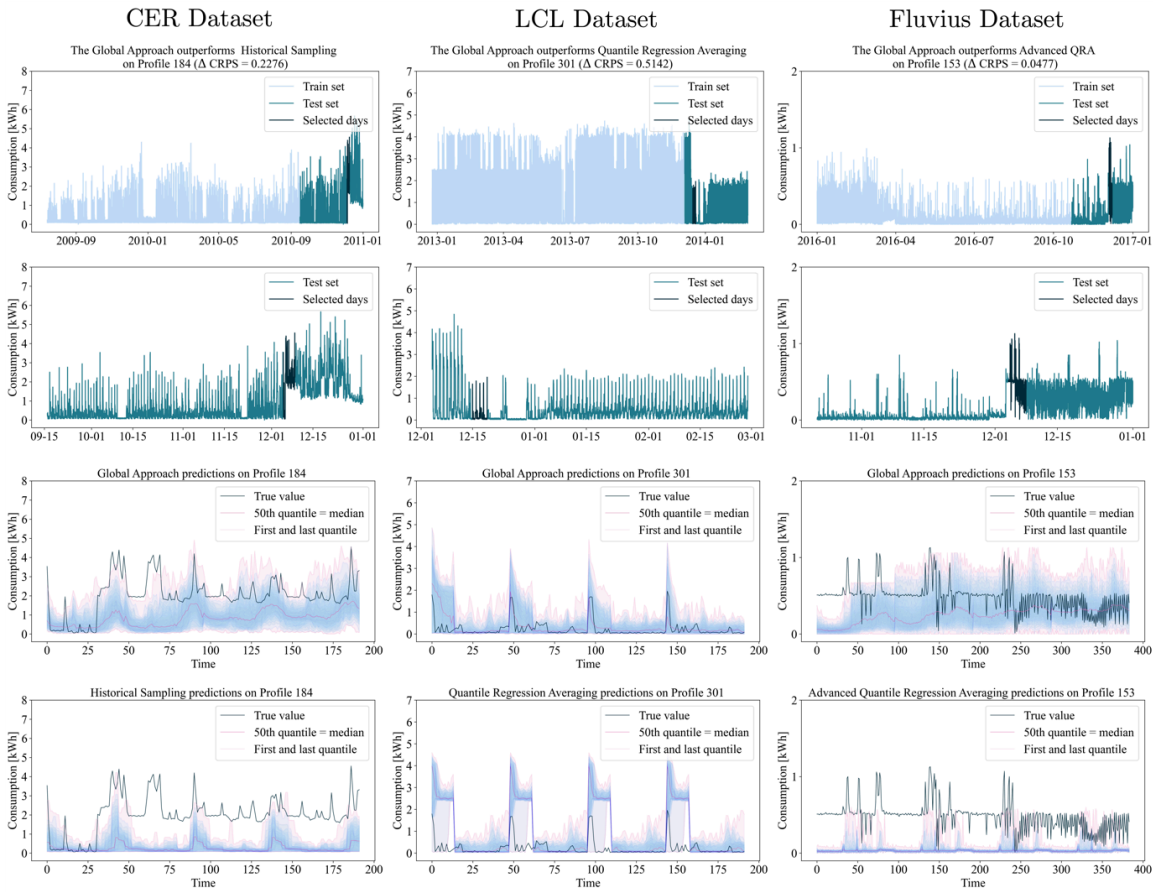
Research of the month by Lola Botmans

"Time series forecasting, application on low-voltage grid data"

Work under supervision of Bart De Moor

Global efforts intensify to address the climate crisis, and this is resonating through headlines, policy agendas, and conversations at all levels of society. To meet the latest COP agreements and related European green deal towards a sustainable future, **we must speed up electrification and increase the share of renewable energy sources**. Accurate energy forecasting then emerges as indispensable. For example, as the transition from traditional vehicles to electric cars accelerates, the demand for home charging and public charging infrastructures intensifies. This not only increases overall electricity consumption but also poses the risk of grid congestion, especially during peak times when many return home to charge simultaneously. **To efficiently manage and mitigate such challenges, precise forecasting of household electricity demand becomes imperative.**

The proposed method, producing short-term forecasts of individual household consumption, tackles the double peak penalty effect. This double penalty effect arises when point forecasting methods accurately predict a peak but with a slight timing error, incurring penalties both when the peak is unpredicted and when it is wrongly anticipated. However, predicting a peak with a slight delay is more valuable than missing it entirely. Employing probabilistic forecasts effectively mitigates this issue. **A novel global probabilistic method is introduced, which requires only a week of historical data from the concerned household to make accurate one-day-ahead predictions**, by leveraging historical data from other households in the dataset. Its adaptability and robustness have been assessed through evaluation across three different datasets and benchmarked with several state-of-the-art methods. The method, unlike all other benchmarks, adapts quickly when large changes in patterns occur, such as a new family moving in or a holiday period.



