Online adaptive lasso estimation in vector autoregressive models for high dimensional wind power forecasting

Wind power forecasts with lead times of up to a few hours are essential to the optimal and economical operation of power systems and markets. Vector autoregression (VAR) is a framework that has been shown to be well suited to predicting for several wind farms simultaneously by considering the spatio-temporal dependencies in their time series. Lasso penalisation yields sparse models and can avoid overfitting the large numbers of coefficients in higher dimensional settings. However, estimation in VAR models usually does not account for changes in the spatio-temporal wind power dynamics that are related to factors such as seasons or wind farm setup changes, for example. This paper tackles this problem by proposing a time-adaptive lasso estimator and an efficient coordinate descent algorithm for updating the VAR model parameters recursively online. The approach shows good abilities to track changes in the multivariate time series dynamics on simulated data. Furthermore, in two case studies it shows clearly better predictive performances than the non-adaptive lasso VAR and univariate autoregression.

Characterization of eQTLs associated with androstenone by RNA sequencing in porcine testis

Characterization of genetic variants affecting genome-wide gene expression levels (expression quantitative trait loci or eQTLs) in pig testes may improve our understanding of genetic architecture of boar taint (an animal welfare trait) and helps in genome-assisted or genomic selection programs. The aims of this study were to identify eQTLs associated with androstenone, to find candidate eQTLs for low androstenone, and to validate the top eQTL by reverse transcriptase quantitative PCR (RT-qPCR). Gene expression profiles were obtained by RNA sequencing in testis from Danish crossbred pigs and genotype data by 80K single nucleotide polymorphism panel. A total of 262 eQTLs [false discovery rate (FDR) < 0.05] were identified by using two software packages: Matrix eQTL and Krux eQTL. Of these, 149 cis-acting eQTLs were significantly associated with androstenone concentrations and gene expression (FDR < 0.05). The eQTLs were associated with several genes of boar taint relevance including CYP1A2, CYB5D1, and SPHK2. One eQTL gene, AMPH, was differentially expressed (FDR < 0.05) and affected by chicory. Five candidate eQTLs associated with low androstenone concentrations were discovered, including the top eQTL associated with CYP1A2. RT-qPCR confirmed target gene expression to be significantly (P < 0.05) different based on eQTL genotypes. Furthermore, eQTLs were enriched as QTLs for 15 boar taint related traits from the PigQTLdb. This is the first study to report eQTLs in testes of commercial crossbred pigs used in pork production and to reveal genetic architecture of boar taint. Potential applications include development of a DNA test and in advanced genomic selection models for boar taint.
Oscillatory connectivity as a diagnostic marker of dementia due to Alzheimer's disease

Objective: Quantitative EEG power has not been as effective in discriminating between healthy aging and Alzheimer's disease as conventional biomarkers. But EEG coherence has shown promising results in small samples. The overall aim was to evaluate if EEG connectivity markers can discriminate between Alzheimer's disease, mild cognitive impairment, and healthy aging and to explore the early underlying changes in coherence. Methods: EEGs were included in the analysis from 135 healthy controls, 117 patients with mild cognitive impairment, and 117 patients with Alzheimer's disease from six Nordic memory clinics. Principal component analysis was performed before multinomial regression. Results: We found classification accuracies of above 95% based on coherence, imaginary part of coherence, and the weighted phase-lag index. The most prominent changes in coherence were decreased alpha coherence in Alzheimer's disease, which was correlated to the scores of the 10-word test in the Consortium to Establish a Registry for Alzheimer's Disease battery. Conclusions: The diagnostic accuracies for EEG connectivity measures are higher than findings from studies investigating EEG power and conventional Alzheimer's disease biomarkers. Furthermore, decreased alpha coherence is one of the earliest changes in Alzheimer's disease and associated with memory function. Significance: EEG connectivity measures may be useful supplementary diagnostic classifiers.
Deep learning-based visual recognition of Rumex for robotic precision farming
In this paper we address the problem of recognising the Broad-leaved dock (Rumex obtusifolius L.) in grasslands from high-resolution 2D images. We discuss and present the determining factors for developing and implementing weed visual recognition algorithms using deep learning. This analysis, leads to the formulation of the proposed algorithm. Our implementation exploits Transfer Learning techniques for deep learning-based feature extraction, in combination with a classifier for weed recognition. A prototype robotic platform has been used to make available an image dataset from a dairy farm containing broad-leaved docks. The evaluation of the proposed algorithm on this dataset shows that it outperforms competing weed/plant recognition methods in recognition accuracy, while producing low false-positive rates under real-world operation conditions.

