Automated probe microscopy via evolutionary optimization at the atomic scale

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Abstract
We describe the development and application of an imaging protocol, which evolves a scanning probe’s atomic structure in parallel with automated optimization of the scan parameters. Our protocol coerces the system into a state that produces a specific atomic resolution image type without human involvement.

Electrostatic effects on contacts to carbon nanotube transistors

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Abstract
We use numerical simulations to investigate the effect of electrostatics on the source and drain contacts of carbon nanotube field-effect transistors. We find that unscreened charge on the nanotube at the contact-channel interface leads to a potential barrier that can significantly hamper transport through
the device. This effect is largest for intermediate gate voltages and for contacts near the ohmic-Schottky crossover, but can be mitigated with a reduction in the gate oxide thickness. These results help to elucidate the important role that contact geometry plays in the performance of carbon nanotube electronic devices.

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**Diagnosis of breast cancer recurrence using a microfluidic device featuring tethered cationic polymers**

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**Abstract**

In this study, we grafted pH-responsive poly(2-dimethylaminoethyl methacrylate) (PDMAEMA) onto a Si substrate as the medium in a microfluidic device to detect breast cancer recurrence DNA (bcrDNA584) and a control human genomic DNA (hgDNA528) at extremely low concentrations (down to 0.15 ng/μl). The quantities of these two DNAs obtained through the capture and release from tethered PDMAEMA brushes under pH tuning conditions were sufficient for them to be amplified recognizably, suggesting that this approach could be used in miniaturized lab-on-a-chip cartridges for rapid disease diagnosis.

Size-sensitive sorting of microparticles through control of flow geometry
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Abstract

We demonstrate a general concept of flow manipulation in microfluidic environments, based on controlling the shape and position of flow domains in order to force switching and sorting of microparticles without moving parts or changes in design geometry. Using microbubble acoustic streaming, we show that regulation of the relative strength of streaming and a superimposed Poiseuille flow allows for size-selective trapping and releasing of particles, with particle size sensitivity much greater than what is imposed by the length scales of microfabrication. A simple criterion allows for quantitative tuning of microfluidic devices for switching and sorting of particles of desired size.

Distributed Algorithms for Environment Partitioning in Mobile Robotic Networks

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Abstract

A widely applied strategy for workload sharing is to equalize the workload assigned to each resource. In mobile multiagent systems, this principle directly leads to equitable partitioning policies whereby: 1) the environment is equitably divided into subregions of equal measure; 2) one agent is assigned to each subregion; and 3) each agent is responsible for service requests originating within its own subregion. The current lack of distributed algorithms for the computation of equitable partitions limits the applicability of equitable partitioning policies to limited-size multiagent systems operating in known, static environments. In this paper, first we
design provably correct and spatially distributed algorithms that allow a team of agents to compute a convex and equitable partition of a convex environment. Second, we discuss how these algorithms can be extended so that a team of agents can compute, in a spatially distributed fashion, convex and equitable partitions with additional features, e.g., equitable and median Voronoi diagrams. Finally, we discuss two application domains for our algorithms, namely dynamic vehicle routing for mobile robotic networks and wireless ad hoc networks. Through these examples, we show how one can couple the algorithms presented in this paper with equitable partitioning policies to make these amenable to distributed implementation. More in general, we illustrate a systematic approach to devise spatially distributed control policies for a large variety of multiagent coordination problems. Our approach is related to the classic Lloyd algorithm and exploits the unique features of power diagrams.

Reachability analysis of uncertain systems using bounded-parameter Markov decision processes

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Abstract
Verification of reachability properties for probabilistic systems is usually based on variants of Markov processes. Current methods assume an exact model of the dynamic behavior and are not suitable for realistic systems that operate in the presence of uncertainty and variability. This research note extends existing methods for Bounded-parameter Markov Decision Processes (BMDPs) to solve the reachability problem. BMDPs are a generalization of MDPs that allows modeling uncertainty. Our results show that interval value iteration converges in the case of an undiscounted reward criterion that is required to formulate the problems of maximizing the probability of reaching a set of desirable states or minimizing the probability of reaching an unsafe set. Analysis of the computational complexity is also presented.