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CONTENTION-AWARE PERFORMANCE ANALYSIS OF MOBILITY-ASSISTED ROUTING

A large body of work has theoretically analyzed the performance of mobility-assisted routing schemes for intermittently connected mobile networks.

However, the vast majority of these prior studies have ignored wireless contention. Recent papers have shown through simulations that ignoring contention leads to inaccurate and misleading results, even for sparse networks.

In this paper, we analyze the performance of routing schemes under contention. First, we introduce a mathematical framework to model contention. This framework can be used to analyze any routing scheme with any mobility and channel model.

Then, we use this framework to compute the expected delays for different representative mobility-assisted routing schemes under random direction, random waypoint, and community-based mobility models.

Finally, we use these delay expressions to optimize the design of routing schemes while demonstrating that designing and optimizing routing schemes using analytical expressions that ignore contention can lead to suboptimal or even erroneous behavior.

Index Terms

Delay-tolerant networks, wireless contention, performance analysis, mobility-assisted routing.

OPPORTUNISTIC SCHEDULING WITH RELIABILITY GUARANTEES IN COGNITIVE RADIO NETWORKS

We develop opportunistic scheduling policies for cognitive radio networks that maximize the throughput utility of the secondary (unlicensed) users subject to maximum collision constraints with the primary (licensed) users.

We consider a cognitive network with static primary users and potentially mobile secondary users. We use the technique of Lyapunov Optimization to design an online flow control, scheduling, and resource allocation algorithm that meets the desired objectives and provides explicit performance guarantees.

Index Terms

Cognitive radio, queuing analysis, resource allocation, Lyapunov optimization.

A FLEXIBLE PRIVACY-ENHANCED LOCATION-BASED SERVICES SYSTEM FRAMEWORK AND PRACTICE

Location-based services (LBSs) are becoming increasingly important to the success and attractiveness of next-generation wireless systems. However, a natural tension arises between the need for user privacy and the flexible use of location information.

In this paper, we present a framework to support privacy-enhanced LBSs. We classify the services according to several basic criteria, and we propose a hierarchical key distribution method to support these services. The main idea behind the system is to hierarchically encrypt location information under different keys, and distribute the appropriate keys only to group members with the necessary permission.

Four methods are proposed to deliver hierarchical location information while maintaining privacy. We propose a key tree rebalancing algorithm to maintain the rekeying performance of the group key management. Furthermore, we present a practical LBS system implementation.

Hierarchical location information coding offers flexible location information access which enables a rich set of LBSs. Our load tests show such a system is highly practical with good efficiency and scalability.

Index Terms

Location-based services, location privacy, social networks, hierarchical key distribution

WATERMARKING RELATIONAL DATABASES USING OPTIMIZATION BASED TECHNIQUES

Proving ownership rights on outsourced relational databases is a crucial issue in today internet-based application environments and in many content distribution applications.

In this paper, we present a mechanism for proof of ownership based on the secure embedding of a robust imperceptible watermark in relational data. We formulate the watermarking of relational databases as a constrained optimization problem, and discuss efficient techniques to solve the optimization problem and to handle the constraints.

Our watermarking technique is resilient to watermark synchronization errors because it uses a partitioning approach that does not require marker tuples. Our approach overcomes a major weakness in previously proposed watermarking techniques.

Watermark decoding is based on a threshold-based technique characterized by an optimal threshold that minimizes the probability of decoding errors.

We implemented a proof of concept implementation of our watermarking technique and showed by experimental results that our technique is resilient to tuple deletion, alteration and insertion attacks.

Keywords:

Watermarking, Digital Rights, Optimization

QUIVER: CONSISTENT OBJECT SHARING FOR EDGE SERVICES

We present Quiver, a system that coordinates service proxies placed at the “edge” of the Internet to serve distributed clients accessing a service involving mutable objects. Quiver enables these proxies to perform consistent accesses to shared objects by migrating the objects to proxies performing operations on those objects.

These migrations dramatically improve performance when operations involving an object exhibit geographic locality, since migrating this object into the vicinity of proxies hosting these operations will benefit all such operations.

Other workloads benefit from Quiver, dispersing the computation load across the proxies and saving the costs of sending operation parameters over the wide area when these are large.

Quiver also supports optimizations for single-object reads that do not involve migrating the object. We detail the protocols for implementing object operations and for accommodating the addition, involuntary disconnection, and voluntary departure of proxies. We also evaluate Quiver through experiments on PlanetLab.

Finally, we discuss the use of Quiver to build an e-commerce application and a distributed network traffic modeling service.

Index Terms

Edge services, migration, serializability.

LOCATION-BASED SPATIAL QUERIES WITH DATA SHARING IN WIRELESS BROADCAST ENVIRONMENTS

Location-based spatial queries (LBSQs) refer to spatial queries whose answers rely on the location of the inquirer. Efficient processing of LBSQs is of critical importance with the ever-increasing deployment and use of mobile technologies.

We show that LBSQs have certain unique characteristics that traditional spatial query processing in centralized databases does not address. For example, a significant challenge is presented by wireless broadcasting environments, which often exhibit high-latency database access.

In this paper, we present a novel query processing technique that, while maintaining high scalability and accuracy, manages to reduce the latency considerably in answering location-based spatial queries.

Our approach is based on peer-to-peer sharing, which enables us to process queries without delay at a mobile host by using query results cached in its neighboring mobile peers. We illustrate the appeal of our technique through extensive simulation results.

RANDOMCAST: AN ENERGY-EFFICIENT COMMUNICATION SCHEME FOR MOBILE AD HOC NETWORKS

Abstract—In mobile ad hoc networks (MANETs), every node overhears every data transmission occurring in its vicinity and thus, consumes energy unnecessarily. In IEEE 802.11 Power Saving Mechanism (PSM), a packet must be advertised before it is actually transmitted.

When a node receives an advertised packet that is not destined to itself, it switches to a low-power sleep state during the data transmission period, and thus, avoids overhearing and conserves energy. However, since some MANET routing protocols such as Dynamic Source Routing (DSR) collect route information via overhearing, they would suffer if they are used in combination with 802.11 PSM.

