Journal updates for 2015.07.31

Biophysical Journal

Vol. 109, no. 1,2
Nothing of interest

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Proceedings of the National Academy of Sciences, USA

(vol. 112, no. 27,28)
Nothing of interest

Vol. 112, no. 9

Biased Brownian motion as a mechanism to facilitate nanometer-scale exploration of the microtubule plus end by a kinesin-8

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Kinesin-8s are plus-end–directed motors that negatively regulate microtubule (MT) length. Well-characterized members of this subfamily (Kip3, Kif18A) exhibit two important properties: (i) They are "ultraprocessive," a feature enabled by a second MT-binding site that tethers the motors to a MT track, and (ii) they dissociate infrequently from the plus end. Together, these characteristics combined with their plus-end motility cause Kip3 and Kif18A to enrich preferentially at the plus ends of long MTs, promoting MT catastrophes or pausing. Kif18B, an understudied human kinesin-8, also limits MT growth during mitosis. In contrast to Kif18A and Kip3, localization of Kif18B to plus ends relies on binding to the plus-end tracking protein EB1, making the relationship between its potential plus-end–directed motility and plus-end accumulation unclear. Using single-molecule assays, we show that Kif18B is only modestly processive and that the motor switches frequently between directed and diffusive modes of motility. Diffusion is promoted by the tail domain, which also contains a second MT-binding site that decreases the off rate of the motor from the MT lattice. In cells, Kif18B concentrates at the extreme tip of a subset of MTs, superseding EB1. Our data demonstrate that kinesin-8 motors use diverse design principles to target MT plus ends, which likely target them to the plus ends of distinct MT subpopulations in the mitotic spindle.

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Review of Scientific Instruments

(vol. 86, no. 7)

Not complete yet.

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IEEE Transactions on Automatic Control
(vol. 60, no. 8)

Formal Verification and Synthesis for Discrete-Time Stochastic Systems

Lahijanian, M. Andersson, S.B. ; Belta, C.

Formal methods are increasingly being used for control and verification of dynamic systems against complex specifications. In general, these methods rely on a relatively simple system model, such as a transition graph, Markov chain, or Markov decision process, and require abstraction of the original continuous-state dynamics. It can be difficult or impossible, however, to find a perfectly equivalent abstraction, particularly when the original system is stochastic. Here we develop an abstraction procedure that maps a discrete-time stochastic system to an Interval-valued Markov Chain (IMC) and a switched discrete-time stochastic system to a Bounded-parameter Markov Decision Process (BMDP). We construct model checking algorithms for these models against Probabilistic Computation Tree Logic (PCTL) formulas and a synthesis procedure for BMDPs. Finally, we develop an efficient refinement algorithm that reduces the uncertainty in the abstraction. The technique is illustrated through simulation.

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IEEE Transactions on Nanotechnology

Early access online

Nano-manipulation and Real-time Compressive Tracking

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Quick tracking in nano-manipulation has been attracting increasing attention among scientific researchers and engineers, because it can significantly enhance the effectiveness and efficiency of nano-manipulation. The main reasons that hinder the improvement of accuracy and efficiency of nano-manipulation are the lack of effective real-time tracking and unavoidable perturbations by uncertainties and nonlinearities in the manipulation system. In this paper, we present a new strategy based on compressive sensing to realize quick real-time tracking nano-manipulation trajectory and build a new kinematic model for objects to be manipulated to overcome the effect of tip positioning and contacting biases on nano-manipulation with AFM. With this approach, the deviation of the object from the pre-designed

trajectory during the manipulation can be corrected with much less time with up to two-thirds of time less than the traditional method and the object can be smoothly moved to any destination in the nano-space. The approach requires no priori knowledge about the system, environment and objects being manipulated. It is validated that this strategy works for both hard, regular objects and soft, irregular samples by experiments.

IEEE Transactions on Signal Processing (Issue 15, 16, 2015)

IEEE/ASME Transactions on Mechatronics (Issue 2, 2015)

Robust Linear Regression Analysis - A Greedy Approach

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Abstract

The task of robust linear estimation in the presence of outliers is of particular importance in signal processing, statistics and machine learning. Although the problem has been stated a few decades ago and solved using classical (considered nowadays) methods, recently, it has attracted more attention in the context of sparse modeling, where several notable contributions have been made. In the present manuscript, a new approach is considered in the framework of greedy algorithms. The noise is split into two components: a) the inlier bounded noise and b) the outliers, which are explicitly modeled by employing sparsity arguments. Based on this scheme, a novel efficient algorithm (Greedy Algorithm for Robust Denoising-GARD), is derived. GARD alternates between a least square optimization criterion and an Orthogonal Matching Pursuit (OMP) selection step that identifies the outliers. The case where only outliers are present has been studied separately, where bounds on the Restricted Isometry Property guarantee that the recovery of the signal via GARD is exact. Moreover, theoretical results concerning convergence as well as the the recovery of the support of the sparse outlier vector and derivation of error bounds in the case of additional bounded noise are discussed. Finally, we provide extensive simulations, which demonstrate the comparative advantages of the new technique.

