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Nothing of interest

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Ultrasound-triggered disruption and self-healing of reversibly cross-linked hydrogels for drug delivery and enhanced chemotherapy

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Biological systems are exquisitely sensitive to the location and timing of physiologic cues and drugs. This spatiotemporal sensitivity presents opportunities for developing new therapeutic approaches. Polymer-based delivery systems are used extensively for attaining localized, sustained release of bioactive molecules. However, these devices typically are designed to achieve a constant rate of release. We hypothesized that it would be possible to create digital drug release, which could be accelerated and then switched back off, on demand, by applying ultrasound to disrupt ionically cross-linked hydrogels. We demonstrated that ultrasound does not permanently damage these materials but enables nearly digital release of small molecules, proteins, and condensed oligonucleotides. Parallel in vitro studies demonstrated that the concept of applying temporally short, high-dose “bursts” of drug exposure could be applied to enhance the toxicity of mitoxantrone toward breast cancer

cells. We thus used the hydrogel system in vivo to treat xenograft tumors with mitoxantrone, and found that daily ultrasound-stimulated drug release substantially reduced tumor growth compared with sustained drug release alone. This approach of digital drug release likely will be applicable to a broad variety of polymers and bioactive molecules, and is a potentially useful tool for studying how the timing of factor delivery controls cell fate in vivo.

SBA comment: details unimportant. What is important is this is an application of hydrogels, perhaps supporting research on details of internal structure of same.

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Nothing of interest

(vol. 111, no. 30)

Hierarchical random walks in trace fossils and the origin of optimal search behavior

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Efficient searching is crucial for timely location of food and other resources. Recent studies show that diverse living animals use a theoretically optimal scale-free random search for sparse resources known as a Lévy walk, but little is known of the origins and evolution of foraging behavior and the search strategies of extinct organisms. Here, using simulations of self-avoiding trace fossil trails, we show that randomly introduced strophotaxis (U-turns)—initiated by obstructions such as self-trail avoidance or innate cueing—leads to random looping patterns with clustering across increasing scales that is consistent with the presence of Lévy walks. This predicts that optimal Lévy searches may emerge from simple behaviors observed in fossil trails. We then analyzed fossilized trails of benthic marine organisms by using a novel path analysis technique and find the first evidence, to our knowledge, of Lévy-like search strategies in extinct animals. Our results show that simple search behaviors of extinct animals in heterogeneous environments give rise to hierarchically nested Brownian

walk clusters that converge to optimal Lévy patterns. Primary productivity collapse and large-scale food scarcity characterizing mass extinctions evident in the fossil record may have triggered adaptation of optimal Lévy-like searches. The findings suggest that Lévy-like behavior has been used by foragers since at least the Eocene but may have a more ancient origin, which might explain recent widespread observations of such patterns among modern taxa.

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Nothing of interest

Review of Scientific Instruments

(vol. 85, no. 6)

Note: Fast imaging of DNA in atomic force microscopy enabled by a local raster scan algorithm

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Approaches to high-speed atomic force microscopy typically involve some combination of novel mechanical design to increase the physical bandwidth and advanced controllers to take maximum advantage of the physical capabilities. For certain classes of samples, however,imaging time can be reduced on standard instruments by reducing the amount of measurementthat is performed to image the sample. One such technique is the local raster scan algorithm, developed for imaging of string-like samples. Here we provide experimental results on the use of this technique to image DNA samples, demonstrating the efficacy of the scheme and illustrating the order-of-magnitude improvement in imaging time that it provides.

(vol. 85, no. 7)

Nothing of interest

IEEE Transactions on Automatic Control (vol. 59, no. 6)

Quickest Detection of a Random Pulse in White Gaussian Noise

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A class of stochastic processes characterized by rapid transitions in their structure is considered and the quickest detection of such transitions is studied in a Bayesian framework. The emphasis is on stochastic processes consisting of a randomly arrived causal pulse (possibly with a set of random parameters such as amplitude and duration) and an additive white Gaussian noise. In this model, the pulse shape and the prior joint density of the arrival time and other random parameters are assumed known. The task of quickest detection in this paper is described mathematically by minimizing the expected detection error. The detection error is represented by a nonlinear function of the distance between the actual transition time and its associated detection time. The assumptions on this function are fairly mild and allow to flexibly design its shape for a desired trade-off between the detection delay and the false alarm rate. Two special cases of such design are well known error measures: mean squared and mean absolute error. The quickest detection problem-a subclass of optimal stopping time problems-is formulated as a stochastic optimal control problem and is resolved using dynamic programming. The optimal detection rule is determined in terms of the solution of an integral equation that cannot be directly solved due to its complexity. This equation is later used to develop a class of suboptimal detection rules and a lower bound on the minimum error. Using this lower bound, it is shown for a numerical example that the suboptimal detector is nearly optimal.

Seems like it might be useful to a few of us: detecting edges in AFM or triggering tracking in confocal

Tracking Control for Nonlinear Networked Control Systems

Postoyan, R. ; CRAN, Univ. de Lorraine, Vandœuvre, France ; van de Wouw, N. ; Nesic, D. ; Heemels, W.P.M.H.

We investigate the tracking control of nonlinear networked control systems (NCS) affected by disturbances. We consider a general scenario in which the network is used to ensure the communication between the controller, the plant and the reference system generating the desired trajectory to be tracked. The communication constraints induce non-vanishing errors (in general) on the feedforward term and the output of the reference system, which affect the convergence of the tracking error. As a consequence, available results on the stabilization of equilibrium points for NCS are not applicable. Therefore, we develop an appropriate hybrid model and we give sufficient conditions on the closed-loop system, the communication protocol and an explicit bound on the maximum allowable transmission interval guaranteeing that the tracking error converges to the origin up to some errors due to both the external disturbances and the aforementioned non-vanishing network-induced errors. The results cover a large class of the so-called uniformly globally asymptotically stable protocols which include the well-known round-robin and try-once-discard protocols. We also introduce a new dynamic protocol suitable for tracking control. Finally, we show that our approach can be used to derive new results for the observer design problem for NCS. It has to be emphasized that the approach is also new for the particular case of sampled-data systems.

Averaging Criteria for Asymptotic Stability of Time-Varying Systems

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We establish averaging type sufficient conditions for local asymptotic stability for nonlinear time-varying systems. Our main result is based on an extension of the averaging methodology employed in a recent paper by Tsinias and Stamati (published in the same journal), dealing with asymptotic stability for “slow” time-varying systems.

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Nothing of interest

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Journal of Optics, vol. 6, no. 7

3D dual-virtual-pinhole assisted single particle tracking microscopy

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We propose a novel approach for high-speed, three-dimensional single particle tracking (SPT), which we refer to as dual-virtual-pinhole assisted single particle tracking microscopy (DVPaSPTM). DVPaSPTM system can obtain axial information of the sample without optical or mechanical depth scanning, so as to offer numbers of advantages including faster imaging, improved efficiency and a great reduction of photobleaching and phototoxicity. In addition, by the use of the dual-virtual-pinhole, the effect that the quantum yield exerts to the fluorescent signal can be eliminated, which makes the measurement independent of the surroundings and increases the accuracy of the result. DVPaSPTM system measures the intensity within different virtual pinholes of which the radii are given by the host computer. Axial information of fluorophores can be measured by the axial response curve through the ratio of intensity signals. We demonstrated the feasibility of the proposed method by a series of experiments. Results showed that the standard deviation of the axial measurement was 19.2 nm over a 2.5 μm range with 30 ms temporal resolution.