Allowing no overhearing may critically deteriorate the performance of the underlying routing protocol, while unconditional overhearing may offset the advantage of using PSM. This paper proposes a new communication mechanism, called RandomCast, via which a sender can specify the desired level of overhearing, making a prudent balance between energy and routing performance.

In addition, it reduces redundant rebroadcasts for a broadcast packet, and thus, saves more energy. Extensive simulation using ns-2 shows that RandomCast is highly energy-efficient compared to conventional 802.11 as well as 802.11 PSM-based schemes, in terms of total energy consumption, energy goodput, and energy balance.

Index Terms

Energy balance, energy efficiency, mobile ad hoc networks, network lifetime, overhearing, power saving mechanism

ENTROPY BASED ADAPTIVE FLOW AGGREGATION

Internet traffic flow measurement is vitally important for network management, accounting and performance studies. Cisco's NetFlow is a widely deployed flow measurement solution that uses a configurable static sampling rate to control processor and memory usage on the router and the amount of reporting flow records generated.

But during flooding attacks the memory and network bandwidth consumed by flow records can increase beyond what is available.

Currently available countermeasures have their own problems:

- 1) reject new flows when the cache is full—some legitimate new flows will not be counted;
- 2) export not-terminated flows to make room for new ones—this will exhaust the export bandwidth; and
- 3) adapt the sampling rate to traffic rate—this will reduce the overall accuracy of accounting, including legitimate flows.

In this paper, we propose an entropy based adaptive flow aggregation algorithm. Relying on information-theoretic techniques, the algorithm efficiently identifies the clusters of attack flows in real time and aggregates those large number of short attack flows into a few metaflows.

Compared to currently available solutions, our solution not only alleviates the problem in memory and export bandwidth, but also significantly improves the accuracy of legitimate flows. Finally, we evaluate our system using both synthetic trace file and real trace files from the Internet.

Index Terms

Data summarization, information theory, network monitoring, traffic measurement.

Geographic ad hoc networks use position information for routing. They often utilize stateless greedy forwarding and require the use of recovery algorithms when the greedy approach fails.

We propose a novel idea based on virtual repositioning of nodes that allows to increase the efficiency of greedy routing and significantly increase the success of the recovery algorithm based on local information alone.

We explain the problem of predicting dead ends, which the greedy algorithm may reach and bypassing voids in the network, and introduce Node Elevation Ad hoc Routing (NEAR), a solution that incorporates both virtual positioning and routing algorithms that improve performance in ad hoc networks containing voids.

We demonstrate by simulations the advantages of our algorithm over other geographic ad hoc routing solutions.

Index Terms

Ad hoc, routing, distributed, elevation, repositioning

ADAPTIVE NEURAL NETWORK TRACKING CONTROL OF MIMO NONLINEAR SYSTEMS WITH UNKNOWN DEAD ZONES AND CONTROL DIRECTIONS

In this paper, adaptive neural network (NN) tracking control is investigated for a class of uncertain multiple-input–multiple- output (MIMO) nonlinear systems in triangular control structure with unknown nonsymmetric dead zones and control directions.

The design is based on the principle of sliding mode control and the use of Nussbaum-type functions in solving the problem of the completely unknown control directions.

It is shown that the dead-zone output can be represented as a simple linear system with a static time-varying gain and bounded disturbance by introducing characteristic function.

By utilizing the integral-type Lyapunov function and introducing an adaptive compensation term for the upper bound of the optimal approximation error and the dead-zone disturbance, the closed-loop control system is proved to be semiglobally uniformly ultimately bounded, with tracking errors converging to zero under the condition that the slopes of unknown dead zones are equal. Simulation results demonstrate the effectiveness of the approach.

Index Terms

Adaptive control, dead zone, neural network (NN) control, Nussbaum function, sliding mode control.

A FRAMEWORK FOR THE CAPACITY EVALUATION OF MULTIHOP WIRELESS NETWORKS, 2009

The specific challenges of multihop wireless networks lead to a strong research effort on efficient protocols design where the offered capacity is a key objective. More specifically, routing strategy largely impacts the network capacity, i.e. the throughput offered to each flow.

In this work, we propose a complete framework to compute the upper and the lower bounds of the network capacity according to a physical topology and a given routing protocol.

The radio resource sharing principles of CSMA-CA is modeled as a set of linear constraints with two models of fairness. The first one assumes that nodes have a fair access to the channel, while the second one assumes that on the radio links.

We then develop a pessimistic and an optimistic scenarios for radio resource sharing, yielding a lower bound and an upper bound on the network capacity for each fairness case.

Our approach is independent of the network topology and the routing protocols, and provides therefore a relevant framework for their comparison. We apply our models to a comparative analysis of a well-known flat routing protocol OLSR against two main self-organized structure approaches, VSR and localized CDS.

Index Terms

network capacity, multihop wireless networks, upper and lower bounds, linear programming

CONTINUOUS FLOW WIRELESS DATA BROADCASTING FOR HIGH-SPEED ENVIRONMENTS

With the increasing popularity of wireless networks and mobile computing, data broadcasting has emerged as an efficient way of delivering data to mobile clients having a high degree of commonality in their demand patterns.

This paper proposes an adaptive wireless push system that operates efficiently in environments characterized by high broadcasting speeds and a-priori unknown client demands for data items.

The proposed system adapts to the demand pattern of the client population in order to reflect the overall popularity of each data item. We propose a method for feedback collection by the server so that the client population can enjoy a performance increase in proportion to the broadcasting speed used by the server.

Simulation results are presented which reveal satisfactory performance in environments with a-priori unknown client demands and under various high broadcasting speeds.

Index Terms

Adaptive systems, data broadcasting, high-speed, learning automata.

DYNAMIC AND AUTO RESPONSIVE SOLUTION FOR DISTRIBUTED DENIAL-OF-SERVICE ATTACKS DETECTION IN ISP NETWORK, 2009

Denial of service (DoS) attacks and more particularly the distributed ones (DDoS) are one of the latest threat and pose a grave danger to users, organizations and infrastructures of the Internet. Several schemes have been proposed on how to detect some of these attacks, but they suffer from a range of problems, some of them being impractical and others not being effective against these attacks.

