DOWNLOAD PDF OPTICAL DATA PROCESSING: APPLICATIONS (TOPICS IN APPLIED PHYSICS : VOL. 23)

Chapter 1 : Vibration Detection Using Optical Fiber Sensors

Part of the Topics in Applied Physics book series (TAP, volume 23) Chapters Table of contents Optical Data Processing Applications. Editors; David Casasent;.

Innovation Center Denmark, Silicon Valley, University of California, Los Angeles Powerful image detection algorithm source code released February 10, The Phase Stretch Transform algorithm, as it is known, is a physics-inspired computational approach to processing images and information. The algorithm grew out of UCLA research on a technique called photonic time stretch, which has been used for ultrafast imaging and detecting cancer cells in blood. It is available for free download on two open source platforms, Github and Matlab File Exchange. Making it available as open source code will allow researchers to work together to study, use and improve the algorithm, and to freely modify and distribute it. It also will enable users to incorporate the technology into computer vision and pattern recognition applications and other image-processing applications. Please click here to read further. With this calculator, you will be able to determine the stretch factor, RF bandwidth, and required optical bandwidth amongst other parameters. Please click here to explore further. With this calculator, you will be able to calculate the relationship between time and optical color wavelength or frequency , as well as practical limitations such as spectral resolution, maximum group delay, and dispersive element loss. The need to compress massive volumes of data in real-time has fueled interest in nonuniform stretch transformations -- operations that reshape the data according to its sparsity. Using nonlinear group delay dispersion and time-stretch imaging, they were able to optically warp the image such that the information-rich portions are sampled at a higher sample density than the sparse regions. This was done by restructuring the image before optical-to-electrical conversion followed by a uniform electronic sampler. Image compression was demonstrated at 36 million frames per second in real-time. All talks are by invitation only. Our goal is to bring leading companies as well as university research groups from the US, Denmark and elsewhere together to present, discuss and showcase newest trends and best practice within photonic technologies for photonics in big data and real time analytics. Thanks to all our speakers our audience the workshop was a big success - we look forward to welcoming you to the 7th edition of the workshop in ! The presentation from the workshop may now be downloaded and reviewed from the workshop website. To provide a seamless user experience, these networks must be aware of network conditions and be agile in directing traffic. This in turn requires fast and accurate optical performance monitoring at full data rate. High speed optical performance monitoring has several challenges. It requires analog-to-digital converters ADC and digital processors that operate at the ultrahigh data rates of optical networks. Achieving high-speed, low-noise, and low-power ADC is very difficult and digital processors operating at such speeds are power hungry. Bahram Jalali and including graduate students Cejo K. This system achieves real-time data acquisition and processing at a record 1. It employs photonic time-stretch enhanced recorder TiSER technology to create an optical "slow-motion" to slow down the fast data so it can be digitized and processed. The FPGA digitally recovers the data and generates real-time eye diagrams in-service, unlike a bit error-rate tester BERT , which is used for out-of-service analytics. The optical network channel carrying the streaming video packets was analyzed by TiSAP to generate real-time eye diagrams of the data. Real-time, in-service, optical performance monitoring demonstrated here can be used to provide feedback to the software defined networking SDN to implement agile optical networks for automated network restoration, disaster recovery, efficient routing, and bandwidth management. December 20 conference in Atlanta, Georgia on December 3rd, First demonstration of optical real-time data compression March 17, -- Applied Physics letters link pdf We experimentally demonstrate the first instrument for compressing the time-bandwidth product of analog signals in real-time. By performing self-adaptive stretch, this technology enables digitizers to capture waveforms beyond their bandwidth with digital data size being reduced at the same time. For proof of concept experiments, we compress the modulation bandwidth of an optical signal by times. At the same time, we reduce its modulation time-bandwidth product i. Dispersive data compression addresses the big data problem in real-time instruments and in optical communications. Conventionally, sufficient dispersion is required to bring the pulse into the temporal far-field so that the spectrum can be read as the temporal waveform. The Coherent Time-Stretch Transform obviates this requirement while simultaneously enabling high-throughput acquisition of complex optical fields in single-shot measurements. Full-field spectra are recovered via temporal interferometry on waveforms dispersed in the temporal near field. Real-time absorption spectra, including both amplitude and phase information, are acquired at 37 MHz. New Compression Method Reduces Big Data Bottleneck New discovery is rooted in physics and the arts December 18, Big Data refers generally to vast amounts of information collected by networked devices and systems. In this domain, data capture is technologically simple and the challenge lies in the post-capture analytics and transmission. Big Data is also prominent in other domains where the capture of data is challenging as well, such as in the medical sciences, telecom and basic research in the sciences. In these areas, communication signals and scientific phenomena of interest tend to occur on time scales and at throughput levels that are too fast to be sampled and digitized in real time. In other words, the Big Data problem is not just limited to analytics; it also includes data capture, storage, and transmission. Anamorphic Stretch Transform AST is a new mathematical transform that offers a solution for Big Data bottleneck, it slows down ultrafast signal so it can be captured with a slower instrument and at the same time it compresses the volume of the resulting data. It does so by reducing the length-bandwidth product. AST can operate on both analog and all-digital data such as on images where it outperforms JPEG and other standard compression techniques. AST is a non-iterative algorithm and does not need any feature detection, feedback. Their work was also featured in Nature Methods link pdf.

