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STADIUS
Center for Dynamical Systems, Signal Processing and Data Analytics

STADIUS Newsletter

April 2023

AWARDS ▪ EVENTS ▪ STAFF UPDATE ▪ PUBLICATIONS

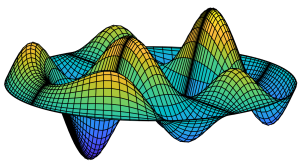
Welcome to April edition of the STADIUS Newsletter

In this Newsletter, we are introducing a new section: **"STADIUS research of the month"**.
In this section, we want to highlight some research activities of our STADIUS Colleagues.
If you want to contribute to this section and present to STADIUS your research topic, please do not hesitate to contact Aldona.

This month, we introduce you to **Christof Vermeersch** and his research on multiparameter eigenvalue problems in system identification.

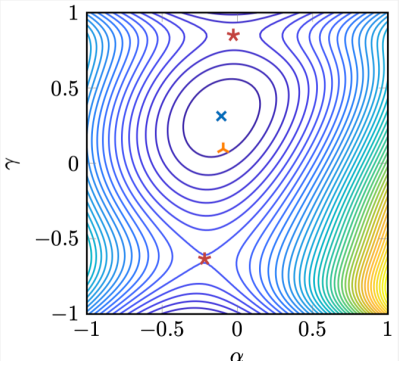
Enjoy the read below.

RESEARCH of the month



Christof Vermeersch: "*It is just an eigenvalue problem*"

One of the essential tools in linear algebra is, without any doubt, the standard eigenvalue decomposition. Eigenvalues and eigenvectors describe the intrinsic system dynamics of many natural and scientific phenomena; they explain how a system evolves along the eigenvector direction. For some phenomena, however, a single spectral parameter does not



capture the entire system dynamics and multiple spectral parameters, or eigentuples, are necessary. Multispectral theory has its historical roots in boundary-value problems for partial differential equations. Today, within the context of prof. Bart De Moor's **ERC grant**, we try to rephrase many system identification problems as (rectangular) multiparameter eigenvalue problems in order to find the globally optimal model parameters.

When talking about (rectangular) multiparameter eigenvalue problems, a follow-up question quickly emerges: "How can we solve this type of problems?" For one-parameter eigenvalue problems, the number of available solution approaches is almost uncountable, ranging from algorithms to tackle very large and sparse problems to techniques that deal with a special matrix structure. The literature on (rectangular) multiparameter eigenvalue problems is much less expansive. In our research, we try to identify the globally optimal parameters of misfit-versus-latency models. An essential research challenge is the development of the algorithms that solve the underlying (rectangular) multiparameter eigenvalue problems. One way of tackling these problems is to go "Back to the Roots" and consider a block extension of the well-known Macaulay matrix from polynomial system solving. By exploiting the structured null/column space of this large block Macaulay matrix constructed from the coefficient matrices of the (rectangular) multiparameter eigenvalue problem, we can retrieve the unknown eigentuples. This novel approach sounds easy, but the devil (and research) is in the (numerical/computational) details!

Events @ STADIUS

Interpretable deep learning for cancer personalized medicine

When: **2/05/2023**

Where: **B00.35 at ESAT**

By: **Maria Rodriguez Martinez**, IBM Zürich

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 in courses on (aspects of) AI: www.vaia.be

STADIUS Seminar about spinoff Aspect Analytics

When: **17/05/2023, 14:30 - 15:30**

Where: **Aula C, ESAT**

By: **Marc Claesen**

Recently approved projects

We are glad to share the news that following projects were recently approved:

- EU HORIZON-HLTH-2022-IND **PHASE IV** *"Privacy compliant health data as a service for AI development"*
  - Coordinator: University of Turku
  - Involved @STADIUS: Maarten De Vos

- EU HORIZON-MSCA-2022-DN **BioacAI** *"Bioacoustic AI for wildlife protection"*
  - Coordinator: Stichting Naturalis Biodiversity Center
  - Involved @STADIUS: Toon van Waterschoot

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.

23-52

Hautecoeur C., De Lathauwer L., Gillis N., Glineur F., "Least-squares methods for nonnegative matrix factorization over rational functions", Technical Report 23-52, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023. Accepted for publication in *IEEE Transactions on Signal Processing*.
Lirias number: 4079861.