This paper reports the design principles and evaluation results of our proposed framework that autonomously detects and accurately characterizes a wide range of flooding DDoS attacks in ISP network. Attacks are detected by the constant monitoring of propagation of abrupt traffic changes inside ISP network.

For this, a newly designed flow-volume based approach (FVBA) is used to construct profile of the traffic normally seen in the network, and identify anomalies whenever traffic goes out of profile. Consideration of varying tolerance factors make proposed detection system scalable to the varying network conditions and attack loads in real time.

Six-sigma method is used to identify threshold values accurately for malicious flows characterization. FVBA has been extensively evaluated in a controlled test-bed environment. Detection thresholds and efficiency is justified using receiver operating characteristics (ROC) curve.

For validation, KDD 99, a publicly available benchmark dataset is used. The results show that our proposed system gives a drastic improvement in terms of detection and false alarm rate.

Index Terms

Distributed Denial of Service Attacks, False Positives, False Negatives, ISP Network, Network Security

**EFFICIENT MULTI-PARTY DIGITAL SIGNATURE USING
ADAPTIVE SECRET SHARING FOR LOW-POWER DEVICES IN
WIRELESS NETWORKS**

In this paper, we propose an efficient multi-party signature scheme for wireless networks where a given number of signees can jointly sign a document, and it can be verified by any entity who possesses the certified group public key.

Our scheme is based on an efficient threshold key generation scheme, which is able to defend against both static and adaptive adversaries.

Specifically, our key generation method employs the bit commitment technique to achieve efficiency in key generation and share refreshing; our share refreshing method provides proactive protection to long-lasting secret and allows a new signee to join a signing group.

We demonstrate that previous known approaches are not efficient in wireless networks, and the proposed multi-party signature scheme is flexible, efficient, and achieves strong security for low-power devices in wireless networks.

Index Terms

Multi-party signature, distributed key generation, elliptic curve cryptosystems.

GUARANTEED DELIVERY FOR GEOGRAPHICAL ANYCASTING IN WIRELESS MULTI-SINK SENSOR AND SENSOR-ACTOR NETWORKS

In the anycasting problem, a sensor wants to report event information to one of sinks or actors. We describe the first localized anycasting algorithms that guarantee delivery for connected multi-sink sensor-actor networks.

Let $S(x)$ be the closest actor/sink to sensor x , and $|xS(x)|$ be distance between them. In greedy phase, a node s forwards the packet to its neighbor v that minimizes the ratio of cost $\text{cost}(|sv|)$ of sending packet to v (here we specifically apply hop-count and power consumption metrics) over the reduction in distance $(|sS(s)| - |vS(v)|)$ to the closest actor/sink.

A variant is to forward to the first neighbor on the shortest weighted path toward v . If none of neighbors reduces that distance then recovery mode is invoked.

It is done by face traversal toward the nearest connected actor/sink, where edges are replaced by paths optimizing given cost. A hop count based and two variants of localized power aware anycasting algorithms are described. We prove guaranteed delivery property analytically and experimentally

HIERARCHICAL BAYESIAN SPARSE IMAGE RECONSTRUCTION WITH APPLICATION TO MRFM

This paper presents a hierarchical Bayesian model to reconstruct sparse images when the observations are obtained from linear transformations and corrupted by an additive white Gaussian noise.

Our hierarchical Bayes model is well suited to such naturally sparse image applications as it seamlessly accounts for properties such as sparsity and positivity of the image via appropriate Bayes priors.

We propose a prior that is based on a weighted mixture of a positive exponential distribution and a mass at zero. The prior has hyperparameters that are tuned automatically by marginalization over the hierarchical Bayesian model. To overcome the complexity of the posterior distribution, a Gibbs sampling strategy is proposed.

The Gibbs samples can be used to estimate the image to be recovered, e.g. by maximizing the estimated posterior distribution. In our fully Bayesian approach the posteriors of all the parameters are available. Thus our algorithm provides more information than other previously proposed sparse reconstruction methods that only give a point estimate.

The performance of the proposed hierarchical Bayesian sparse reconstruction method is illustrated on synthetic data and real data collected from a tobacco virus sample using a prototype MRFM instrument.

Index Terms

Deconvolution, MRFM imaging, sparse representation, Bayesian inference, MCMC methods

OFFLINE LOOP INVESTIGATION FOR HANDWRITING ANALYSIS

Study of Rough Set and Clustering Algorithm in Network Security Management Getting a better grasp of computer network security is of great significance to protect the normal operation of network system.

Based on rough set (RS), clustering model, security features reduction and clustering algorithm are presented, which provides a basis of network security strategies. Further research is to mine and process the dynamic risks and management of network security.

Using the reduction methods, the simplified network security assessment data set is established. The extraction by the decision-making rules is proposed and verified.

Through the results, it is concluded that the method could be in line with the actual situation of decision-making rules.

Keywords

RS, clustering algorithm, network security, K-W method

HIGH PERFORMANCE COOPERATIVE TRANSMISSION PROTOCOLS BASED ON MULTIUSER DETECTION AND NETWORK CODING

Cooperative transmission is an emerging communication technique that takes advantage of the broadcast nature of wireless channels. However, due to low spectral efficiency and the requirement of orthogonal channels, its potential for use in future wireless networks is limited.

In this paper, by making use of multiuser detection (MUD) and network coding, cooperative transmission protocols with high spectral efficiency, diversity order, and coding gain are developed. Compared with the traditional cooperative transmission protocols with singleuser detection, in which the diversity gain is only for one source user, the proposed MUD cooperative transmission protocols have the merit that the improvement of one user's link can also benefit the other users.

In addition, using MUD at the relay provides an environment in which network coding can be employed. The coding gain and high diversity order can be obtained by fully utilizing the link between the relay and the destination.

From the analysis and simulation results, it is seen that the proposed protocols achieve higher diversity gain, better asymptotic efficiency, and lower bit error rate, compared to traditional MUD schemes and to existing cooperative transmission protocols.

From the simulation results, the performance of the proposed scheme is near optimal as the performance gap is 0.12dB for average bit error rate (BER) 10^{-6} and 1.04dB for average BER 10^{-3} , compared to two performance upper bounds.

Index Terms

Detection, coding, communication networks, and cooperative systems.