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The validity of daily patient-reported anxiety measured using smartphones and the association with stress, quality of life and functioning in patients with bipolar disorder
Background: More than half of patients with bipolar disorder (BD) experience anxiety, which is associated with impaired functioning. In patients with BD, the present study aimed (1) to validate daily patient-reported symptoms of anxiety measured using smartphones against clinically rated symptoms of anxiety, (2) to estimate the prevalence of anxiety symptoms, and (3) to investigate the associations between patient-reported anxiety symptoms and stress, quality of life and functioning. Methods: A total of 84 patients with BD evaluated their anxiety symptoms daily for nine months using a smartphone-based system. Data on clinically evaluated symptoms of anxiety and functioning and patient-reported stress and quality of life were collected from each patient at five fixed time points during follow-up. Results: The patients presented mild affective symptoms only. The reporting of anxiety symptoms was evaluated for validity according to clinically evaluated anxiety scores based on the two anxiety sub-items of the Hamilton Depression Rating Scale. The patients experienced symptoms of anxiety 19.3% of the time. There were statistically significant associations between anxiety and stress, quality of life and functioning (all p-values < 0.0001). Conclusion: In patients with BD in full or partial remission, the self-reporting of anxiety symptoms using smartphones was validated. Anxiety is associated with increased stress, decreased quality of life and functioning even during full or partial remission. Identifying anxiety symptoms thus has clinical impact, which suggests that smartphones may serve as a valid tool.

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An investigation of hydromechanical effect on well productivity in fractured porous media using full factorial experimental design

We propose a statistical investigation of the hydromechanical effect on well productivity in fractured porous media using full factorial experimental design. Factors affecting the well productivity have been investigated quantitatively, then ranked based on their impacts. The outcomes of this study can be used as a guideline for studying the uncertainties involved in well productivity. The results show that six main factors, initial reservoir pressure, matrix permeability, far-field stresses, fracture stiffness, fracture density, and fracture connectivity have effects on initial well productivity and its reduction, dictating the relationship between well productivity and drawdown pressure. Since the interactions among these factors cannot be neglected, all main factors should be investigated simultaneously for their effects on the well productivity. Results also show that the impact of each main factor is different, to reduce the computational cost, the most significant factors can be selected for the sensitivity analysis based on their ranks.

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Developing a combinatorial optimisation approach to design district heating networks based on deep geothermal energy

Plants increasingly exploit high geothermal energy potentials in German district heating networks. Municipal planners need instruments to design the district heating network for geothermal heat. This paper presents a combinatorial mixed-integer linear optimisation model and a three-stage heuristic to determine the minimum-cost district heating systems in municipalities. The central innovations are the ability to optimise both the structure of the heating network and the location of the heating plant, the consideration of partial heat supply from district heating and the scalability to larger municipalities. A comparison of optimisation and heuristic for three exemplary municipalities demonstrates the efficiency of the latter: the optimisation takes between 500% and $1 \times 10^7\%$ more time than the heuristic. The deviations of the heuristic's calculated total investments for the district heating system compared to the optimisation are in all cases below 5%, and in 80% of cases below 0.3%. The efficiency of the heuristic is further demonstrated by comparison with the Nearest-Neighbour-Heuristic, which is less efficient and substantially overestimates the total costs by up to 80%. The heuristic can also be used to design district heating networks in holistic energy system optimisations due to the novel possibility of connecting an arbitrary number of buildings to the network. Future work should focus on a more precise consideration of heat losses, as well as taking additional geological and topographical conditions into account.

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A hybrid modelling method for improving estimates of the average energy-saving potential of a building stock