Projection Matrix Optimization for Sparse Signals in Structured Noise

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Abstract

We consider the problem of estimating a signal which has been corrupted with structured noise. When the signal of interest accepts a sparse representation, only a small number of measurements are required to retain all the information. The measurements are mapped to a lower dimensional space through a projection matrix. We propose a method to optimize the design of this matrix where the objective is not only to reduce the amount of data to be processed but also to reject the undesired signal components. As a result, we reduce the computation time and the error on the estimation of the unknown parameters of the sparse model, with respect to the uncompressed data. The proposed method has tunable parameters that can affect its performance. Optimal tuning would require a comprehensive study of parameter variations and options. To avoid this learning burden, we also introduce a variant of the algorithm that is free from tuning, without significant loss of performance. Using synthetic data, we analyze the performance of the proposed algorithms and their robustness against errors in the model parameters. Additionally, we illustrate the performance of the method through a radar application using real clutter data with a still target and with a synthetic moving target.

A Particle Multi-Target Tracker for Superpositional Measurements Using Labeled Random Finite Sets

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Abstract
In this paper we present a general solution for multi-target tracking with superpositional measurements. Measurements that are functions of the sum of the contributions of the targets present in the surveillance area are called superpositional measurements. We base our modelling on Labeled Random Finite Set (RFS) in order to jointly estimate the number of targets and their trajectories. This modelling leads to a labeled version of Mahlers multi-target Bayes filter. However, a straightforward implementation of this tracker using Sequential Monte Carlo (SMC) methods is not feasible due to the difficulties of sampling in high dimensional spaces. We propose an efficient multi-target sampling strategy based on Superpositional Approximate CPHD (SA-CPHD) filter and the recently introduced Labeled Multi-Bernoulli (LMB) and Vo-Vo densities. The applicability of the proposed approach is verified through simulation in a challenging radar application with closely spaced targets and low signal-to-noise ratio.

Extended Target Tracking Using Gaussian Processes

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Abstract
In this paper, we propose using Gaussian processes to track an extended object or group of objects, that generates multiple measurements at each scan. The shape and the kinematics of the object are simultaneously estimated, and the shape is learned online via a Gaussian process. The proposed algorithm is capable of tracking different objects with different shapes within the same surveillance region. The shape of the object is expressed analytically, with well-defined confidence intervals, which can be used for gating and association. Furthermore, we use an efficient recursive implementation of the algorithm by deriving a state space model in which the Gaussian process regression problem is cast into a state estimation problem.

Poisson Group Testing: A Probabilistic Model for Boolean Compressed Sensing

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Abstract
We introduce a novel probabilistic group testing framework, termed Poisson group testing, in which the number of defectives follows a right-truncated Poisson distribution. The Poisson model has a number of new applications, including dynamic testing with diminishing relative rates of defectives. We consider both nonadaptive and semi-adaptive identification methods. For nonadaptive methods, we derive a lower bound on the number of tests required to identify the defectives with a probability of error that asymptotically converges to zero; in addition, we propose test matrix constructions for which the number of tests closely matches the lower bound. For semiadaptive methods, we describe a lower bound on the expected number of tests required to identify the defectives with zero error probability. In addition, we propose a stage-wise reconstruction algorithm for which the expected number of tests is only a constant factor away from the lower bound. The methods rely only on an estimate of the average number of defectives, rather than on the individual probabilities of subjects being defective.

Minimum-Time Trajectory Planning and Control of a Pick-and-Place Five-Bar Parallel Robot

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Abstract
This paper presents trajectory planning optimization and real-time control of a special five-bar parallel robot. Planning is based on a cubic spline stochastic approach that minimizes trajectory time and selects the best combination of working mode regions to circumvent all parallel singularities, allowing the size of the workspace to be increased. Identification of the dynamic model of the robot and its actuators allows a precise implementation of the trajectory planning and real-time control approach. The optimization algorithm achieves a fast trajectory and a controller that operates with an error of less than 0.7 for both actuated joints of the robot.