Chapter 2 : Electrical & Systems Engineering | Washington University in St. Louis

Force detectors rely on resonators to transduce forces into a readable signal. Usually, these resonators operate in the linear regime and their signal appears amidst a competing background comprising thermal or quantum fluctuations as well as readout noise.

To replace electronic components with optical ones, an equivalent optical transistor is required. This is achieved using materials with a non-linear refractive index. In particular, materials exist [4] where the intensity of incoming light affects the intensity of the light transmitted through the material in a similar manner to the current response of a bipolar transistor. These will be nonlinear optical crystals used to manipulate light beams into controlling other light beams. Like any computing system, an Optical computing system needs three things to function. Fiber optic cable optical storage, eg. Substituting electrical components will need data format conversion from photons to electrons, which will make the system slower. Controversy[edit] There are disagreements between researchers about the future capabilities of optical computers; whether or not they may be able to compete with semiconductor-based electronic computers in terms of speed, power consumption, cost, and size is an open question. Critics note that [7] real-world logic systems require "logic-level restoration, cascadability, fan-out and inputâ€"output isolation", all of which are currently provided by electronic transistors at low cost, low power, and high speed. For optical logic to be competitive beyond a few niche applications, major breakthroughs in non-linear optical device technology would be required, or perhaps a change in the nature of computing itself. Light, which is an electromagnetic wave , can only interact with another electromagnetic wave in the presence of electrons in a material, [10] and the strength of this interaction is much weaker for electromagnetic waves, such as light, than for the electronic signals in a conventional computer. This may result in the processing elements for an optical computer requiring more power and larger dimensions than those for a conventional electronic computer using transistors. However, any electromagnetic wave must obey the transform limit , and therefore the rate at which an optical transistor can respond to a signal is still limited by its spectral bandwidth. However, in fiber optic communications , practical limits such as dispersion often constrain channels to bandwidths of 10s of GHz, only slightly better than many silicon transistors. Obtaining dramatically faster operation than electronic transistors would therefore require practical methods of transmitting ultrashort pulses down highly dispersive waveguides. Switching is obtained using nonlinear optical effects when two or more signals are combined. Other approaches currently being investigated include photonic logic at a molecular level , using photoluminescent chemicals. In a recent demonstration, Witlicki et al. There are 2 basic properties of light that are actually used in this approach: The light can be delayed by passing it through an optical fiber of a certain length. The light can be split into multiple sub rays. This property is also essential because we can evaluate multiple solutions in the same time. When solving a problem with time-delays the following steps must be followed: The first step is to create a graph-like structure made from optical cables and splitters. Each graph has a start node and a destination node. The light enters through the start node and traverses the graph until it reaches the destination. It is delayed when passing through arcs and divided inside nodes. The light is marked when passing through an arc or through an node so that we can easily identify that fact at the destination node. At the destination node we will wait for a signal fluctuation in the intensity of the signal which arrives at a particular moment s in time. If there is no signal arriving at that moment, it means that we have no solution for our problem. Otherwise the problem has a solution. Fluctuations can be read with an photodetector and an oscilloscope. The first problem attacked in this way was the Hamiltonian path problem. The simplest one is the subset sum problem. The light will enter in Start node. It will be divided into 2 sub rays of smaller intensity. These 2 rays will arrive into the second node at moments a1 and 0. We expect fluctuations in the intensity of the signal at no more than 4 different moments. In the destination node we expect fluctuations at no more than 16 different moments which are all the subsets of the given. If we have a fluctuation in the target moment B, it means that we have a solution of the problem, otherwise there is no subset whose sum of elements equals B. For the practical implementation we cannot have zero-length cables, thus all cables are increased with a small fixed for all value k. Wavelength-based computing[edit] Wavelength-based computing [14] can be used to solve the 3-SAT problem with n variables, m clause and with no more than 3 variables per clause. Each wavelength, contained in a light ray, is considered as possible value-assignments to n variables. The optical device contains prisms and mirrors are used to discriminate proper wavelengths which satisfy the formula. Computing by xeroxing on transparencies[edit] This approach uses a Xerox machine and transparent sheets for performing computations. Using at most 2k copies of the truth table, each clause is evaluated at every row of the truth table simultaneously. The solution is obtained by making a single copy operation of the overlapped transparencies of all m clauses. Masking optical beams[edit] The travelling salesman problem has been solved in [16] by using an optical approach. All possible TSP paths have been generated and stored in a binary matrix which was multiplied with another gray-scale vector containing the distances between cities. The multiplication is performed optically by using an optical correlator. Optical Fourier co-processors[edit] Many computations, particularly in scientific applications, require frequent use of the 2D discrete Fourier transform DFT â€” for example in solving differential equations describing propagation of waves or transfer of heat. Though modern GPU technologies typically enable high-speed computation of large 2D DFTs, recently techniques have been developed that can perform DFTs optically by utilising the natural Fourier transforming property of lenses. The input is encoded using a liquid crystal spatial light modulator and the result is measured using a conventional CMOS or CCD image sensor. Such optical architectures can offer superior scaling of computational complexity due to the inherently highly interconnected nature of optical propagation, and have been used to solve 2D heat equations. Initially Yamamoto and his colleagues built an Ising machine using lasers, mirrors, and other optical components commonly found on an optical table.