23-53

Schott J., Gransier R., Moonen M., Wouters J., "The potential of objective T-level determination in CI recipients using envelope following responses", Technical Report 23-53, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-54

Dan J., Foged M.T., Vandendriessche B., Van Paesschen W., Bertrand A., "Sensor selection and miniaturization limits for detection of interictal epileptiform discharges with wearable EEG", *Journal of Neural Engineering*, vol. 20, no. 1, Feb. 2023, pp. 1-14.
Lirias number: 4006564.

23-55

Nijs M., Smets T., Waelkens E., De Moor B., "KL-NMF as best suited NMF variant for the analysis of mass spectrometry imaging data",*Regional Mass Spectrometry*

Imaging Spring Workshop, Uppsala, Sweden, Mar. 2023.
Lirias number: 4079863.

23-58

Meylemans D., Van Hoef S., Wamba Momo L., Crema Garcia F., Mestdagh W., Thomas I., Cornelissen J., BarlÃƒÂ© C., De Vlieghere C., Tormans G., De Moor B., Miserez M., "The Flanders inguinal and femoral hernia repair prospective registry (FLIPR) : A 5-year analysis of groin hernia surgery in Flanders with focus on laparoscopic groin hernia surgery", *Belgian Surgical Week (BSW 2023)*, Belgium, Oostende, Apr. 2023.
Lirias number: 4080045.

23-59

Schmetterling R., Burghi T.B., Sepulchre R., "Robust online estimation of biophysical neural circuits", Technical Report 23-59, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-60

Huo Y., Chaffey T., Sepulchre R., "Regularized learning of fading memory systems", Technical Report 23-60, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-61

Bin M., Marconi L., Sepulchre R., "An internal model principle for open systems", Technical Report 23-61, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-62

Chaffey T., van Waarde H.J., Sepulchre R., "Relaxation systems and cyclic monotonicity", Technical Report 23-62, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-63

Novak M., Langone R., Alzate C., Suykens J.A.K., "Accelerated sparse Kernel Spectral Clustering for large scale data clustering problems", Technical Report 23-63, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-64

Strypsteen T., Bertrand A., "Neural Source Coding for bandwidth-efficient brain-computer interfacing with wireless neuro-sensor networks", Technical Report 23-64, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023. Accepted for publication in *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) 2023*.
Lirias number: 4080416.

23-65

De Plaen H., De Plaen P.-F., Suykens J. A. K., Proesmans M., Tuytelaars T., Van Gool L., "Unbalanced Optimal Transport: A Unified Framework for Object Detection", Technical Report 23-65, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023. Accepted for publication in *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*.
Lirias number: 4080428.

23-66

Vermeersch C., Lagauw S., De Moor B., "Multivariate Polynomial Optimization in Complex Variables Is a (Rectangular) Multiparameter Eigenvalue Problem", Technical Report 23-66, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-67

Cao Z., Seeuws N., De Vos M., Bertrand A., "A Novel Loss for Change Point Detection Models with Time-invariant Representations", Technical Report 23-67, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-68

De Brouwer E., *Machine Learning for Patient Trajectories*, PhD thesis, Faculty of Engineering, KU Leuven (Leuven, Belgium), Mar. 2023, 253 p.
Lirias number: 4068023.

23-69

Samaey G., Vandewalle J., *The invisible power of mathematics. The pervasive impact of mathematical engineering in every day life.*, vol. 17112 of *Copernicus Books*, Springer, 2022, 176 p.
Lirias number: 4080429.

23-70

Lambrechts A., Van Dijck C., Wirix-Speetjens R., Vander Sloten J., Maes F., Van Huffel S., "Preoperative prediction of optimal femoral implant size by regularized

regression on 3D femoral bone shape", *Applied Sciences*, vol. 13, 2023, 4344 p.
Lirias number: 4073162.

23-71

Kenis R., Laude E., Patrinos P., "Convex relaxations for large-scale manifold-valued nonconvex problems with graphical structure : An optimal transport approach", Technical Report 23-71, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-72

Laude E., Patrinos P., "Bergman proximal augmented Lagrangian revisited : Relative errors, ergodic convergence and efficient first-order oracle", Technical Report 23-72, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023.

23-73

Chaffey T., Sepulchre R., "Monotone one-port circuits", Technical Report 23-73, ESAT-STADIUS, KU Leuven (Leuven, Belgium), 2023. Accepted for publication in *IEEE Transactions on Automatic Control*.
Lirias number: 4080365.

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