Assessing the energy-saving potential in a building stock requires accurate prediction of the energy use in buildings, as well as estimating effects of imposing energy-conservation measures. Bottom-up building physics-based building stock energy models are widely used for this purpose. However, deficient data (e.g. data related to the use of the building) compel modellers to use normative assumptions in its place, thereby compromising the accuracy of building-physics based models. Furthermore, validation of building-physics based building stock energy models is often lacking. In the present study, a hybrid bottom-up building stock energy model was developed in order to overcome the drawbacks of traditional building-physics (engineering) based modelling methods. Using a sample of more than 100,000 residential buildings, individual building-physics based models were calibrated against energy use data in a multiple linear regression setting, thereby providing a novel hybrid bottom-up building stock energy model. Furthermore, embedding building-physics based building energy models in a statistical model made it possible to validate the model by means of common statistical measures. The proposed hybrid model provided significantly more accurate estimates of the energy use in an unseen sample of buildings than a purely building-physics based building stock energy model. Moreover, as the hybrid model included a unique building-physical description of each building in the sample, it could be used for estimating the effect of imposing an arbitrary energy upgrade. This way of setting up a hybrid building stock energy model provides a simple, yet accurate, approach for estimating the energy-saving potential of a building stock that could be used for informing policy makers and other stakeholders.
Benefit of Higher Maximum Force Output on Listening Effort in Bone-Anchored Hearing System Users: A Pupillometry Study

OBJECTIVES: The aim of this study was to compare listening effort, as estimated via pupillary response, during a speech-in-noise test in bone-anchored hearing system (BAHS) users wearing three different sound processors. The three processors, Ponto Pro (PP), Ponto 3 (P3), and Ponto 3 SuperPower (P3SP), differ in terms of maximum force output (MFO) and MFO algorithm. The hypothesis was that listeners would allocate lower listening effort with the P3SP than with the PP, as a consequence of a higher MFO and, hence, fewer saturation artifacts in the signal. DESIGN: Pupil dilations were recorded in 21 BAHS users with a conductive or mixed hearing loss, during a speech-in-noise test performed at positive signal-to-noise ratios (SNRs), where the speech and noise levels were individually adjusted to lead to 95% correct intelligibility with the PP. The listeners had to listen to a sentence in noise, retain it for 3 seconds and then repeat it, while an eye-tracking camera recorded their pupil dilation. The three sound processors were tested in random order with a single-blinded experimental design. Two conditions were performed at the same SNR: Condition 1, where the speech level was designed to saturate the PP but not the P3SP, and condition 2, where the overall sound level was decreased relative to condition 1 to reduce saturation artifacts. RESULTS: The P3SP led to higher speech intelligibility than the PP in both conditions, while the performance with the P3 did not differ from the performance with the PP and the P3SP. Pupil dilations were analyzed in terms of both peak pupil dilation (PPD) and overall pupil dilation via growth curve analysis (GCA). In condition 1, a significantly lower PPD, indicating a decrease in listening effort, was obtained with the P3SP relative to the PP. The PPD obtained with the P3 did not differ from the PPD obtained with the other two sound processors. In condition 2, no difference in PPD was observed across the three processors. The GCA revealed that the overall pupil dilation was significantly lower, in both conditions, with both the P3SP and the P3 relative to the PP, and, in condition 1, also with the P3SP relative to the P3. CONCLUSIONS: The overall effort to process a moderate to loud speech signal was significantly reduced by using a sound processor with a higher MFO (P3SP and P3), as a consequence of fewer saturation artifacts. These findings suggest that sound processors with a higher MFO may help BAHS users in their everyday listening scenarios, in particular in noisy environments, by improving sound quality and, thus, decreasing the amount of cognitive resources utilized to process incoming speech sounds.

Generation and sampling of quantum states of light in a silicon chip

Implementing large instances of quantum algorithms requires the processing of many quantum information carriers in a hardware platform that supports the integration of different components. Although established semiconductor fabrication processes can integrate many photonic components, the generation and algorithmic processing of many photons has been a bottleneck in integrated photonics. Here, we report the on-chip generation and algorithmic processing of quantum states of light with up to eight photons. Switching between different optical pumping regimes, we implement the scattershot, Gaussian and standard boson sampling protocols in the same silicon chip, which integrates
linear and nonlinear photonic circuitry. We use these results to benchmark a quantum algorithm for calculating molecular vibronic spectra. Our techniques can be readily scaled for the on-chip implementation of specialized quantum algorithms with tens of photons, pointing the way to efficiency advantages over conventional computers.