The figure showcases an analysis of one profile from each dataset. These profiles are instances where the global approach significantly outperforms the alternative method. The top row of subplots provides an overview of the complete profiles, where the light blue colored segments represent the training set, the dark blue colored segments the test set, and the black colored segment the part of the test set for which the predictions are shown in the two bottom graphs. The first prediction stems from the global approach, while the second prediction reflects the alternative approach. The true values are in black. The lowest and highest quantiles are in pink, as well as the median. The intermediate quantiles are in blue. It becomes apparent that the global approach demonstrates superior adaptability to changes in consumption patterns, i.e., profiles experiencing concept drift.

For more information about this research read: Times series forecasting, applications on low voltage grid data.

News

STADIUS professor Moreau unveils unethical research: 29 articles retracted, so far.

After an extensive four-year effort by bioinformatician Yves Moreau, "Molecular Genetics & Genomic Medicine" recently **retracted 18 papers** on genetics and genomics. This move comes in the wake of earlier retractions by other publishers over the past four years. In total, 29 articles have been retracted so far because of

their reliance on **genetic material that was apparently obtained without consent** or related ethical issues.

The retracted studies were centered on genetic research on minority populations, such as the Uyghurs, Tibetans, and Hui, who reside in regions rife with reported human rights abuses, according to Human Rights Watch. Moreover, many of the authors were found to have affiliations with Chinese law enforcement agencies. When requested, the **authors failed to demonstrate explicit consent from the individuals** whose genetic data they utilized for their research.

When asked about his involvement in confronting ethical dilemmas, Moreau (KU Leuven ESAT STADIUS) emphasized: "Ethics is not a checkbox exercise". **Ethical considerations must be part of the fabric of scientific inquiry, from its inception**. While he appreciates the publishers' belated efforts to enforce stricter guidelines, he views the retractions as a strong signal towards scientists: unethical research can be exposed and rectified, damaging your reputation a long time after the facts.

Moreau's vigilance extends beyond these current retractions: he has **flagged an additional 70 papers** which publishers are currently scrutinizing. His commitment to ethical integrity doesn't stop yet. In an interview with Science, he raises **concerns about facial recognition technology** and about genetic testing kit manufacturers catering to Chinese law enforcement.

Read more:

- Genetics journal retracts 18 papers from China due to human rights concerns.
- 'Ethics is not a checkbox exercise.' Bioinformatician Yves Moreau reacts to mass retraction of papers from China

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Outstanding results reported in 2023 in the Flanders AI Research Program

The Key Performance Indicators (KPI) in 2023 underscore the scale and significance of the Flanders AI Research Program's endeavors: Only at KU Leuven we have reported:

- 137 publications
- 72 involved PhD researchers
- 14 defended PhD theses

A notable achievement stems from the collaborative efforts of STADIUS at KU Leuven and VITO/EnergyVille, showcasing groundbreaking advancements in low-voltage grid simulations:

Novel end-to-end representative-days clustering approach for speeding up low-voltage grid simulations. (KU Leuven-STADIUS, VITO/EnergyVille)
Low-voltage grid (LVG) state estimations help in grid expansion planning and preventing congestion events. However, country-scale simulations pose a high computational burden. To reduce the calculation time, we can cluster the similar days of a year, and only simulate the most representative day of each cluster. Using real-world, quarter-hour residential consumption time series, meteorological and calendar features, we have developed a novel end-to-end representative-days clustering framework. Our framework has been successfully applied and validated in the Flemish LVG using anonymized consumption time series provided by Fluvius. By using only 30 representative days we have managed to achieve a 12.2x simulation speedup without losing too much accuracy. Typically, a one-year simulation of the LVG takes 120 days, but with our approach this reduces to only 10 days.

Awards



IEEE CIS Neural Network Pioneer Awards for Johan Suykens

We are very proud to announce that Johan Suykens has received the **2024 Neural Network Pioneer Award:** "*For contributions to least squares support vector machines*".

The IEEE Computational Intelligence Society Neural Networks Pioneer Award recognizes significant contributions to early concepts and sustained developments in the field of neural networks. This award recognizes two types of pioneering contributions: (1) fundamental understanding and (2) engineering application.

Read more about the IEEE CIS Awards.

