Strategic Management: The theory and practice of strategy in (business) organizations.
This work is the result of an ongoing study on the patterns and trends on both the theory and practice in the field of strategic management carried out at the Section of Innovation Systems and Foresight. The report focuses on different issues regarding the broad topic of strategy in organizations, but special attention is given to three relevant issues regarding the current diversification and fragmentation in the field of strategic management: • The lack of a universally accepted definition of what strategy is, • The multi-disciplinary nature of the field, and • The development and evolution of our knowledge on human cognition and organizations’ behaviour. These issues are addressed from the perspective of influential scholars and practitioners of different disciplines, yet they are discussed from the angle of business organizations.

On the Design of Tilting-Pad Thrust Bearings
Pockets are often machined in the surfaces of tilting-pad thrust bearings to allow for hydrostatic jacking in the start-up phase. Pockets and other recesses in the surfaces of bearing pads influence the pressure distribution and thereby the position of the pivot resulting in the most advantageous pad convergence ratio. In this thesis, a theoretical approach is applied in the attempt to quantify the influence of recesses in the pad surfaces. The recesses may be relatively deep and enclosed as is the case with pockets designed for hydrostatic jacking. Such recesses are characterized by low friction and a small pressure build-up. As in parallel-step bearings the recesses may also have a depth of the same order of magnitude as the oil film thickness. Such recesses are characterized by a strong pressure build-up caused by the reduction of the flow area at the end of the recess. Numerical models based on the Reynolds equation are used. They include the effects of variations of viscosity with temperature and the deformation of the bearing pads due to pressure and thermal gradients. The models are validated using measurements. Tilting-pad bearings of standard design are studied and the influences of the bearing length-to-width ratio, pad deformation and injection pocket size are quantified. Suggestions for the design of energy efficient bearings are given. The results show that correctly dimensioned, bearings with oil injection pockets have smaller friction coefficients than bearings with plain pads. Placing the pockets in the high-pressure zones close to the trailing edges of the bearing pads causes a substantial reduction in the friction coefficient. The design
of the recess sizes and positions leading to the largest improvements is studied and design suggestions for various pad geometries are given. Parallel-step bearings theoretically have smaller friction coefficients than tilting-pad bearings. A design of a tilting-pad bearing is suggested which combines the benefits of the two types of bearings in a tilting-pad bearing with inlet pockets. This design results in a substantial reduction of the friction loss. Both this bearing and the bearing design with enclosed recesses in the high-pressure regions of the pads suffer from a higher sensitivity to the position of the pivot. The design of such bearing is therefore no trivial task.

General information
State: Published
Organisations: Solid Mechanics, Department of Mechanical Engineering
Contributors: Heinrichson, N.
Number of pages: 98
Publication date: Jun 2007

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Original language: English
Electronic versions:
Afhandling.pdf
Source: orbit
Source-ID: 202294
Research output: Research › Ph.D. thesis – Annual report year: 2007

Surface energy and work function of elemental metals
We have performed an ab initio study of the surface energy and the work function for six close-packed surfaces of 40 elemental metals by means of a Green’s-function technique, based on the linear-muffin-tin-orbitals method within the tight-binding and atomic-sphere approximations. The results are in excellent agreement with a recent full-potential, all-electron, slab-supercell calculation of surface energies and work functions for the 4d metals. The present calculations explain the trend exhibited by the surface energies of the alkali, alkaline earth, divalent rare-earth, 3d, 4d, and 5d transition and noble metals, as derived from the surface tension of liquid metals. In addition, they give work functions which agree with the limited experimental data obtained from single crystals to within 15%, and explain the smooth behavior of the experimental work functions of polycrystalline samples as a function of atomic number. It is argued that the surface energies and work functions calculated by present day ab initio methods are at least as accurate as the experimental values.

General information
State: Published
Organisations: Theoretical Atomic-scale Physics, Department of Physics, Technical University of Denmark
Contributors: Skriver, H. L., Rosengaard, N. M.
Pages: 7157-7168
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BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
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Scopus rating (2017): CiteScore 3.34 SJR 1.604 SNIP 1.04
Web of Science (2017): Impact factor 3.813
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Web of Science (2016): Indexed yes
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Web of Science (2015): Indexed yes

Cloud Radio Access Network (C-RAN) is a novel mobile network architecture which can address a number of challenges that mobile operators face while trying to support ever-growing end-users' needs towards 5th generation of mobile
networks (5G). The main idea behind C-RAN is to split the base stations into radio and baseband parts, and pool the Baseband Units (BBUs) from multiple base stations into a centralized and virtualized BBU Pool. This gives a number of benefits in terms of cost and capacity. However, the challenge is then to find an optimal functionality splitting point as well as to design the so-called fronthaul network, interconnecting those parts. This thesis focuses on quantifying those benefits and proposing a flexible and capacity-optimized fronthaul network. It is shown that a C-RAN with a functional split resulting in a variable bit rate on the fronthaul links brings cost savings due to the multiplexing gains in the BBU pool and the fronthaul network. The cost of a fronthaul network deployment and operation can be further reduced by sharing infrastructure between fronthaul and other services. The origins of multiplexing gains in terms of traffic burstiness, the tidal effect and various possible functional splits are analyzed and quantified. Sharing baseband resources between many cells is possible for traditional C-RANs. However, in order to further benefit from multiplexing gains on fronthaul, it is recommended to implement a functional split yielding variable bit rate in the fronthaul. For the analyzed data sets, in deployments where diverse traffic types are mixed (bursty, e.g., web browsing and constant bit rate, e.g., video streaming) and cells from various geographical areas (e.g., office and residential) are connected to the BBU pool, the multiplexing gain value reaches six. Using packet-based fronthaul has the potential to utilize fronthaul resources efficiently. However, meeting synchronization and delay requirements is a challenge. As a possible solution, the use of IEEE Precision Time Protocol (PTP) (also known as 1588v2) has been evaluated, and for the analyzed scenario it can assure synchronization on the nanosecond level, fulfilling mobile network requirements. Furthermore, mechanisms to lower delay and jitter have been identified, namely: source scheduling and preemption. An innovative source scheduling scheme which can minimize jitter has been proposed. The scheme is optimized for symmetric downlink and uplink traffic, but can also be used when downlink traffic exceeds uplink. Moreover, a demonstrator of a Software Defined Networking (SDN) controlled Ethernet fronthaul has been built.