NOVEL PACKET-LEVEL RESOURCE ALLOCATION WITH EFFECTIVE QOS PROVISIONING FOR WIRELESS MESH NETWORKS

Joint power-subcarrier-time resource allocation is imperative for wireless mesh networks due to the necessity of packet scheduling for quality-of-service (QoS) provisioning, multi-channel communications, and opportunistic power allocation.

In this work, we propose an efficient intra-cluster packet-level resource allocation approach. Our approach takes power allocation, subcarrier allocation, packet scheduling, and QoS support into account.

The proposed approach combines the merits of a Karush-Kuhn-Tucker (KKT)-driven approach and a genetic algorithm (GA)-based approach. It is shown to achieve a desired balance between time complexity and system performance. Bounds for the throughputs obtained by real-time and non-real-time traffic are also derived analytically.

Index Terms—Genetic algorithm (GA), Karush-Kuhn-Tucker (KKT), quality-of-service (QoS) provisioning, resource allocation, wireless mesh network (WMN).

MULTI-SERVICE LOAD SHARING FOR RESOURCE MANAGEMENT IN THE CELLULAR/WLAN INTEGRATED NETWORK

With the interworking between a cellular network and wireless local area networks (WLANs), an essential aspect of resource management is taking advantage of the overlay network structure to efficiently share the multi-service traffic load between the interworked systems.

In this study, we propose a new load sharing scheme for voice and elastic data services in a cellular/WLAN integrated network. Admission control and dynamic vertical handoff are applied to pool the free bandwidths of the two systems to effectively serve elastic data traffic and improve the multiplexing gain.

To further combat the cell bandwidth limitation, data calls in the cell are served under an efficient service discipline, referred to as shortest remaining processing time (SRPT) [1]. The SRPT can well exploit the heavy-tailedness of data call size to improve the resource utilization.

An accurate analytical model is developed to determine an appropriate size threshold so that data calls are properly distributed to the integrated cell and WLAN, taking into account the load conditions and traffic characteristics. It is observed from extensive simulation and numerical analysis that the new scheme significantly improves the overall system performance.

Index Terms

Cellular/WLAN interworking, resource management, quality of service, load sharing, vertical handoff, admission control.

SOBIE:A NOVEL SUPER-NODE P2P OVERLAY BASED ON INFORMATION EXCHANGE

In order to guarantee both the efficiency and robustness in the Peer-to-Peer (P2P) network, the paper designs a novel Super-node Overlay Based on Information Exchange called SOBIE.

Differing from current structured and unstructured, or meshed and tree-like P2P overlay, the SOBIE is a whole new structure to improve the efficiency of searching in the P2P network.

The main contributions are

- 1) to select the super-nodes by considering the aggregation of not only the delay, distance, but also the information exchange frequency, exchange time and query similarity especially;**
- 2) to set a score mechanism to identify and prevent the free-riders. Meanwhile, the SOBIE also guarantees the matching between the physical network and logical network and has small-world characteristic to improve the efficiency.**

Large number of experiment results show the advantages of the SOBIE including high efficiency and robustness by such different factors as the query success rate, the average query hops, the total number of query messages, the coverage rate and system connectivity.

Index Terms

P2P overlay, super node, information exchange, topology matching, free-riding

OPTIMAL BACKPRESSURE ROUTING FOR WIRELESS NETWORKS WITH MULTI-RECEIVER DIVERSITY

We consider the problem of optimal scheduling and routing in an ad-hoc wireless network with multiple traffic streams and time varying channel reliability.

Each packet transmission can be overheard by a subset of receiver nodes, with a transmission success probability that may vary from receiver to receiver and may also vary with time.

We develop a simple backpressure routing algorithm that maximizes network throughput and expends an average power that can be pushed arbitrarily close to the minimum average power required for network stability, with a corresponding tradeoff in network delay.

When channels are orthogonal, the algorithm can be implemented in a distributed manner using only local link error probability information, and supports a “blind transmission” mode (where error probabilities are not required) in special cases when the power metric is neglected and when there is only a single destination for all traffic streams.

For networks with general inter-channel interference, we present a distributed algorithm with constant-factor optimality guarantees.

Index Terms

Broadcast advantage, distributed algorithms, dynamic control, mobility, queueing analysis, scheduling

RANDOMCAST: AN ENERGY-EFFICIENT COMMUNICATION SCHEME FOR MOBILE AD HOC NETWORKS

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When a node receives an advertised packet that is not destined to itself, it switches to a low-power sleep state during the data transmission period, and thus, avoids overhearing and conserves energy.

However, since some MANET routing protocols such as Dynamic Source Routing (DSR) collect route information via overhearing, they would suffer if they are used in combination with 802.11 PSM.

Allowing no overhearing may critically deteriorate the performance of the underlying routing protocol, while unconditional overhearing may offset the advantage of using PSM. This paper proposes a new communication mechanism, called RandomCast, via which a sender can specify the desired level of overhearing, making a prudent balance between energy and routing performance.

In addition, it reduces redundant rebroadcasts for a broadcast packet, and thus, saves more energy. Extensive simulation using ns-2 shows that RandomCast is highly energy-efficient compared to conventional 802.11 as well as 802.11 PSM-based schemes, in terms of total energy consumption, energy goodput, and energy balance.

Index Terms

Energy balance, energy efficiency, mobile ad hoc networks, network lifetime, overhearing, power saving mechanism.

ADAPTIVE FUZZY FILTERING FOR ARTIFACT REDUCTION IN COMPRESSED IMAGES AND VIDEOS

A fuzzy filter adaptive to both sample's activity and the relative position between samples is proposed to reduce the artifacts in compressed multidimensional signals.

For JPEG images, the fuzzy spatial filter is based on the directional characteristics of ringing artifacts along the strong edges.

For compressed video sequences, the motion compensated spatiotemporal filter (MCSTF) is applied to intraframe and interframe pixels to deal with both spatial and temporal artifacts.

A new metric which considers the tracking characteristic of human eyes is proposed to evaluate the flickering artifacts. Simulations on compressed images and videos show improvement in artifact reduction of the proposed adaptive fuzzy filter over other conventional spatial or temporal filtering approaches.