Chapter 3 : American Journal of Optics and Photonics :: Science Publishing Group

True on-demand high-repetition-rate single-photon sources are highly sought after for quantum information processing applications. However, any coherently driven two-level quantum system suffers from a finite re-excitation probability under pulsed excitation, causing undesirable multi-photon emission.

This is an open access article distributed under the Creative Commons Attribution License , which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Abstract Condition monitoring of heavy electromechanical equipment is commonly accomplished in the industry using vibration analysis. Several techniques, mainly based on capacitive and piezoelectric accelerometers, have been applied for predictive maintenance. However, the negative influence of the electromagnetic interference EMI can be a real problem when electrical signals are used to detect and transmit physical parameters in noisy environments such as electric power generator plants with high levels of EMI. Optical fiber sensors are increasingly used because of the nonelectrical nature of signals. In this paper, the most frequently used vibration optical fiber sensors will be reviewed, classifying them by the sensing techniques and measurement principles. Introduction Since a few decades ago, fiber optic sensors technology has experimented a revolution by the hand of fiber optic telecommunication product outgrowths with optoelectronic devices [1 â€" 4]. These new areas of opportunities include the potential of replacing the majority of environmental sensors in existence today, as well as opening up entire markets where sensors with comparable capability do not exist. These new technologies, combined with advances in optical transducers, have enabled remote vibration monitoring using compact portable instrument packages in highly localized parts of electrical machinery with inherent electrical isolation, superior dielectric properties, and immunity to electromagnetic interference [2 , 3]. In addition, optical fiber sensors can offer noncontact, perturbation-free means of monitoring as they provide a new approach to vibration monitoring in electromechanical equipment. Fiber optic sensors can be generally classified in two groups: However, optical fiber sensors also can be classified by their working principles. In Figure 1 a general classification of vibration sensors is shown: Fiber bragg gratings FBG are fabricated using a longitudinal periodic perturbation of the refractive index of the core of an optical fiber. In this paper this three measurement principles will be analyzed. Vibration optical fiber sensors classification. Intensity-Based Vibration Sensors Intensity-based sensor techniques have been studied and implemented in the last 25 years see Figure 2. Evolution of vibration intensity-based sensor, source database: These sensors can be classified into two broad categories if physical contact with the vibrating object exists or not. Usually noncontact structures use a reflective signal to detect displacement or vibration while the other structures i. As a general rule, in the intensity-based sensor structure the light intensity from the source is modulated by the transducing device; then it is guided to the detector, translated to electronic signals, and adequately processed [9] as shown in Figure 3. Configuration for intensity modulation systems. In many cases, it is necessary to have a referencing mechanism in order to maintain the sensor calibrated. Without this referencing mechanism, optical power fluctuations due to the source, couplers, connectors, or any other optical components in the system can introduce significant relative errors. In some cases, digital communication techniques such as code division multiple access CDMA or spread spectrum techniques SSTs can reduce noise impact [6 , 10 â€" 15]. Microbend Structure The microbend sensor was one of the earliest Intensity-based sensors to be developed [16 â€" 18]. Basically, in this structure, the light intensity decreases by the losses caused by the induced microcurvatures see Figure 4. The deformation causes a coupling of the optical power from the core-guided modes to higher order radiation modes; these modes are attenuated by the surrounding medium. Both multimode and single-mode fibers have been used for the constructions of these sensors [19]. While multimode microbend sensors show the maximum sensitivity when the bending frequency is equal to the difference in propagation constants for the propagating and radiation modes [20], in single-mode optical fiber microbend sensors, the maximum sensitivity is achieved when the spatial bend frequency equals the difference between the propagation constants of the fundamental mode and a discrete cladding mode [21]. An example of this technique