**General information**

State: Published  
Organisations: Department of Photonics Engineering, Networks Technology and Service Platforms  
Contributors: Checko, A.  
Number of pages: 170  
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Original language: English  
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ACheckoPhDTesisCRANFinalRC.pdf  
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Source-ID: 123789696  

**Introduction to computed tomography**

**General information**

State: Published  
Organisations: Manufacturing Engineering, Department of Mechanical Engineering  
Contributors: Cantatore, A., Müller, P.  
Number of pages: 76  
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Publisher: DTU Mechanical Engineering  
Original language: English  
Electronic versions:  
Introduction_to_CT.pdf  
Source: dtu  
Source-ID: u::6016  
Research output: Research › Report – Annual report year: 2012

**Evaluating and prioritizing technologies for adaptation to climate change. A hands on guidance to multi criteria analysis (MCA) and the identification and assessment of related criteria**

The objective of this guidance is to guide consultants, decision makers and technical experts on how to facilitate discussions for prioritizing adaptation technologies, and to support the stakeholders in identifying appropriate criteria for this analysis.

**General information**

State: Published
Organisations: Department of Management Engineering, UNEP DTU Partnership
Contributors: Trærup, S. L. M., Bakkegaard, R. K.
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Source: PublicationPreSubmission
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Research output: Research › Report – Annual report year: 2015

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**Recycling CO2 into Sustainable Hydrocarbon Fuels: Electrolysis of CO2 and H2O**

**General information**
State: Published
Organisations: Electrochemistry, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy
Contributors: Graves, C. R.
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Source: orbit
Source-ID: 271818
Research output: Research › Ph.D. thesis – Annual report year: 2010

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**The Development of an Online Grading System for Distributed Grading in a Large First Year Project-Based Design Course**

AC 2012-3467: This paper presents an online grading system that was developed to collect, process, and return the grades produced by juries using a series of rubrics in a first year project-based design course. It discusses the design requirements, features, and implementation of the online grading system, as well as reactions from course faculty and staff members. It is shown that this system has a number of advantages over analog grading methods, including scalability, real-time feedback on the status of grading, the reduced potential for human error in compiling grades, the ability for jury members to grade remotely and to revise their grades after submission, the ability for course administrators to easily review grading results and remove statistical outliers from the score set, the ability to return both provisional and final grades to the course faculty, staff, and students in a timely manner, and the ability to archive and export grading data for future use. Although the online system is a clear improvement over paper-based rubrics, it is also shown that small details can interfere with usability and thus user satisfaction and that compatibility with mobile devices is a necessary, but still unaddressed, requirement.

**General information**
State: Published
Organisations: Technical University of Denmark, Korean Advanced Institute of Science and Technology (KAIST)
Contributors: Thompson, M. K., Ahn, B.
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Research output: Research › peer-review › Article in proceedings – Annual report year: 2012
Clinker Burning Kinetics and Mechanism

The industrial cement process is subject to several changes in order to reduce the high energy consumption and thereby increase the profitability of cement production. These changes also affect the core of the entire cement producing process: the clinker formation in the rotary kiln. Thus, in order to maintain or even improve clinker quality (and output), we need a better understanding of the development of clinker properties inside the kiln to react upon the impact of process changes. Clinker formation in industrial rotary kilns is very complex due to a vast number of interacting parameters: kiln dimensions, rotation velocity, temperature, gas composition, heat transfer phenomena, etc. These conditions can only be partly simulated in ordinary lab-scale experiments. Thus, the objectives of this project have been to establish test equipment to simulate the industrial clinker burning process on a laboratory scale and to conduct clinker formation experiments in order to derive knowledge on gradual clinker property development, as a function of different process parameters.

A new lab-scale setup rotary kiln simulator (RKS) was designed and built for this purpose. It is assembled of two parts: an ordinary lab-scale heating furnace and a sample motion system. The motion system consists of a SiC tube, which moves the sample, placed in a Pt/Rh-crucible, at a chosen velocity through the heating furnace. Simultaneously, the sample is rotated around its horizontal axis with a chosen rotation velocity. The heating furnace consists of five individual heating zones, which are set to obtain a temperature ramp from ~900-1540 °C. Furthermore, the atmosphere in the system can be set to any mixture of N2, O2 and CO2. Thus, the rotary kiln simulator features most important parameters of the industrial cement rotary kiln (ICRK): gradual temperature increase, rotation velocity and gas phase composition.

An investigation of clinker formation vs. heating profile and rotational velocity were conducted, and the influence on the clinker phase composition and clinker agglomeration was deduced. Independent of the raw meal used, the different clinker phases were formed in three stages: 1. C2S, C3A and C4AF formation at ~900-1350 °C; 2. Clinker melt formation at ~1350-1400 °C; and 3. C3S formation at >1350 °C. The first temperature of clinker melt occurrence varied slightly depending on the type of raw meal used.

The influence of different heating profiles on clinker formation was studied, and it was observed that C3S formation was more complete, the faster the sample was heated to a temperature >1400 °C. However, only with relative long residence times above this temperature clinker phase compositions similar to industrial clinker, i.e. with high C3S concentration and low CaO concentration, were obtained. It was concluded, that the maximum temperature of 1540 °C in the RKS does not simulate the maximum temperature in the ICRK. Thus, the maximum temperature of 1450 °C, as is often stated in literature, is likely often not applicable.
Agglomeration of the raw meal was observed to start already at 900 °C. The agglomerates formed are first rather weak, but increase in hardness with increasing temperature. The size of the agglomerates as well as the amount formed was found to be dependent on the rotation velocity: the higher the rotation velocity, the higher was the amount of agglomerates < 1mm. The higher rotation velocity also resulted in a decrease of the total amount of agglomerates, whereas the amount of material lining on the reactor walls increased.