Index Terms

Artifact reduction, flickering metric, fuzzy filter, motion compensated spatio-temporal filter.

A NEW RELIABLE BROADCASTING IN MOBILE AD HOC NETWORKS

A New Reliable Broadcasting Algorithm for mobile ad hoc networks will guarantee to deliver the messages from different sources to all the nodes of the network.

The nodes are mobile and can move from one place to another. The solution does not require the nodes to know the network size, its diameter and number of nodes in the network.

The only information a node has its identity (IP Address) and its position. On average, only a subset of nodes transmits and they transmit only once to achieve reliable broadcasting.

The algorithm will calculate the relative position of the nodes with respect to the broadcasting source node. The nodes that are farthest from the source node will rebroadcast and this will minimize the number of rebroadcasts made by the intermediate nodes and will reduce the delay latency.

The proposed algorithm will adapt itself dynamically to the number of concurrent broadcasts and will give the least finish time for any particular broadcast. It will be contention free, energy efficient and collision free.

Key words

Broadcasting Algorithm, IP Address, Mobile Ad Hoc Networks, Collision, Delay latency.

AN XML-BASED ADL FRAMEWORK FOR AUTOMATIC GENERATION OF MULTITHREADED COMPUTER ARCHITECTURE SIMULATORS

Computer architecture simulation has always played a pivotal role in continuous innovation of computers. However, constructing or modifying a high quality simulator is time consuming and error-prone.

Thus, often Architecture Description Languages (ADLs) are used to provide an abstraction layer for describing the computer architecture and automatically generating corresponding simulators. Along the line of such research, we present a novel XML-based ADL, its compiler, and a generation methodology to automatically generate multithreaded simulators for computer architecture.

We utilize the industry-standard extensible markup language XML to describe the functionality and architecture of a modeled processor. Our ADL framework allows users to easily and quickly modify the structure, register set, and execution of a modeled processor.

To prove its validity, we have generated several multithreaded simulators with different configurations based on the MIPS five-stage processor, and successfully tested with two programs.

CLONE DETECTION AND REMOVAL FOR ERLANG/OTP WITHIN A REFACTORING ENVIRONMENT

A well-known bad code smell in refactoring and software maintenance is duplicated code, or code clones. A code clone is a code fragment that is identical or similar to another.

Unjustified code clones increase code size, make maintenance and comprehension more difficult, and also indicate design problems such as lack of encapsulation or abstraction.

This paper proposes a token and AST based hybrid approach to automatically detecting code clones in Erlang/OTP programs, underlying a collection of refactorings to support user-controlled automatic clone removal, and examines their application in substantial case studies.

Both the clone detector and the refactorings are integrated within Wrangler, the refactoring tool developed at Kent for Erlang/OTP

Keywords

Erlang, refactoring, Wrangler, duplicated code, program analysis, program transformation.

A RELATION-BASED PAGE RANK ALGORITHM FOR SEMANTIC WEB SEARCH ENGINES

With the tremendous growth of information available to end users through the Web, search engines come to play ever a more critical role. Nevertheless, because of their general-purpose approach, it is always less uncommon that obtained result sets provide a burden of useless pages.

The next-generation Web architecture, represented by the Semantic Web, provides the layered architecture possibly allowing overcoming this limitation. Several search engines have been proposed, which allow increasing information retrieval accuracy by exploiting a key content of Semantic Web resources, that is, relations.

However, in order to rank results, most of the existing solutions need to work on the whole annotated knowledge base. In this paper, we propose a relation-based page rank algorithm to be used in conjunction with Semantic Web search engines that simply relies on information that could be extracted from user queries and on annotated resources.

Relevance is measured as the probability that a retrieved resource actually contains those relations whose existence was assumed by the user at the time of query definition.

Index Terms

Semantic Web, knowledge retrieval, search process, query formulation.

DYNAMICS OF MULTIPLE-SELLER AND MULTIPLE-BUYER SPECTRUM TRADING IN COGNITIVE RADIO NETWORKS: A GAME-THEORETIC MODELING APPROACH

We consider the problem of spectrum trading with multiple licensed users (i.e., primary users) selling spectrum opportunities to multiple unlicensed users (i.e., secondary users). The secondary users can adapt the spectrum buying behavior (i.e., evolve) by observing the variations in price and quality of spectrum offered by the different primary users or primary service providers.

The primary users or primary service providers can adjust their behavior in selling the spectrum opportunities to secondary users to achieve the highest utility. In this paper, we model the evolution and the dynamic behavior of secondary users using the theory of evolutionary game. An algorithm for the implementation of the evolution process of a secondary user is also presented.

To model the competition among the primary users, a noncooperative game is formulated where the Nash equilibrium is considered as the solution (in terms of size of offered spectrum to the secondary users and spectrum price). For a primary user, an iterative algorithm for strategy adaptation to achieve the solution is presented.

The proposed game-theoretic framework for modeling the interactions among multiple primary users (or service providers) and multiple secondary users is used to investigate network dynamics under different system parameter settings and under system perturbation.

Index Terms

Cognitive radio, dynamic spectrum sharing, spectrum trading, Nash equilibrium, evolutionary equilibrium, replicator dynamics.

ENERGY–ROBUSTNESS TRADEOFF IN CELLULAR NETWORK POWER CONTROL

In the seminal paper by Foschini and Miljanic in 1993, a distributed power control algorithm was developed to meet SIR targets with minimal powers in cellular network uplinks. Since the SIR on an active link may dip below the SIR target during the transient after a new user enters the cell, Bambos et al. proposed an active link protection algorithm to provide robustness, at the expense of higher energy consumption.

This paper examines the tradeoff between energy and robustness. An optimization problem is formulated where robustness is captured in the constraint and the price of robustness penalized in the objective function.

A distributed algorithm is developed to solve this problem. Local convergence and optimality of equilibrium are proved for the algorithm. The objective function modulates the tradeoff between energy and robustness, and between energy and speed of admission, as illustrated through a series of numerical experiments.

A parameterized family of objective functions is constructed to control the transient and equilibrium properties of robust distributed power control.

Index Terms—Distributed optimization, duality, power control, wireless networks.