has been reported by Pandey and Yadav in [22]. They used a microbending sensor placed into a construction panel to detect pressure and deformation. The calibration of this sensor was made in laboratory conditions, therefore the output optical power was directly related with the pressure applied to the sensor, see Figure 5. Setup of embedded fiber-optic microbend sensor for measurement of high pressure and crack detection. Noncontact Displacement Intensity-Based Sensor Noncontact dynamic displacement sensors are commonly used for vibration detection. A reflective scheme is used to detect vibrations where one fiber is used as an emitter source and one or more fibers are used as collectors Figure 6. The reflection from the surrounding surfaces near the target can be minimized using data treatment techniques [10 , 12]. Configuration for dynamic displacement intensity-based sensor. An example of this configuration is shown in Figure 7. The main advantage of this configuration is the low cost of fabrication of the sensor and transducer. Schematic experimental setup of fiber optic displacement sensor for the measurement of vibrational frequency reproduced from [23] with permission of Elsevier. However, although intensity-based fiber optic sensors are easy to build, a significant error can be introduced due to changes in the light source power. Losses due to physical configuration and reflective surfaces outside of the measure system often impact the final measurement accuracy. Fortunately, referencing for source-intensity fluctuations is relatively easy to implement Recently, Perrone and Vallan [12] presented a high-resolution and cheap optical sensor using plastic optical fibers to measure vibrations of up to several tens of KHz by using an intensity-detection scheme followed by a nondemanding data processing to compensate for the vibrating surface reflectivity and measurement chain gains. In this sensor, one fiber is used to transmit the light whereas the other fiber collects the light rejected by the target whose vibrations have to be measured. The received signal is processing after the photo detector conversion. The experimental setup used by Perrone et al. Plastic optical fiber sensor setup [12]. Those intensity-based sensors are usually low cost and versatile structures. Even the particular in reflective experimental setups of those sensors allows them to be used in noncontact applications. In the last three decades, a lot of applications of this structure have been developed, supported by an extraordinary explosion of optical communication and the use of optical fiber as transmission guide and measurement material. The evolution of this optical structure as vibration sensor can be seen in Figure 9. This sensor can be built by using chemical processes or by fusion currents. The reflectance ratio of reflected irradiance to incident irradiance is periodic with the round-trip phase , difference between beams, as shown in where the surface reflectivity of the cavity surfaces determines the cavity finesse. The finesse is defined as Many of these interferometers suffer the common problem of directional ambiguity in fringe motion when the measured target changes direction since the output interference signals are cosinusoidal in nature [35 , 36]. General solutions include additional or multiple interrogating cavities, multiple wavelength and quadrature phase-shifting techniques. The interference fringes are detected as an electrical signal and feedback into a comparator circuit to generate the desired quadrature condition. The alignment of the fiber end faces is maintained by a bonded capillary tube or can be placed one in front of the other. In this case, a coherent source is necessary to avoid excessive power losses. As the substrate and the attached tube are strained, the reflected interference signal varies in response to the changes in cavity spacing see Figure More sophisticated configurations of extraordinary sensitivity have been developed using fiber brag gratings working as mirrors [41]. In the next sections several selected examples will be analyzed. One example of this is shown in Figure In this configuration, a wavelength transform- WT- based signal processing methodology was employed to count optical fringes. WT-based tool was developed by the authors for unambiguous identification of frequency components from a nonsinusoidal vibration situation of multiple fringes and complex frequency measurements. Schematic of a reflective EFPI sensor connected with one fiber and measurement system. In this work, it was showed a feasible method to calibrate the PVDF strain sensor using four points from the Bessel harmonics of a fiber optic EFPI sensor which did not required of complex demodulation schemes other than standard spectrum analyzer capability. The scheme of the structure is shown