The establishment of the RKS setup will allow more realistic clinker formation studies in future and thus potentially an experimental lab-scale access to the understanding of important parameters in the ICRK. The obtained qualitative and quantitative data on clinker phase composition and on agglomerate formation depended on operational parameters are essential for the development/improvement of models for bed material process in the ICRK, and for the development steps to improve the reactor technology.

Stress concentrations in keyways and optimization of keyway design

Keys and keyways are one of the most common shaft–hub connections. Despite this fact very little numerical analysis has been reported. The design is often regulated by standards that are almost half a century old, and most results reported in the literature are based on experimental photoelastic analysis. The present paper shows how numerical finite element (FE) analysis can improve the prediction of stress concentration in the keyway. Using shape optimization and the simple super elliptical shape, it is shown that the fatigue life of a keyway can be greatly improved with up to a 50 per cent reduction in the maximum stress level. The design changes are simple and therefore practical to realize with only two active design parameters.
Electromagnetic Waves
This book is dedicated to various aspects of electromagnetic wave theory and its applications in science and technology. The covered topics include the fundamental physics of electromagnetic waves, theory of electromagnetic wave propagation and scattering, methods of computational analysis, material characterization, electromagnetic properties of plasma, analysis and applications of periodic structures and waveguide components, etc.
FPGA Acceleration by Dynamically-Loaded Hardware Libraries

Hardware acceleration is a viable solution to obtain energy efficiency in data intensive computation.

In this work, we present a hardware framework to dynamically load hardware libraries, HLL, on reconfigurable platforms (FPGAs). Provided a library of application-specific processors, we load on-the-fly the specific processor in the FPGA, and we transfer the execution from the CPU to the FPGA-based accelerator.

Results show that significant speed-up and energy efficiency can be obtained by HLL acceleration on system-on-chips where reconfigurable fabric is placed next to the CPUs.

Very High Frequency Switch-Mode Power Supplies.: Miniaturization of Power Electronics.

The importance of technology and electronics in our daily life is constantly increasing. At the same time portability and energy efficiency are currently some of the hottest topics. This creates a huge need for power converters in a compact form factor and with high efficiency, which can supply these electronic devices. This calls for new technologies in order to miniaturize the power electronics of today. One way to do this is by increasing the switching frequency dramatically and develop very high frequency switch mode power supplies. If these converters can be designed to operate efficiently, a huge size, weight and cost reduction can be achieved due to the smaller energy storing elements needed at these frequencies. The research presented in this thesis focuses on exactly this. First various technologies for miniaturization of power supplies are studied, e.g. piezo electric transformers, wide band gap semiconductors and integrated power supplies. Afterwards a wide range of topologies suited for operation at very high frequencies is investigated and the most promising ones are tested experimentally. Through a comparison of these topologies the class DE inverter is found to be superior to the other alternatives, at least for converters with hundreds of volts as input and a few tens of watts output power. A class DE inverter does however require a high side gate drive, which have never been presented before for these frequencies and voltages. This thesis presents the worlds first high side gate drive capable of operating at these frequencies and voltage levels. With this gate drive the worlds first class DE inverter operating at very high frequencies with more than 100 V input is also developed and presented. These achievements are considered huge breakthroughs in the development of technologies for very high frequency switch mode power supplies. At these highly elevated frequencies normal bulky magnetics with heavy cores consisting of rare earth materials, can be replaced by air core
inductors embedded in the printed circuit board. This is investigated thoroughly and both spirals, solenoids and toroids are considered, both for use as inductors and transformers. Two control methods are also investigated, namely burst mode control and outphasing. It is shown that a very flat efficiency curve can be achieved with burst mode. A 89.5% efficient converter is implemented and the efficiency only drops 5% at 10% load. This is some of the highest efficiencies presented for converters operating at these frequencies. Burst mode control does however have two major drawbacks, i.e. introductions of low frequency harmonics and decreased control bandwidth. Outphasing is therefore investigated as an alternative, which does not introduce these drawbacks. In the last chapter the conducted and radiated electromagnetic interference from two prototypes are investigated, one running with constant output and one with burst mode control implemented. By the end of the thesis it is shown, that a size reduction of 70%, weight reduction of 81%, cost reduction of 56% and efficiency gain of 4.5%-points can be achieved with a very high frequency class DE converter, compared to a commercial product.
Call Center Capacity Planning

The main topics of the thesis are theoretical and applied queueing theory within a call center setting. Call centers have in recent years become the main means of communication between customers and companies, and between citizens and public institutions. The extensively computerized infrastructure in modern call centers allows for a high level of customization, but also induces complicated operational processes. The size of the industry together with the complex and labor intensive nature of large call centers motivates the research carried out to understand the underlying processes. The customizable infrastructure allows customers to be divided into classes depending on their requests or their value to the call center operator. The agents working in call centers can in the same way be split into groups based on their skills. The discipline of matching calls from different customer classes to agent groups is known as skills-based routing. It involves designing the routing policies in a way that results in customers receiving a desired service level such as the waiting time they experience. The emphasis of this thesis is on the design of these policies. The first paper, Queues with waiting time dependent service, introduces a novel approach to analyzing queueing systems. This involves using the waiting time of the first customer in line as the primary variable on which the analysis is based. The legacy approach has been to use the number of customers in queue. The new approach facilitates exact analysis of systems where service depends on the waiting time. Two such systems are analyzed, one where a server can adapt its service speed according to the waiting time of the first customer in line. The other deals with a two-server setup where one of the servers is only allowed to take customers who have waited a certain fixed amount of time. The latter case is based on a commonly used rule in call centers to control overflow between agent groups. Realistic call center models require multi-server setups to be analyzed. For this reason, an approximation based on the waiting time of the first in line approach is developed in the paper Waiting time dependent multi-server priority queues, which is able to deal with multi-server setups. It is used to analyze a setup with two customer classes and two agent groups, with overflow between them controlled by a fixed threshold. Waiting time distributions are obtained in order to relate the results to the service levels used in call centers. Furthermore, the generic nature of the approximation is demonstrated by applying it to a system incorporating a dynamic priority scheme. In the last paper Optimization of overflow policies in call centers, overflows between agent groups are further analyzed. The design of the overflow policies is optimized using Markov Decision Processes and a gain with regard to service levels is obtained.
Also, the fixed threshold policy is investigated and found to be appropriate when one class is given high priority and when it is desired that calls are answered by the designated agent class and not by other groups through overflow.