Events @ STADIUS

PhD defense - Nick Seeuws
Title: *Detection of disturbances and events in biomedical signals with deep learning*
When: **1/03/2024, 17:00**
Where: **Irish College, Leuven**

AI Driven Data Science - Kickoff Meeting FAIR 2.0 - GC1
When: **04/03/2024, 13:00 - 18:30**
Where: **Irish College, Leuven**

ERC Back to the Roots Seminar: Macaulay matrices, low-displacement rank, and the efficient computation of null-spaces
When: **05/03/2024, 17:00**
Where: **Thermotechnisch Instituut, Aula van de Tweede Hoofdwet**
By: **Nithin Govindarajan**

DEEPK 2024 International Workshop on Deep Learning and Kernel Machines
When: **07/03 - 08/03 2024, 17:00**
Where: **Arenberg Castle**
By: **Johan Suykens**

PhD defense - Hannes De Meulemeester
Title: *Unsupervised Representation Learning and Health Insurance Anomaly Detection*
When: **15/03/2024, 14:00**
Where: Aula De Molen 00.07, Kasteelpark Arenberg 50

ERC Back to the Roots Seminar: A new symbolic-numeric method to solve the multiparemeter eigenvalue problem
When: **21/03/2024, 17:00**
Where: **ELEC B91.300 - aula C**
By: **Mathias Bender**

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

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New colleagues

A warm welcome to new researchers and personnel at STADIUS!

Excited to join STADIUS as a postdoctoral researcher!

I'm **Isaac Wong**, deeply passionate about tackling the data analysis challenges within the Einstein Telescope project to drive innovation in Prof. Tjonnie Li's group. With a Ph.D. in Physics and a specialization in

gravitational-wave data analysis, including expertise in testing general relativity, gravitational-wave lensing, and statistical methods, I'm eager to collaborate, explore new frontiers, and contribute to impactful research.

Looking forward to connecting with fellow scholars and making meaningful strides together!

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

Best of luck!



This month, two colleagues are leaving STADIUS, and we wish them all the best on their new career paths:

- **Elisa Tengan,** who defended her PhD thesis on 23/02 under the supervision of Toon van Waterschoot, will start her new job at Goodix Technology Belgium BV
- **Francesco Tonin,** a researcher from the group of Johan Suykens, will be moving to a postdoctoral position at EPFL.

Good luck with your careers!

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Recently defended PhD theses

- 09/02/2024 Lola Botman: *Times series forecasting, applications on low voltage grid data* supervised by Bart De Moor.
- 23/02/2024: Elisa Tengan: *Spatial audio analysis with constrained microphone setups in adverse acoustic conditions* supervised by Toon van Waterschoot

Congratulations!

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Publication Digest

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.

24-14
Hendrikx S., *Computing tensor decompositions from incomplete and implicit data*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Jan. 2024, 180 p.
Lirias number: 4130493.

24-15
Damiano S., Bondi L., Guntoro A., van Waterschoot T., "A Framework for the Acoustic Simulation of Passing Vehicles Using Variable Length Delay Lines", Technical Report 24-15, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024.

24-16
Geirnaert S., Yao Y., Francart T., Bertrand A., "Stimulus-Informed Generalized Canonical Correlation Analysis for Group Analysis of Neural Responses", Technical Report 24-16, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024.

24-17
Tengan E., *Spatial audio analysis with constrained microphone setups in adverse acoustic conditions*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Feb. 2024, 210 p.
Lirias number: 4139876.

24-18
Chen Y., Tao Q., Tonin F., Suykens J., "Self-Attention through Kernel-Eigen Pair Sparse Variational Gaussian Processes", Technical Report 24-18, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024.

24-19
Besancon M., Garcia J.D., Legat B., Sharma A., "Flexible Differentiable Optimization via Model Transformations", *INFORMS Journal on Computing*, vol. Ahead of Print, Nov. 2023, pp. 1-24.
Lirias number: 4132333.

24-20
Oikonomidis K., Laude E., Latafat P., Themelis A., Patrinos P., "Adaptive proximal gradient methods are universal without approximation", Technical Report 24-20, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024.

24-22
Tao Q., Xi X., Xu J., Suykens J.A.K., "Sparsity via Sparse Group hBcmax Regularization", Technical Report 24-22, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024. Accepted for publication in *American Control Conference 2024*.
Lirias number: 4143386.

24-23
Strypsteen T., *Distributed Deep Neural Networks for Wireless Neuro-Sensor Networks*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Dec. 2023
Lirias number: 4121059.

24-24
Botman L., *Time Series Forecasting, Applications on Low Voltage Grid Data*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Feb. 2024, 167 p.
Lirias number: 4131583.

24-25
Al-Memar M., Fourie H., Vaulet T., Lawson K., Bobdiwala S., Saso S., Farren J., Pipi M., De Moor B., Stalder C., Bennett P., Timmerman D., Bourne T., "Using simple clinical and ultrasound variables to develop a model to predict first trimester pregnancy viability", *European Journal of Obstetrics and Gynecology*, vol. 292, 2024, pp. 187-193.
Lirias number: 4131583.

24-26
Ketcham R., "Non-linear Power Harvesting and α-Fair Resource Allocation in SWIPT", Technical Report 24-26, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2024.



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