TEXTURE IMAGE SEGMENTATION USING SPECTRAL HISTOGRAM AND SKELETON EXTRACTING, FEB. 2009

This paper presents a texture image segmentation algorithm using spectral histogram and skeleton extracting. No need of selecting seed pixels or specifying or deciding the number of regions is its remarkable characteristic.

Based on a local spatial/frequency representation, spectral histogram consists of marginal distributions of responses of a bank of filters and encodes implicitly the local structure of images through the filtering stage and the global appearance through the histogram stage.

The similarity between two spectral histograms is measured using chi²-statistic. According to the similarity among spectral histograms, the initial binary segmentation image can be obtained.

Adopting skeleton extracting algorithm based on mathematical morphology, the final segmentation result can be obtained. Experiments on Brodatz textures give satisfactory results.

AGENT MINING: THE SYNERGY OF AGENTS AND DATA MINING," IEEE INTELLIGENT SYSTEMS, 2009

Autonomous agents and multiagent systems (or agents) and data mining and knowledge discovery (or data mining) are two of the most active areas in information technology. Ongoing research has revealed a number of intrinsic challenges and problems facing each area, which can't be addressed solely within the confines of the respective discipline.

A profound insight of bringing these two communities together has unveiled a tremendous potential for new opportunities and wider applications through the synergy of agents and data mining.

With increasing interest in this synergy, agent mining is emerging as a new research field studying the interaction and integration of agents and data mining. In this paper, we give an overall perspective of the driving forces, theoretical underpinnings, main research issues, and application domains of this field, while addressing the state-of-the-art of agent mining research and development.

Our review is divided into three key research topics: agent-driven data mining, data mining-driven agents, and joint issues in the synergy of agents and data mining.

This new and promising field exhibits a great potential for groundbreaking work from foundational, technological and practical perspectives

Index Terms:

artificial intelligence, autonomous agents, multi-agent systems, knowledge discovery, data mining

A RELATION-BASED PAGE RANK ALGORITHM FOR SEMANTIC WEB SEARCH ENGINES

IEEE Transactions on Knowledge and Data Engineering, 2009

With the tremendous growth of information available to end users through the Web, search engines come to play ever a more critical role. Nevertheless, because of their general purpose approach, it is always less uncommon that obtained result sets provide a burden of useless pages.

Next generation Web architecture, represented by Semantic Web, provides the layered architecture possibly allowing to overcome this limitation. Several search engines have been proposed, which allow to increase information retrieval accuracy by exploiting a key content of Semantic Web resources, that is relations.

However, in order to rank results, most of the existing solutions need to work on the whole annotated knowledge base. In this paper we propose a relation-based page rank algorithm to be used in conjunction with Semantic Web search engines that simply relies on information which could be extracted from user query and annotated resource.

Relevance is measured as the probability that retrieved resource actually contains those relations whose existence was assumed by the user at the time of query definition

Index Terms:

Intelligent Web Services and Semantic Web, Knowledge retrieval, Search process, Query formulation

AN IMPLEMENTATION OF THE BLOWFISH CRYPTOSYSTEM, 2009

The Blowfish cryptosystem is a very fast and useful scheme, even though it was introduced over a decade ago. This cryptosystem consists of two parts, a subkey and S-box generation phase, and an encryption phase.

A short introduction to both algorithms are given, along with a few notes about the Ciphertext Block Chaining (CBC) mode.

Some general information about attacks are explained, along with information about some of the people who have worked to analyze and attempt to break Blowfish. An implementation of a Windows tool for encrypting files which uses Blowfish is also examined in this paper.

The results of the encryption tool clearly demonstrate how fast the encryption is compared to the subkey and S-box generation. The secrecy of the cryptosystem is explained by using several test files of different types, as well as a study of the security with respect to the number of rounds.

Finally, some possible extensions to the software tool to improve its usefulness based on the strength of Blowfish are given.

SSL/TLS WITH QUANTUM CRYPTOGRAPHY, FEB. 2009

The current standard to exchange a secret key for ensuring secure data transmission within the SSL/TLS protocol is based on Public-Key encryption.

This method is only secure as long as the computation power of a potential attacker is limited.

So far, the only way to make an unconditional secure key exchange, is to use quantum key distribution (QKD). With the latest figures of sifting key rates provided by NIST, we show which authentic theoretical final key rates are possible.

Furthermore we present a modified SSL/TLS protocol, which uses quantum key distribution, in different encryption variants.

IMAGE TRANSFORMATIONS AND BLURRING

Pattern Analysis and Machine Intelligence, IEEE Transactions on
Volume 31, Issue 5, May 2009

Since cameras blur the incoming light during measurement, different images of the same surface do not contain the same information about that surface. Thus, in general, corresponding points in multiple views of a scene have different image intensities.

While multiple-view geometry constrains the locations of corresponding points, it does not give relationships between the signals at corresponding locations. This paper offers an elementary treatment of these relationships.

We first develop the notion of "ideal" and "real" images, corresponding to, respectively, the raw incoming light and the measured signal. This framework separates the filtering and geometric aspects of imaging.

We then consider how to synthesize one view of a surface from another; if the transformation between the two views is affine, it emerges that this is possible if and only if the singular values of the affine matrix are positive.

Next, we consider how to combine the information in several views of a surface into a single output image. By developing a new tool called "frequency segmentation," we show how this can be done despite not knowing the blurring kernel.

AUTOMATIC ASCII ART CONVERSION OF BINARY IMAGES USING NON-NEGATIVE CONSTRAINTS

It is hard to avoid ASCII Art in today's digital world, from the ubiquitous emoticons—;)—to the esoteric artistic creations that reside in many people's e-mail signatures, everybody has come across ASCII art at some stage.

The origins of ASCII art can be traced back to the days when computers had a high price, slow operating speeds and low graphics capabilities, which forced computer programmers and enthusiasts to develop some innovative ways to render images using the limited graphics blocks available, viz., text characters.

Here, we treat automatic ASCII art conversion of binary images as an optimisation problem, and present an application of our work on Non-Negative Matrix Factorisation to this task—where a basis constructed from monospace font glyphs is fitted to a binary image using a winner-takes-all assignment.