in Figure 13 , where continuous series of interference signals can be processed for fringe-counting. The main advantage of such a technique is the increased resolution, which can be obtained without further complicated signal processing schemes, because it allows calculating the crossover points and integrate the interference peaks in the algorithm due to the stable optically generated quadrature condition employed. A schematic diagram of the developed system is shown in Figure The system had a resonance peak as low as Hz with a limiting sensitivity of g. The monitoring system is based on low-coherence interferometry [45]; see Figure To enable constant sensitivity detection and the use of conventional RF signal recovery techniques, heterodyning signal processing was adopted. The equation that governs this structure shows the relationship between the optical reflected power and cavity deformation where are constants that represent the amplitude and visibility of the sensor, is the wavelength of the optical source, is the cavity length, and is the unitary deformation of the cavity [27]. Using this scheme, in [27], it was demonstrated that it can be applied for the detection of steady state performance of three phase motors under unbalanced conditions, see Figure The photo-detector output was connected to an oscilloscope with a FFT module to show the vibration spectrum. Some techniques such as wavelength division and transmitted and received optical signal can be used to obtain excellent relation with displacement, strain and vibration measurement. In this section, we have tried to show the wide range of experimental setups and applications that can be achieved using this optical structure. The main issues that can affect this structure are related to the fabrication of the mirrors, whose imperfections and alignment errors can reduce the sensor accuracy. Fiber Bragg Grating Sensors Fiber bragg gratings FGBs are optical fiber devices that consist in a longitudinal periodic perturbation of the refractive index of the core of an optical fiber. Such periodic variation of the optical properties of the fiber confers to it unique optical properties that make these devices ideal for optical sensing applications. In fact, since the first permanent in-line grating was reported in [46 , 47], more and more scientific groups have devoted their research in such devices. In fact, the number of reported works related with vibrations using FBGs have grown significantly since , see Figure 19 although the first strain and temperature sensor was presented in [48 , 49]. Evolution of FBG vibration sensors source database: One of the most valuable properties of FBGs is their strong dependence of the resonance peak on very small variations of the Bragg period which makes them ideal for strain sensing [48 , 49]. They also have additional advantages, for example, their small size that makes them suitable to embed into composite materials [50] or concrete [51], or their dense wavelength multiplexing capability that makes possible multipoint sensing in complicated civil structures such as bridges or highways [52 , 53]. Also, this structure can be used to simultaneous measurement of several parameters such as temperature or humidity [54 â€” 60] and vibrations using wavelength multiplexing techniques. Working Principle The optical properties of an FBG device arise from a series of partial reflectors arranged with a determined spatial period. In the optical fiber FBG, such reflectors are fabricated by altering the refractive index of the core of the optical fiber in a periodic manner, creating dielectric partial mirrors, and consequently a series of interferences occurs as the light travels through the device. In consequence, certain wavelengths which have a constant relation with the period of the refractive index perturbation experiment a strong transmission blockage. Such wavelengths are reflected by the FBG structure, while the device keeps unaltered the rest of the wavelengths, therefore the FBG acts as a wavelength selective reflector. This can be schematically seen in Figure Schematic structure of a fiber bragg grating. A special germanium-doped silica fiber is used in the manufacture of FBG because it is photosensitive, and it is possible to induce refractive index shifts in areas exposed to strong UV radiation. Such patterns are obtained mainly by two different processes: The amount of the change in refractive index in the fiber core is a function of the intensity and duration of the UV light exposure. While interference and masking are the most used techniques for fabricating FBGs, it is possible to write them point-by-point. Here, the laser has a narrow beam that is equal to the grating period. This method is specifically applicable to the fabrication of long-period fiber gratings and tilted gratings.