**Zero On-Site Testing Strategies for Wireless TCMS**

TCMS is a key element for smart railway operation and maintenance. In order to reduce costs and train weight, EU-funded projects are working on the development of wireless TCMS. The data exchanges between trains and ground will be based on wireless technology such as WiFi or Long Term Evolution. First prototypes are available at the European level. To facilitate the testing of the TCMS interface to ground systems, it is important to develop tools able to represent railway environments without going on tracks (zero on-site testing). In this context, we present two strategies to simulate and emulate a complete wireless network (including the core network), based on the Riverbed Modeler and OpenAirInterface platform, able to take into account various train-to-ground contexts (environment, communication and railway networks load). This work considers LTE technology but can be transposed to other types of technology if representative system models are available. As a proof of concept of the test environment, we present results in terms of delay and delivery rates considering TCMS traffic and various railway scenarios such as train speed and wireless network load.
Towards detection of juice filming charging attacks via supervised CPU usage analysis on smartphones

Mobile devices, such as Android and iOS devices, are an attractive target for cyber-criminals, due to the amount of private data that can be accessed or stored on such devices. As public charging facilities become more commonplace, phone charging attacks are no longer fiction. Juice filming charging (JFC) attack is a particular phone charging threat, which can capture or infer users' private information by automatically recording screen information from mobile devices during the entire charging process. In this work, we first investigate the types of phone applications users would interact with the most when charging their devices. Then, we propose a detection approach for JFC attacks solely by analyzing CPU usage. In the evaluation, we collect data from a total of 187 participants, and the findings show that our approach using the SVM classifier can achieve better performance than other approaches. Our work complements existing security mechanisms against charging threats.

Optical sampling to enhance Nyquist-shaped signal detection under limited receiver bandwidth

Insufficient receiver bandwidth destroys the orthogonality of Nyquist-shaped pulses, generating inter-symbol interference (ISI). We propose using an optical pre-sampler to alleviate the requirement on the receiver bandwidth through pulse reshaping. Experiments and simulations using an optically shaped 40-Gbaud Nyquist-shaped on-off-keying signal (N-OOK) show receiver sensitivity improvements of 4- and 7.1-dB under 18- and 11-GHz receiver electrical bandwidths, respectively.
Enhanced Modal Dispersion Estimation Enabled by Chromatic Dispersion Compensation in Optical Vector Network Analysis

Component characterization is fundamental for understanding the limits of optical devices, sub-systems, and transmission systems. With the introduction of space division multiplexing in optical fiber transmission systems, new impairments, such as mode dependent loss and differential mode dispersion arise. Spatially-diverse optical vector network analyzers are capable of measuring these characteristics in a fast single sweep over a very large bandwidth. As a result of this large bandwidth, these analyzers are sensitive to differential chromatic dispersion within the interferometric measurement setup. This study discusses the influence and compensation of differential chromatic dispersion in such systems. Partial chromatic dispersion compensation is demonstrated to improve the representation and accuracy of impulse response measurements obtained from optical vector network analyzers for fibers and components with large differential chromatic dispersion. Analysis of a 39-core few-mode multi-core fiber is discussed, reporting variances of -2.9-0.1 ps/nm, and 0.6-6.9 ps/nm for the two mode groups, respectively, between the few-mode cores. A correlation with the total impulse response is observed. Furthermore, a maximum propagation skew of 20 ns between cores is observed after 13.6 km.

Imaging of glucose metabolism by 13C-MRI distinguishes pancreatic cancer subtypes in mice

Metabolic differences among and within tumors can be an important determinant in cancer treatment outcome. However, methods for determining these differences non-invasively in vivo is lacking. Using pancreatic ductal adenocarcinoma as a model, we demonstrate that tumor xenografts with a similar genetic background can be distinguished by their differing rates of the metabolism of 13C labeled glucose tracers, which can be imaged without hyperpolarization by using newly developed techniques for noise suppression. Using this method, cancer subtypes that appeared to have similar metabolic profiles based on steady state metabolic measurement can be distinguished from each other. The metabolic maps from 13C-glucose imaging localized lactate production and overall glucose metabolism to different regions of some tumors. Such tumor heterogeneity would not be not detectable in FDG-PET.
In this article, we briefly summarize the experiments performed during the first run of the Advanced Wakefield Experiment, AWAKE, at CERN (European Organization for Nuclear Research). The final goal of AWAKE Run 1 (2013-2018) was to demonstrate that 10-20 MeV electrons can be accelerated to GeV energies in a plasma wakefield driven by a highly relativistic self-modulated proton bunch. We describe the experiment, outline the measurement concept and present first results. Last, we outline our plans for the future.

**Proton-driven plasma wakefield acceleration in AWAKE**

In this article, we briefly summarize the experiments performed during the first run of the Advanced Wakefield Experiment, AWAKE, at CERN (European Organization for Nuclear Research). The final goal of AWAKE Run 1 (2013-2018) was to demonstrate that 10-20 MeV electrons can be accelerated to GeV energies in a plasma wakefield driven by a highly relativistic self-modulated proton bunch. We describe the experiment, outline the measurement concept and present first results. Last, we outline our plans for the future.