DATA-MINING-ENHANCED AGENTS IN DYNAMIC SUPPLY-CHAIN-MANAGEMENT ENVIRONMENTS

IEEE Intelligent Systems, May/June 2009

In modern supply chains, stakeholders with varying degrees of autonomy and intelligence compete against each other in a constant effort to establish beneficiary contracts and maximize their own revenue.

In such competitive environments, entities—software agents being a typical programming paradigm—interact in a dynamic and versatile manner, so each action can cause ripple reactions and affect the overall result.

In this article, the authors argue that the utilization of data mining primitives could prove beneficial in order to analyze the supply-chain model and identify pivotal factors.

They elaborate on the benefits of data mining analysis on a well-established agent supply-chain management network, both at a macro and micro level. They also analyze the results and discuss specific design choices in the context of agent performance improvement.

Index Terms:

intelligent agents, data mining, supply chain management, auctions, bidding

FUZZY CONTROL MODEL OPTIMIZATION FOR BEHAVIOR-CONSISTENT TRAFFIC ROUTING UNDER INFORMATION PROVISION

IEEE Transactions on 2009

This paper presents an H-infinity filtering approach to optimize a fuzzy control model used to determine behavior-consistent (BC) information-based control strategies to improve the performance of congested dynamic traffic networks.

By adjusting the associated membership function parameters to better respond to nonlinearities and modeling errors, the approach is able to enhance the computational performance of the fuzzy control model. Computational efficiency is an important aspect in this problem context, because the information strategies are required in subreal time to be real-time deployable.

Experiments are performed to evaluate the effectiveness of the approach. The results indicate that the optimized fuzzy control model contributes in determining the BC information-based control strategies in significantly less computational time than when the default controller is used.

Hence, the proposed H-infinity approach contributes to the development of an efficient and robust information-based control approach.

AN SSL BACK-END FORWARDING SCHEME IN CLUSTER-BASED WEB SERVERS

State-of-the-art cluster-based data centers consisting of three tiers (Web server, application server, and database server) are being used to host complex Web services such as e-commerce applications. The application server handles dynamic and sensitive Web contents that need protection from eavesdropping, tampering, and forgery.

Although the Secure Sockets Layer (SSL) is the most popular protocol to provide a secure channel between a client and a cluster-based network server, its high overhead degrades the server performance considerably and, thus, affects the server scalability.

Therefore, improving the performance of SSL-enabled network servers is critical for designing scalable and high-performance data centers. In this paper, we examine the impact of SSL offering and SSL-session-aware distribution in cluster-based network servers.

We propose a back-end forwarding scheme, called `ssl_with_bf`, that employs a low-overhead user-level communication mechanism like Virtual Interface Architecture (VIA) to achieve a good load balance among server nodes. We compare three distribution models for network servers, Round Robin (RR), `ssl_with_session`, and `ssl_with_bf`, through simulation.

The experimental results with 16-node and 32-node cluster configurations show that, although the session reuse of `ssl_with_session` is critical to improve the performance of application servers, the proposed back-end forwarding scheme can further enhance the performance due to better load balancing.

The `ssl_with_bf` scheme can minimize the average latency by about 40 percent and improve throughput across a variety of workloads.

Index Terms

Secure Sockets Layer, cluster, Web servers, application server layer, load distribution, user-level communication.

EFFICIENT APPROXIMATE QUERY PROCESSING IN PEER-TO-PEER NETWORKS

Peer-to-peer (P2P) databases are becoming prevalent on the Internet for distribution and sharing of documents, applications, and other digital media.

The problem of answering large-scale ad hoc analysis queries, for example, aggregation queries, on these databases poses unique challenges. Exact solutions can be time consuming and difficult to implement, given the distributed and dynamic nature of P2P databases.

In this paper, we present novel sampling-based techniques for approximate answering of ad hoc aggregation queries in such databases. Computing a high-quality random sample of the database efficiently in the P2P environment is complicated due to several factors: the data is distributed (usually in uneven quantities) across many peers, within each peer, the data is often highly correlated, and, moreover, even collecting a random sample of the peers is difficult to accomplish.

To counter these problems, we have developed an adaptive two-phase sampling approach based on random walks of the P2P graph, as well as block-level sampling techniques. We present extensive experimental evaluations to demonstrate the feasibility of our proposed solution.

Index Terms

Approximation methods, computer networks, distributed databases, distributed database query processing, distributed estimation, database systems, distributed systems.

SECURE ELECTRONIC DATA INTERCHANGE OVER THE INTERNET - 2005

Numerous retailers, manufacturers, and other companies within business supply chains are leveraging Applicability Statement #2 (AS2) and other standards developed by the IETF's Electronic Data Interchange over the Internet (EDI-INT) working group (www.imc.org/ietf-ediint/).

Founded in 1996 to develop a secure transport service for EDI business documents, the EDI-INT WG later expanded its focus to include XML and virtually any other electronic business-documentation format.

It began by providing the digital security and message-receipt validation for Internet communication for MIME (Multipurpose Internet Mail Extensions) packaging of EDI.1 EDI-INT has since become the leading means of business-to-business (B2B) transport for retail and other industries. Although invisible to the consumer, standards for secure electronic communication of purchase orders, invoices, and other business transactions are helping enterprises drive down costs and offer flexibility in B2B relationships.

EDI-INT provides digital security of email, Web, and FTP payloads through authentication, content-integrity, confidentiality, and receipt validation.

BENEFIT-BASED DATA CACHING IN AD HOC NETWORKS

Data caching can significantly improve the efficiency of information access in a wireless ad hoc network by reducing the access latency and bandwidth usage.

However, designing efficient distributed caching algorithms is non-trivial when network nodes have limited memory. In this article, we consider the cache placement problem of minimizing total data access cost in ad hoc networks with multiple data items and nodes with limited memory capacity. The above optimization problem is known to be NP-hard.

Defining benefit as the reduction in total access cost, we present a polynomial-time centralized approximation algorithm that provably delivers a solution whose benefit is at least one-fourth (one-half for uniform-size data items) of the optimal benefit.

The approximation algorithm is amenable to localized distributed implementation, which is shown via simulations to perform close to the approximation algorithm. Our distributed algorithm naturally extends to networks with mobile nodes.