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Chapter 4 : Data analysis for optical sensors based on spectroscopy of surface plasmons - IOPscience

â€¢ Office of Basic Energy Sciences â€¢ Office of Nuclear Physics. Topics FY Application Area 1: Advanced Data Analytic Technologies for Systems Biology and.

Visit online course listings to view semester offerings for E35 ESE. A final report must be submitted to the department. Credit variable, maximum 3 units. This course will not count toward the ESE doctoral program. ESE or consent of instructor. ESE , Math A term project is required. Projection theorem, Hahn-Banach theorem. Constrained minima, equality constraints, Lagrange multipliers, calculus of variations, Euler-Lagrange equations, positive cones, inequality constraints. Theory of the potential linear and nonlinear diffusion theory. Linear and nonlinear wave equations. Initial and boundary value problems. Integral equations in boundary value problems. ESE and or equivalent or consent of instructor. In the first part we cover applications of Linear Matrix Inequalities and Semi-Definite Programming to control and estimation problems. In the second part we cover numerical methods to solve optimal control and estimation problems. We cover techniques to discretize optimal control problems, numerical methods to solve them, and their optimality conditions. We apply these results to the Model Predictive Control and Estimation of nonlinear systems. Convex sets, functions, and optimization problems. Basics of convex analysis. Least-squares, linear and quadratic programs, semidefinite programming, minimax, extremal volume, and other problems. Optimality conditions, duality theory, theorems of alternative, and applications. Applications to signal processing, statistics and machine learning, control and mechanical engineering, digital and analog circuit design, and finance. Math and ESE Poisson, Gaussian and Markov processes as models for engineering problems. An in-depth look at the Wiener process. Filtrations and stopping times. Markov processes and diffusions, including semigroup properties and the Kolmogorov forward and backward equations. ESE or equivalent, Math Linear algebra, vector spaces, independence, projections. Data independence, factorization theorem and sufficient statistics. Neyman-Pearson and Bayes detection. Least squares, maximum-likelihood and maximum a posteriori estimation of signal parameters. Conjugate priors, recursive estimation, Wiener and Kalman filters. The first part of the course includes basic network models and their mathematical principles. Topics include a review of graph theory, random graph models, scale-free network models and dynamic networks. The second part of the course includes structure and analysis methods in network science. Topics include network robustness, community structure, spreading phenomena and clique topology. Applications of the topics covered by this course include social networks, power grid, internet, communications, protein-protein interactions, epidemic control, global trade, neuroscience, etc. This course focuses on the following topics: ESE and Physics , or permission of instructor. Topics include electromagnetic wave propagation in free space, confined waveguides, or along engineered surfaces ; electromagnetic wave scattering off nano-particles or molecules ; electromagnetic wave generation and detection antenna and nano-antenna ; inverse scattering problems; and numerical and approximate methods. ESE , or Physics and Physics If time permits, the following topics are selectively covered: ESE and Physics or Physics The following topics are covered: Frequency domain analysis of multivariable control systems. State space control system design methods: Design exercises with CAD computer-aided design packages for engineering problems. Continuous time as well as discrete-time optimal control theory. Time-optimal control, bang-bang controls and the structure of the reachable set for linear problems. Dynamic programming, the Pontryagin maximum principle, the Hamiltonian-Jacobi-Bellman equation and the Riccati partial differential equation. Existence of classical and viscosity solutions. Application to time optimal control, regulator problems, calculus of variations, optimal filtering and specific problems of engineering interest. The formulation and solution of problems in nonlinear estimation theory. The Kalman-Bucy filter and nonlinear analogues. A central motivation is the manipulation of neuronal activity for both scientific and medical applications using emerging neurotechnology and pharmacology. Emphasis is placed on dynamical systems and control theory, including bifurcation and stability analysis of single neuron models and population mean-field models. Synchronization properties of neuronal networks are covered and methods for control of neuronal activity in both oscillatory and non-oscillatory dynamical regimes are developed. Statistical models for neuronal activity are also discussed. An overview of signal processing and data analysis methods for neuronal recording modalities is provided, toward the development of closed-loop neuronal control paradigms. The final evaluation is based on a project or research survey. Linear optimal-based methods in robust control, nonlinear model reference adaptive control. These design methods are currently used in most industry control system design problems. Solution of the state equations and the transition matrix. Controllability, observability, realizations, pole-assignment, observers and decoupling of linear dynamic systems. Riccati equation, terminal regulator and steady-state regulator. Introduction to filtering and stochastic control. Advanced theory of linear dynamic systems. Geometric approach to the structural synthesis of linear multivariable control systems. Disturbance decoupling, system invertibility and decoupling, extended decoupling and the internal model principle. Questions of existence, uniqueness and stability; Lyapunov and frequency-domain criteria; w-limits and invariance, center manifold theory and applications to stability, steady-state response and singular perturbations. Poincare-Bendixson theory, the van der Pol oscillator, and the Hopf Bifurcation theorem. Controllability, observability of nonlinear systems, examined from the viewpoint of differential geometry. Transformation to normal forms. Exact linearization via feedback. Zero dynamics and related properties. Noninteracting control and disturbance decoupling. Noninteracting control with internal stability. Discrete-event systems models and language descriptions. Models for hybrid systems. Conditions for existence and uniqueness. Stability and verification of hybrid systems. Optimal control of hybrid systems. Applications to cyber-physical systems and robotics. The first part of the course covers graduate-level materials in the area of analog circuit synthesis and analysis. The second part of the course covers applications of the fundamental techniques for designing analog signal processors and data converters. Several practical aspects of mixed-signal design, simulation and testing are covered in this course. This is a project-oriented course, and it is expected that the students apply the concepts learned in the course to design, simulate and explore different circuit topologies. Topics include SoC architectures, design tools and methods, as well as system-level tradeoffs between performance, power consumption, energy efficiency, reliability, and programmability. Assignments include hands-on design projects. Open to both graduate and senior undergraduate students. The problems of process synchronization and load balancing in parallel systems are studied. Several selected applications problems are investigated and parallel algorithms for their solution are considered. Selected parallel algorithms are implemented in both a shared memory and distributed memory parallel programming environment. Linear block codes, cyclic codes, BCH and related codes for error detection and correction. Encoder and decoder circuits and algorithms. Spectral descriptions of codes and decoding algorithms. This course introduces the principles underlying modern analog and digital transmission and multiplexing systems and covers a variety of system examples.