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From regular expression matching to parsing

Given a regular expression R and a string Q, the regular expression parsing problem is to determine if Q matches R and if so, determine how it matches, e.g., by a mapping of the characters of Q to the characters in R. Regular expression parsing makes finding matches of a regular expression even more useful by allowing us to directly extract subpatterns of the match, e.g., for extracting IP-addresses from internet traffic analysis or extracting subparts of genomes from genetic data bases. We present a new general techniques for efficiently converting a large class of algorithms that determine if a string Q matches regular expression R into algorithms that can construct a corresponding mapping. As a consequence, we obtain the first efficient linear space solutions for regular expression parsing.

A multispectral camera system for automated minirhizotron image analysis

Aims: Roots are vital organs for plants, but the assessment of root traits is difficult, particularly in deep soil layers under natural field conditions. A popular technique to investigate root growth under field or semi-field conditions is the use of minirhizotrons. However, the subsequent manual quantification process is time-consuming and prone to error. Methods: We developed a multispectral minirhizotron imaging system and a subsequent image analysis strategy for automated root detection. Five wavelengths in the visible (VIS) and near-infrared (NIR) spectrum are used to enhance living roots by a multivariate grouping of pixels based on differences in reflectance; background noise is suppressed by a vesselness enhancement filter. The system was tested against manual analysis of grid intersections for both spring barley (Hordeum vulgare L.) and perennial ryegrass (Lolium perenne L.) cultivars at two time-points. The images of living roots were captured in wet subsoil conditions with dead roots present from a previous crop. Results: Under the soil conditions used in the study, NIR reflectance (940 nm), provided limited ability to separate between rhizosphere components, compared to reflectance in the violet and blue light spectrum (405 nm and 450 nm). Multivariate image analysis of the spectral data, combined with vesselness enhancement and thresholding allowed for automated detection of living roots. Automated image analysis largely replicated the root intensity found during manual grid intersect analysis of the same images. Although some misclassification occurred, caused by elongated structures of dew and chalkstone with similar reflectance pattern as living root, the system provided similar or in some cases improved detection of genotypic differences in the total root length within each tube. Conclusion: The multispectral imaging system allows for automated detection of living roots in minirhizotron studies. The system requires considerably less time than traditional manual recording using grid intersections. The flexible training strategy used for root segmentation offers hope for the transfer to other rhizosphere components and other soil types of interest.
An Efficient Storage of Infrared Video of Drone Inspections via Iterative Aerial Map Construction

In this letter, we present a novel compression algorithm of infrared video sequences captured during drone inspections based on iterative aerial map construction. In our approach, we first apply a stitching algorithm to construct a map of an inspected area assuming that a drone is flying at the same altitude by trajectory close to meander, so that each frame can have a partial overlap with other frame captured much earlier or later. Then, we extract position and rotation angle within the map for each frame and use them as a side information for the video coding. In order to compress an input video sequence, we utilize a multi-view H.265/HEVC with two views. First view is a virtual view generated utilizing the decoded frames of the second view and the side information, whereas the input video is considered as the second view, which is encoded utilizing the virtual view as a reference for the inter-view prediction. The proposed approach has two main benefits. First, the aerial map is generated during decoding utilizing the side information, i.e., the map is not embedded into a bit stream. Second, the inter-view prediction allows to exploit an additional redundancy, which is typical for a drone video. Experimental results show that the proposed algorithm provides 1.4%-2.4% bit rate savings comparing to H.265/HEVC. The maximum possible bit rate savings are estimated from 15.5% to 18.9% assuming that the drone is repeatedly flying many times at exactly the same trajectory.

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Hardlock: Real-time multicore locking
Multiple threads executing on a multicore processor often communicate via shared objects, allocated in main memory, and protected by locks. A lock itself is often implemented with the compare-and-swap operation. However, this operation is retried when the operation fails and the number of retries is unbounded. For hard real-time systems we need to be able to provide worst-case execution time bounds for all operations. The paper presents a time-predictable solution for locking on a multicore processor. Hardlock is an on-chip locking unit that supports concurrent locking without the need to get off-chip. Acquisition of a lock takes 2 clock cycles and release of a lock 1 clock cycle.