Controller Design for Mechanical Impedance Reduction

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Abstract
Mechatronic systems that physically interact with humans should guarantee safety, as well as stability and control performance. Mechanical impedance is an effective means to evaluate the safety of such systems. The mechanical impedance represents the magnitude of reaction forces by mechanical system when it is moved. Therefore, low mechanical impedance is one of the requirements of safe mechatronic systems. However, there exists a tradeoff between mechanical impedance, stability, and control performance. In this paper, a methodology to design control algorithms for reduction of the mechanical impedance with guaranteed stability is proposed. For the controller design, the mathematical definition of the mechanical impedance for open- and closed-loop systems is introduced in this paper. Various analyses on the mechanical impedance from the viewpoint of control systems are given. Then, the controllers are designed for systems with/without right-half complex plane poles and zeros such that they effectively lower the magnitude of mechanical impedance with guaranteed stability. The proposed method is verified through case studies including simulations and experiments.

Optics Express

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Nothing of interest.

Volume 23, Issue 14

Faster super-resolution imaging of high density molecules via a cascading algorithm based on compressed sensing
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This paper proposes a cascading algorithm (CSR) based on compressed sensing, which aims to reduce intensive computations in super-resolution imaging of fluorescence microscopy. Performance of existing algorithms such as CVX and L1H drop sharply when applied to obtain finer images with high density molecules. CSR fully exploits the extreme sparsity property of molecules in the compressed sensing model and progressively restricts solution space stage by stage. We perform a comprehensive study of existing algorithms and the proposed algorithm under different resolutions and molecules' densities. Simulation and experimental results confirm the performance advantage of CSR when applied to recover dense molecules.

Physical Review E

Volume 92, Issue 1

Langevin formulation of a subdiffusive continuous-time random walk in physical time
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Systems living in complex nonequilibrated environments often exhibit subdiffusion characterized by a sublinear power-law scaling of the mean square displacement. One of the most common models to describe such subdiffusive dynamics is the continuous-time random walk (CTRW). Stochastic trajectories of a CTRW can be described in terms of the subordination of a normal diffusive process by an inverse Levy-stable process. Here, we propose an equivalent Langevin formulation of a force-free CTRW without subordination. By introducing a different type of non-Gaussian noise, we are able to express the CTRW dynamics in terms of a single Langevin equation in physical time with additive noise. We derive the full multipoint statistics of this noise and compare it with the scaled Brownian motion (SBM), an alternative stochastic model describing subdiffusive dynamics. Interestingly, these two noises are identical up to the second order correlation functions, but different in the higher order statistics. We extend our formalism to general waiting time distributions and force fields and compare our results with those of the SBM. In the presence of external forces, our proposed noise generates a different class of stochastic processes, resembling a CTRW but with forces acting at all times.

Stochastic Processes and their Applications

Volume 122, Issue 7

A Contrast Estimator for Completely or Partially Observed Hypoelliptic Diffusion
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Parameter estimation for two-dimensional hypoelliptic diffusions is considered within two observations frameworks: complete observations where both coordinates are discretely observed and partial observations where only the first coordinate is discretely observed. Since the volatility matrix is degenerate, Euler contrast estimators can not be used directly. For complete observations, we introduce an Euler contrast based on the second coordinate only. For partial observations, we define an Euler contrast for an integrated diffusion resulting from a transformation of the original one. We present a theoretical study where the estimators are proved to be consistent and asymptotically Gaussian. A numerical application to Langevin systems illustrates the nice properties of both complete and partial observations estimators.

Mechatronics

No issue released for July

European Journal of Control (*Volume 24, July 2015, Pages 14–32*)

Automated driving: The role of forecasts and uncertainty—A control perspective

Ashwin Carvalho, Stéphanie Lefévre, Georg Schildbach, Jason Kong, Francesco Borrelli

Abstract

Driving requires forecasts. Forecasted movements of objects in the driving scene are uncertain. Inevitably, decision and control algorithms for autonomous driving need to cope with such uncertain forecasts. In assisted driving, the uncertainty in the human/vehicle interaction further increases the complexity of the control design task.

Our research over the past ten years has focused on control design methods which systematically handle uncertain forecasts for autonomous and semi-autonomous vehicles. This paper presents an overview of our findings and discusses relevant aspects of our recent results.

Keywords: Automated driving; Autonomous cars; Model predictive control; Adaptive learning