**General information**
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling
Contributors: Nielsen, T. B.
Publication date: Mar 2010

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Source-ID: 251790
Research output: Research › Ph.D. thesis – Annual report year: 2010

**Efficiency of Compressed Air Energy Storage**
The simplest type of a Compressed Air Energy Storage (CAES) facility would be an adiabatic process consisting only of a compressor, a storage and a turbine, compressing air into a container when storing and expanding when producing. This type of CAES would be adiabatic and would if the machines were reversible have a storage efficiency of 100%. However, due to the specific capacity of the storage and the construction materials the air is cooled during and after compression in practice, making the CAES process diabatic. The cooling involves exergy losses and thus lowers the efficiency of the storage significantly. The efficiency of CAES as an electricity storage may be defined in several ways, we discuss these and find that the exergetic efficiency of compression, storage and production together determine the efficiency of CAES. In the paper we find that the efficiency of the practical CAES electricity storage is 25-45% and thus has a quite low efficiency, which is close to the efficiency of the simple diabatic CAES-process. Adiabatic CAES would reach significantly higher storage efficiency about 70-80%.

**General information**
State: Published
Organisations: Thermal Energy, Department of Mechanical Engineering
Contributors: Elmegaard, B., Brix, W.
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Electronic versions:
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**Optimization of Anaerobic Digestion of Sewage Sludge Using Thermophilic Anaerobic Pre-Treatment**

**General information**
State: Published
Organisations: Bioscience and Technology, Department of Systems Biology
Contributors: Lu, J.
Publication date: Aug 2007

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Architectural Research Paradigms: an overview and a research example

As Architectural Research is in the process of re-establishing itself as a research discipline according to university standards, it may appear as if the pool of knowledge generated by more than three millennia of experimental research and its internal systems of evaluation are being grossly devalued and colonized by attitudes to research that are imported or even imposed from the outside. Does architectural research have to rely on imported theory from philosophy, the social or the natural sciences in order to meet societal acceptance of its relevance? What constitutes architectural research as a particular research discipline, what are its main characteristics and how can its paradigms, methodologies, strategies and tactics be described? What should be essential aspects of doctoral curriculae in architecture? Discussing Groat and Wang’s Architectural Research Methods in the light of Reflected Practice, and Organizational Knowledge Creation, a framework is presented that includes evolving paradigms and art in architectural research, and demonstrate how this framework allows one to describe the paradigmatic shifts that happened during the course of a PhD research project involving cross-disciplinary teamwork.

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State: Published
Organisations: Technical University of Denmark
Contributors: Sattrup, P. A.
Number of pages: 19
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New Product Introduction in the Pharmaceutical Industry

Due to the limited time of the monopoly provided by patent protection that is used for recouping the R&D investment, pharmaceutical companies focus on keeping time-to-market for new products as short as possible. This process is however getting more uncertain, as the outcome of clinical trials is unknown and negotiations with authorities have become harder, making market introduction more difficult. This dissertation treats the new product introduction process in the pharmaceutical industry from an operations perspective. The overarching aim of this dissertation is to improve the planning methodology in this critical process. In an empirical study, the process is first analyzed in detail, leading to the identification of several gaps in the industry’s current planning approaches. To support a set of key operational decisions towards market launch, a model is subsequently developed, considering uncertainty and several important industry characteristics. The model is used to gain several insights on the use of risk packaging and on keeping time-to-market short. As capacity in secondary pharmaceutical production is critical for product availability, a capacity planning model for a new drug delivery system is also developed. It captures the ramp-up phase in a better way, while considering inventory build up, plant validation and limited shelf life. The performance of several ramp-up functions is tested and insights into ramp-up management are presented. The dissertation is concluded with showing the new proposed planning structure, concluding in the preceding chapters and outlining future research possibilities.

General information
State: Published
Organisations: Department of Management Engineering, Management Science, Department of Chemical and Biochemical Engineering, CAPEC-PROCESS, Technische Universität München
Contributors: Hansen, K. R. N., Hvam, L., Grunow, M., Akkerman, R., Gani, R.
Number of pages: 125
Publication date: 2014
Moulded Pulp Manufacturing: Overview and Prospects for the Process Technology

Eco-friendly packaging such as moulded pulp products have gained commercial importance in the recent years. However, it remains a greatly under-researched area, and there is an arising need to consolidate the best practices from research and industry in order to increase its implementation. The goal of this paper is to give an overview of the main aspects involved in the manufacture of moulded pulp products. This includes a classification of moulded pulp products, historical and current applications, production processes, materials, mechanical properties and environmental sustainability. Moreover, based on the latest research in the field, an innovative drying technique that utilizes concepts derived from impulse drying is presented, and the implementation of this process technology is discussed.