Chapter 5 : Paul Prucnal | Electrical Engineering - Princeton University

Covers instrumentation and systems for automatic measurement, and automation based on laser and optoelectronic technologies Presents basic and applied research on Solid state physics, optics and holography in applications to computers and measurement techniques; Physical aspects of micro- and.

Chapter 6 : Optical computing - Wikipedia

Topic Scope: A highly regarded, premium quality must read for everyone in the optics field that offers applications-centered research in optics, photonics, imaging, and sensing. Topics germane to the journal include optical technology, lasers, photonics, environmental optics, and information processing.

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Chapter 7 : Optical Transition Probabilities of Er3+ Ions in ErBa3B9O18 Crystal

We have examined the noise sources for a surface plasmon resonance (SPR) sensor system to facilitate optimization of SPR sensor instrumentation and data-processing methods for high-resolution SPR sensing.

Chapter 8 : OSA | About OSA Publishing

Other practical applications include marking, dicing, trimming, repairing, patterning, bending, and rapid prototyping. In this article, the state of the art of LDW for industrial applications in Japan, the United States, and Europe is reviewed, and its future prospects are discussed.

Chapter 9 : OSA | Applied Optics

Original contributions in all technical fields of optics such as optical materials, optical devices, optical systems, and/or topics related to theoretical and experimental aspects of new principles are welcome.