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Scopus rating (2016): CiteScore 1.76 SJR 0.622 SNIP 0.927
Web of Science (2016): Impact factor 1.32
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BFI (2014): BFI-level 1
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BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.3 SJR 0.52 SNIP 1.647
Web of Science (2012): Impact factor 0.737
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.45 SJR 0.678 SNIP 1.451
The European Water Framework Directive addresses the issue of pollution from urban waste water and is thereby changing the scope of sewage treatment. As part of this process, the Neptune project (EU, FP6) focuses on developing new and upgrading existing technologies of waste water and sludge treatment for municipal waste water. A special focus area in Neptune is sludge handling because the sludge amount is expected to increase due to advanced waste water treatment. The main sludge processing methods assessed in Neptune can be divided into two categories: disintegration processes before anaerobic digestion (thermal hydrolysis and ultrasound disintegration) and inertisation processes performed at high temperatures (incineration, pyrolysis, gasification, wet oxidation) but they all aim at volume reduction and removal of biodegradable compounds before safe sludge disposal or reuse of its resources. As part of a sustainability assessment (or "best practice evaluation"), a comparison between the existing and new sludge handling techniques have been done by use of life cycle assessment (LCA). The concept of induced impacts as compared to avoided impacts when introducing a new sludge treatment technology is used for the environmental comparison. Emissions from the treatment of the sludge as well as energy consumption and production, chemical consumption, infrastructures and transport are taken into account. This poster will present the results of LCA's performed on different inertisation technologies. Incineration is used as the reference process, as it is the only existing well-developed technology, while other techniques like pyrolysis and gasification are relatively new, and only exist at lab-scale or pilot-plant scale.

Environmental sustainability of wastewater sludge treatments

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Contributors: Boyer-Souchet, F., Larsen, H. F.
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Source: PublicationPreSubmission
Source-ID: 130090162
Research output: Research - peer-review \ Review – Annual report year: 2017
High Efficiency Power Converter for Low Voltage High Power Applications

The topic of this thesis is the design of high efficiency power electronic dc-to-dc converters for high-power, low-input-voltage to high-output-voltage applications. These converters are increasingly required for emerging sustainable energy systems such as fuel cell, battery or photo voltaic based energy systems. Applications include systems for emergency power back-up (UPS), de-centralized combined heat and power systems, traction applications such as hybrid electrical vehicles, forklift trucks and special applications such as low emission power generation for truck and ship containers, and remote power generation for light towers, camper vans, boats, beacons, and buoys etc. A review of current state-of-the-art is presented. The best performing converters achieve moderately high peak efficiencies at high input voltage and medium power level. However, system dimensioning and cost are often determined by the performance at the system worst case operating point which is usually at minimum input voltage and maximum power. Except for the non-regulating V6 converters, all published solutions exhibit a very significant drop in conversion efficiency at minimum input voltage and maximum output power. A detailed analysis of dominant loss factors in high power converters for low voltage applications is presented. The analysis concludes that: • Power transformers for low voltage high power, if properly designed, will have extremely low leakage inductance. • If optimally designed, boost converters will be much more efficient than comparable buck type converters for high power low voltage applications. • The use of voltage clamp circuits to protect primary switches in boost converters is no longer needed for device protection. On the other hand, they will dramatically increase power losses. Moreover, if a converter is properly designed, primary side voltage clamp circuits will not even work in low voltage high power converters. • Very high conversion efficiency can be achieved. Peak efficiency of 98% and worst case minimum efficiency of 96.8% are demonstrated on a 1.5 kW converter. The ability to - and challenges involved in - scaling of power converters for low voltage applications in the power range of 1-10 kW are analyzed. The analysis concludes that power MOSFETs needs to be paralleled extensively to scale power level to 10 kW. Maintaining fast current switching and reliable current sharing is essential. Further, the high ac-current carrying loop on the converter primary side will become increasingly difficult to scale due to fundamental issues such as physical size of components and penetration depth in copper. Finally a new method for partial paralleling of multiple primary power stages in isolated boost converters is presented. Maximum benefit of scaling in terms of higher efficiency and lower cost is preserved by only paralleling primary switches and the critical high ac-current loop. Dynamic current sharing is inherently guaranteed between parallel power stages. The principle can be applied to all isolated boost type converters and, in principle, an unlimited number of power stages can be paralleled. Feasibility and operation of the new topology are demonstrated on a dual 3 kW and a quad 10 kW prototype converter. Measured peak efficiency is 98.2% and worst case minimum efficiency is between 96.5% and 96.9%.

Colloidal Plasmonic Titanium Nitride Nanoparticles: Properties and Applications

Optical properties of colloidal plasmonic titanium nitride nanoparticles are examined with an eye on their photothermal and photocatalytic applications via transmission electron microscopy and optical transmittance measurements. Single crystal titanium nitride cubic nanoparticles with an average size of 50 nm, which was found to be the optimum size for cellular uptake with gold nanoparticles [1], exhibit plasmon resonance in the biological transparency window and demonstrate a high absorption efficiency. A self-passivating native oxide at the surface of the nanoparticles provides an additional degree of freedom for surface functionalization. The titanium oxide shell surrounding the plasmonic core can create new
opportunities for photocatalytic applications.

General information
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Organisations: Department of Photonics Engineering, Metamaterials, Purdue University
Contributors: Guler, U., Suslov, S., Kildishev, A. V., Boltasseva, A., Shalaev, V. M.
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Tragacanth Gum: Structural Composition, Natural Functionality and Enzymatic Conversion as Source of Potential Prebiotic Activity
Gum tragacanth derived from the plant (Astragalus sp.) has a long history of use as a stabilizing, viscosity-enhancing agent in food emulsions. The gum is mainly produced in the Middle East, and permitted for food use in the US as well as in Europe (E-number E413). Gum tragacanth is known to confer very high viscosities when in aqueous solution, and is described as a complex, highly branched, heterogeneous hydrophilic polysaccharide. The gum contains pectinaceous arabinogalactans and fucose-substituted xylogalacturonans. The objective of this PhD study was to evaluate tragacanth samples from six species of Iranian Astragalus for their emulsion stabilizing effects and their detailed chemical composition in order to examine any possible correlation between the make-up and the emulsion stabilizing properties of gum tragacanth. Also, enzymatic modification of highly fucose content of tragacanth gum and separation via membrane technique to get different molecular size. Furthermore, examination of compositional structure and effect of different molecular size on potential prebiotic was evaluated.
The first part of the present study was selected of six different species of Astragalus and exudates of gum and fractionated by centrifugation to soluble and insoluble. To examine correlation between composition structure, sugar composition and
methoxyl and acetyl content was determined. The six gum samples varied with respect to their levels and ratios of watersoluble and water-swellable fractions, their monosaccharide composition, methoxylation, and acetylation degrees. Emulsion and rheological properties of different gum solution was assessed with WPI as an emulsifier in protein base emulsion and correlation of each composition on emulsion stability was established. Tragacanth gum solution added in emulsion and without emulsion showed shear thinning properties in all gums. The emulsion stabilization effect correlated linearly and positively to the methoxylation degree, and galacturonic acid content of the gums, but not to acetyl or fucose content. A particularly high correlation was found between methoxyl level in the soluble gum part and emulsion stabilization.

The results of this work provide some important clues to the emulsion stabilization mechanisms in relation to the structure composition of tragacanth gums.

From our knowledge and many research for application of this gum in food industry and unique properties of this gum with arabinogalactan and fucoxylogalacturonans in the structure of we decided to evaluate bioactivity of this gum. To date, different commercial of prebiotic compound available but still new compound is needed and interested. The main process for the production of prebiotic is enzymatic process. Thus, the next study of work was using commercial pectinolytic enzyme to get different molecular size and purified with membrane technique and get three different fraction: HAG1 < 2 kDa; 2 kDa< HAG2 < 10 kDa; HAG3 > 10 kDa. HPAEC results shown that these three fractions varied with respect to composition and HAG1 and HAG2 were enriched in arabinose, galactose, and galacturonic acid, but low in fucose and xylose; whereas HAG3 was high in xylose, fucose and galacturonic acid, but low in arabinose and galactose. The structural composition of different fractions with linkage analysis shown that the structure of gum tragacanth fractions was different and included 1,4-bonded galacturonic acid backbone with terminally linked fucose and (1,3)-linked xylose, as well as terminally linked xylose called fucoxylogalacturanan. In addition, the presence of (1,4)-galactose linkages and 1,5 Ara linkage presumably correspond to arabinogalactan-derived galactan.

Determination of prebiotic effect of different fraction in vitro were assessed on seven different probiotic strains in single culture fermentations on: Bifidobacterium longum subsp. longum (2 strains), B. longum subsp. infantis (3 strains), Lactobacillus acidophilus, B. lactis, and on one pathogenic strain of Clostridium perfringens. The fractions HAG1 and HAG2 consistently promoted higher growth of the probiotic strains than HAG3, especially of the three B. longum subsp. infantis strains, and the growth promotion on HAG1 and HAG2 was better than that on galactan (control). HAG3 completely inhibited the growth of the Cl. perfringens strain.

In summary of this study:
• Emulsion stabilization of the gum is related to the gum composition and structure, and mainly galacturonic acid content and degree of esterification are important
• low molecular size oligosaccharides produced enzymatically has higher potential prebiotic activity than longer chain gum saccharides
• Tragacanth gum can be a new source for development of innovative functional foods with health claims
How to Train Deep Variational Autoencoders and Probabilistic Ladder Networks

Variational autoencoders are a powerful framework for unsupervised learning. However, previous work has been restricted to shallow models with one or two layers of fully factorized stochastic latent variables, limiting the flexibility of the latent representation. We propose three advances in training algorithms of variational autoencoders, for the first time allowing to train deep models of up to five stochastic layers, (1) using a structure similar to the Ladder network as the inference model, (2) warm-up period to support stochastic units staying active in early training, and (3) use of batch normalization. Using these improvements we show state-of-the-art log-likelihood results for generative modeling on several benchmark datasets.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Cognitive Systems, University of Copenhagen, Aalto University
Contributors: Sønderby, C. K., Raiko, T., Maaløe, L., Sønderby, S. K., Winther, O.
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Caractérisation de l'acier inoxydable après trempe superficielle à basse température

General information
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Organisations: Department of Management Engineering
Contributors: Christansen, T., Somers, M. A. J.
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Research output: Research › Journal article – Annual report year: 2006

The properties of helium: Density, specific heats, viscosity, and thermal conductivity at pressures from 1 to 100 bar and from room temperature to about 1800 K
An estimation of the properties of helium is carried out on the basis of a literature survey. The ranges of pressure and temperature chosen are applicable to helium-cooled atomic reactor design. A brief outline of the theory for the properties is incorporated, and comparisons of the recommended data with the data calculated from intermolecular potential functions are presented.

General information
State: Published
Organisations: Risø National Laboratory, Rise National Laboratory for Sustainable Energy
Contributors: Petersen, H.
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The DTU 10-MW Reference Wind Turbine

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Organisations: Department of Wind Energy, Aeroelastic Design, Wind Turbines
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Plasticitetsteori for jord som Coulomb materiale

General information
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Organisations: Department of Civil Engineering
Contributors: Jantzen, T.
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Source-ID: 208900
Research output: Research › Ph.D. thesis – Annual report year: 2007

Wind Forces on Container Ships
An investigation of the wind forces acting on a 9,000+ TEU container ship has been carried out through a series of wind tunnel tests. It was investigated how the wind forces depend on the container configuration on the deck using a 1:450 scale model and a series of appropriate container configurations. The wind tunnel tests were carried out in the naturally existing boundary layer of the wind tunnel. The longitudinal and transverse forces and the yaw moment were measured and the measurements were corrected for the effects of the boundary layer and blockage in the wind tunnel. The results are presented as nondimensional coefficients. It is concluded, that the measured forces and moment depend on the container configuration on deck, and the results may provide a general idea of how the magnitude of the wind forces is affected by a given container stacking configuration on a similar container ship.

General information
State: Published
Organisations: Department of Mechanical Engineering, Fluid Mechanics, Coastal and Maritime Engineering
Contributors: Andersen, I. M. V.
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Remote Sensing for Wind Energy

The Remote Sensing in Wind Energy report provides a description of several topics and it is our hope that students and others interested will learn from it. The idea behind it began in year 2008 at DTU Wind Energy (formerly Risø) during the first PhD Summer School: Remote Sensing in Wind Energy. Thus it is closely linked to the PhD Summer Schools where state-of-the-art is presented during the lecture sessions. The advantage of the report is to supplement with in-depth, article style information. Thus we strive to provide link from the lectures, field demonstrations, and hands-on exercises to theory. The report will allow alumni to trace back details after the course and benefit from the collection of information. This is the third edition of the report (first externally available), after very successful and demanded first two, and we warmly acknowledge all the contributing authors for their work in the writing of the chapters, and we also acknowledge all our colleagues in the Meteorology and Test and Measurements Sections from DTU Wind Energy in the PhD Summer Schools. We hope to continue adding more topics in future editions and to update and improve as necessary, to provide a truly state-of-the-art 'guideline' available for people involved in Remote Sensing in Wind Energy.

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State: Published
Organisations: Department of Wind Energy, Meteorology, Test and Measurements, University of Stuttgart, Leosphere, University of Colorado, Karlsruhe Institute of Technology, ZephIR Lidar, National Renewable Energy Laboratory, Institute for Atmospheric Science and Climate
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Publication date: 2013

Kedeleffektiviteter for oliefyr og naturgaskedler i enfamiliehuse

General information
State: Published
Organisations: Section for Building Physics and Services, Department of Civil Engineering, Danish Technological Institute, Danish Gas Technology Centre A/S
Publication date: 2004
Digital Signal Processing for Optical Coherent Communication Systems

In this thesis, digital signal processing (DSP) algorithms are studied to compensate for physical layer impairments in optical fiber coherent communication systems. The physical layer impairments investigated in this thesis include optical fiber chromatic dispersion, polarization demultiplexing, light sources frequency and phase offset and phase noise. The studied DSP algorithms are considered as key building blocks in digital coherent receivers for the next generation of optical communication systems such as 112-Gb/s dual polarization (DP) quadrature phase shift keying (QPSK) optical transmission links.

Highlight results presented in this PhD thesis include three areas. First, we present an experimental demonstration of enhanced tolerance to phase noise using pilot-tone-aided phase noise mitigation DSP algorithms. To the best of our knowledge, it is the first experimental demonstration of high phase noise tolerance of 40-Gb/s coherent DP-QPSK systems using vertical cavity surface emitting lasers (VCSELs) as transmitter and local oscillator lasers. Second, in order to fulfill the strict constrains of spectral efficiency, this thesis shows the pioneering experimental demonstration of high spectrum narrowing tolerance 112-Gb/s DP-QPSK optical coherent systems using digital adaptive equalizer. The demonstrated results show that off-line DSP algorithms are able to reduce the bit error rate (BER) penalty induced by signal spectrum narrowing. Third, we also investigate bi-directional transmission of carrierless amplitude and phase (CAP) modulation format signal. In this thesis we focus on the experimental demonstration of DSP channel estimation implementations with CAP signal in the bi-directional optical transmission system.

Furthermore this thesis proposes recongurable and ultra dense wavelength division multiplex (U-DWDM) optical coherent systems based on 10-Gbaud QPSK. We report U-DWDM 1.2-Tb/s QPSK coherent system achieving spectral efficiency of 4.0-bit/s/Hz. In the experimental demonstration, digital decision feed back equalizer (DFE) algorithms and a finite impulse response (FIR) equalizer algorithms are implemented to reduce the inter channel interference (ICI). This PhD thesis also investigates a parallel block-divided overlapped chromatic dispersion DSP compensation algorithm. The essential benefit of using a parallel chromatic dispersion compensation algorithm is that it demands less hardware requirements than a conventional serial chromatic dispersion compensation algorithm.

In conclusion, the digital signal processing algorithms presented in this thesis have shown to improve the performance of digital assisted coherent receivers for the next generation of optical fiber transmission links.
Modular Multilevel Converter Modelling, Control and Analysis under Grid Frequency Deviations

A tool for component sizing for MMCs has been developed and tested through simulations in PLECS. The steady-state behaviour under grid frequency deviations - interesting for offshore wind farm connections - has been analysed, providing insights in MMC characteristics and further testing the proposed tool.

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Source-ID: u::5437
Research output: Research - peer-review › Article in proceedings – Annual report year: 2012

Large-scale Roll-to-Roll Fabrication of Organic Solar Cells for Energy Production

The global energy consumption is increasing steadily while natural energy sources are running out sooner or later. Solar electricity is one of many renewable energy sources that contributes to the world’s demand. Organic solar cells (OPV) are an attractive 3rd generation solar technology that can be produced cheaply and very fast from solution with printing processes. The current research all around the world is still focused on lab-scale sized devices « cm², ITO-glass substrates, and spin coating as the main fabrication method. These OPV devices are far from any practical application although record efficiencies beyond 10% could be achieved.

This dissertation describes process workflows and roll-to-roll (R2R) fabrication methods for upscaling the OPV technology to solar module sizes that enable real power production even at efficiencies <2 %. The fundamental cell technology was based on flexible plastic substrates and ITO-free transparent conductive electrodes made from special designed flexo printed silver grids, rotary screen printed PEDOT:PSS, and slot-die coated ZnO (= Flextrode). The organic solar cell was fabricated by slot-die coating a light absorbing photoactive layer (e. g. P3HT:PCBM) on top of the Flextrode substrate and completed by rotary screen printed PEDOT:PSS and silver electrodes. All layers were R2R printed and coated from solution under full ambient vacuum-free conditions with fabrication speeds reaching 25mmin⁻¹ for some of the layers. Fabrication of modules with high power output requires intelligent connection of single cells that should involve as less as possible manual processes such as wiring or soldering. The problem was solved by serially connecting thousands of single cells entirely during the R2R processing by printing thin-film silver conductors. High voltage networks require only thin conductors to efficiently transport the relatively low current of the organic solar cells. The serial connection was possible through a special designed pattern layout that combined 1-dimensional coating and 2-dimensional printing processes. The so-called Infinity concept allowed the fabrication of virtually infinitely large module sizes without manual wiring. High voltage modules with 21000 cells, open circuit voltage >10 kV and power output >220Wpeak could be successfully manufactured while having only two terminal contacts.

Real energy production from these modules was studied by setting up a whole solar park based on OPV modules. Infinity modules with a length of 100m (width 0.3 m) were rolled out and taped onto a wooden structure. The maximum power output of six parallel-connected modules with a total active area of 88.2m² was beyond 1.3 kW while having energy payback times P1 year. Alternative installation concepts such as a balloon or special designed solar tubes on land or water were proved to be functional as well. Solar tubes with Infinity modules of around 200W generated 18 kWh in 5 weeks. The energy was fed back into the Danish power grid.

The dissertation contains a brief introduction of organic solar cell technology and reviews important R2R compatible manufacturing methods including photonic sintering. The fabrication, design, and challenges of Flextrode and Infinity modules are described in detail. The potential future energy production is presented through large-scale OPV installation scenarios and performance analyses. Fatal failures such as fully burned cells are described while easy repair mechanisms are shown that avoid costly replacements of full modules. A conclusion and outlook finalizes the dissertation.

General information
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Organisations: Department of Energy Conversion and Storage, Functional organic materials
Contributors: Hösel, M., Krebs, F. C.
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Corrosion in electronics: Overview of failures and countermeasures

Many field failure returns of electronics are marked as “no failure found”, yet numerous of these failures are likely due to corrosion, since corrosion related failures are not easily detected during subsequent failure analysis. In some cases failures are intermittent and occur because of service life conditions (humidity and contamination) where water film formation on the printed circuit board assembly (PCBA) leads to leakage currents resulting in wrong output signal of the electronic device. If the leakage current itself will not result in malfunctioning of the electronics, the formed water film and potential bias of the PCBA will eventually lead to failure caused by more easy recognisable corrosion. Typical corrosion failure types seen in electronics are galvanic corrosion, electrochemical migration, and other types of bias induced...
corrosion. This paper describes the most commonly used metals and alloys in electronic devices including aluminium, gold, copper, silver, tin, lead and their alloys. Galvanic series performed in a flux solution is presented together with examples of galvanic corrosion causing failure of electronics. Failures that find root cause in the manufacturing process are described in details, e.g. flux activator related failures. Failures caused by service life conditions with high humidity and sulphur containing gaseous environments are also described. Finally it is described how the architecture of the PCBA (the placement of components) will affect its corrosion reliability. Infrared camera imaging is used to show the thermal distribution of the PCBA during power on periods and can reveal local cold spots on the PCBA being prone to condensation and corrosion.

**General information**

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**Selection of environmental sustainable fiber materials for wind turbine blades - a contra intuitive process?**

Over the recent decades biomaterials have been marketed successfully supported by the common perception that biomaterials and environmental sustainability de facto represents two sides of the same coin. The development of sustainable composite materials such as blades for small-scale wind turbines have thus partially been focused on the substitution of conventional fiber materials with bio-fibers. The major question is if this material substitution actually, is environmental sustainable. In order to assess a wide pallet of environmental impacts and taking into account positive and negative environmental trade-offs over the entire life-span of composite materials, life cycle assessment (LCA) can be applied. In the present case study, four different types of fibers (carbon, glass, flax and carbon/flax mixture) are compared in terms of environmental sustainability and cost. Applying one of the most recent life cycle impact assessment methods, it is demonstrated that the environmental sustainability of the mixed carbon/flax fiber based composite material is better than that of the flax fibers alone. This observation may be contra-intuitive, but is mainly caused by the fact that the bio-material resin demand is by far exceeding the resin demand of the conventional fibers, and since the environmental burden of the resin is comparable to that of the fibers, resin demand is in terms of environmental sustainability important. On the other hand is the energy demand and associated environmental impacts in relation to the production of the carbon and glass fibers considerable compared to the impacts resulting from resin production. The ideal fiber solution, in terms of environmental sustainability, is hence the fiber composition having the lowest resin demand and lowest overall energy demand. The optimum environmental solution hence turns out to be a 70:30 flax:carbon mix, thereby minimizing the use of carbon fibers and resin. On top of the environmental sustainability assessment, a cost assessment of the four fiber solutions was carried out. The results of the economical assessment which turns out to not complement the environmental sustainability, pin-point that glass fibers are the most effective fiber material.

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Formation, Decomposition and Cracking of Biomass Tars in Gasification

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Coherent lidar modulated with frequency stepped pulse trains for unambiguous high duty cycle range and velocity sensing in the atmosphere

Range unambiguous high duty cycle coherent lidars can be constructed based on frequency stepped pulse train modulation, even continuously emitting systems could be envisioned. Such systems are suitable for velocity sensing of dispersed targets, like the atmosphere, at fast acquisition rates. The lightweight synthesized frequency sweeper is a suitable generator yielding fast pulse repetition rates and stable equidistant frequency steps. Theoretical range resolution profiles of modulated lidars are presented.

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Organisations: Electromagnetic Systems, Department of Electrical Engineering
Contributors: Lindelöw, P. J. P., Mohr, J. J.
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