We simulate our distributed algorithm using a network simulator (ns2), and demonstrate that it significantly outperforms another existing caching technique (by Yin and Cao [30]) in all important performance metrics.

The performance differential is particularly large in more challenging scenarios, such as higher access frequency and smaller memory

ON THE COMPUTATIONAL COMPLEXITY AND EFFECTIVENESS OF N-HUB SHORTEST-PATH ROUTING

In this paper we study the computational complexity and effectiveness of a concept we term "N-hub Shortest- Path Routing" in IP networks.

N-hub Shortest-Path Routing allows the ingress node of a routing domain to determine up to N intermediate nodes ("hubs") through which a packet will pass before reaching its final destination.

This facilitates better utilization of the network resources, while allowing the network routers to continue to employ the simple and well-known shortest-path routing paradigm. Although this concept has been proposed in the past, this paper is the first to investigate it in depth.

We apply N-hub Shortest-Path Routing to the problem of minimizing the maximum load in the network. We show that the resulting routing problem is NP-complete and hard to approximate.

However, we propose efficient algorithms for solving it both in the online and the offline contexts. Our results show that N-hub Shortest-Path Routing can increase network utilization significantly even for ??.

Hence, this routing paradigm should be considered as a powerful mechanism for future datagram routing in the Internet

PFUSION: A P2P ARCHITECTURE FOR INTERNET-SCALE CONTENT-BASED SEARCH AND RETRIEVAL

The emerging Peer-to-Peer (P2P) model has become a very powerful and attractive paradigm for developing Internet-scale systems for sharing resources, including files and documents.

The distributed nature of these systems, where nodes are typically located across different networks and domains, inherently hinders the efficient retrieval of information.

In this paper, we consider the effects of topologically aware overlay construction techniques on efficient P2P keyword search algorithms. We present the Peer Fusion (pFusion) architecture that aims to efficiently integrate heterogeneous information that is geographically scattered on peers of different networks. Our approach builds on work in unstructured P2P systems and uses only local knowledge.

Our empirical results, using the pFusion middleware architecture and data sets from Akamai's Internet mapping infrastructure (AKAMAI), the Active Measurement Project (NLNR), and the Text REtrieval Conference (TREC) show that the architecture we propose is both efficient and practical.

Index Terms

Information retrieval, peer-to-peer, overlay construction algorithm

A SOFTWARE DEFECT REPORT AND TRACKING SYSTEM IN AN INTRANET

This paper describes a case study where SofTrack - a Software Defect Report and Tracking System – was implemented using internet technology in a geographically distributed organization.

Four medium to large size information systems with different levels of maturity are being analyzed within the scope of this project. They belong to the Portuguese Navy's Information Systems Infrastructure and were developed using typical legacy systems technology: COBOL with embedded SQL for queries in a Relational Database environment.

This pilot project of Empirical Software Engineering has allowed the development of techniques to help software managers to better understand, control and ultimately improve the software process.

Among them are the introduction of automatic system documentation, module's complexity assessment and effort estimation for maintenance activities in the organization

MULTIPLE ANT COLONIES OPTIMIZATION FOR LOAD BALANCING IN DISTRIBUTED SYSTEMS

Ant colony optimization (ACO) has proved its success as a meta-heuristic optimization in several network applications such as routing and load balancing. In this paper, a proposed ACO algorithm for load balancing in distributed systems will be presented.

This algorithm is fully distributed in which information is dynamically updated at each ant movement. Multiple colonies paradigm will be adopted such that each node will send a colored colony throughout the network.

Using colored ant colony helps in preventing ants of the same nest from following the same route, and hence enforcing them to be distributed all over the nodes in the network.

Each ant acts like a mobile agent that carries newly updated load balancing information to the next visited node. Finally, the proposed algorithm will be compared with the standard work-stealing algorithm

WORKFLOW MINING: DISCOVERING PROCESS MODELS FROM EVENT LOGS

Contemporary workflow management systems are driven by explicit process models, i.e., a completely specified workflow design is required in order to enact a given workflow process.

Creating a workflow design is a complicated time-consuming process and, typically, there are discrepancies between the actual workflow processes and the processes as perceived by the management.

Therefore, we have developed techniques for discovering workflow models. The starting point for such techniques is a so-called “workflow log” containing information about the workflow process as it is actually being executed.

We present a new algorithm to extract a process model from such a log and represent it in terms of a Petri net. However, we will also demonstrate that it is not possible to discover arbitrary workflow processes.

In this paper, we explore a class of workflow processes that can be discovered. We show that the algorithm can successfully mine any workflow represented by a so-called SWF-net.

Index Terms

Workflow mining, workflow management, data mining, Petri nets

DISTRIBUTED DATA MINING IN CREDIT CARD FRAUD DETECTION CREDIT CARD TRANSACTIONS CONTINUE

To grow in number, taking an ever-larger share of the US payment system and leading to a higher rate of stolen account numbers and subsequent losses by banks. Improved fraud detection thus has become essential to maintain the viability of the US payment system.

Banks have used early fraud warning systems for some years. Large-scale data-mining techniques can improve on the state of the art in commercial practice. Scalable techniques to analyze massive amounts of transaction data that efficiently compute fraud detectors in a timely manner is an important problem, especially for e-commerce.

Besides scalability and efficiency, the fraud-detection task exhibits technical problems that include skewed distributions of training data and nonuniform cost per error, both of which have not been widely studied in the knowledge-discovery and datamining community.

In this article, we survey and evaluate a number of techniques that address these three main issues concurrently. Our proposed methods of combining multiple learned fraud detectors under a “cost model” are general and demonstrably useful; our empirical results demonstrate that we can significantly reduce loss due to fraud through distributed data mining of fraud models.

QUANTUM CRYPTOGRAPHIC KEY DISTRIBUTION PROTOCOLS

The application of the principles of quantum mechanics to cryptography has led to a respectable new dimension in confidential communication.

As a result of these developments, it is now possible to construct cryptographic communication systems which detect unauthorized eavesdropping should it occur, and which give a incontestable guarantee of no eavesdropping should it not occur.

Here several protocols for such communication systems are explored. We first examine quantum bit commitment protocols which are proven as not being unconditionally secure, then, we take a look at proposed protocols which are constructed to disprove the proofs claiming that unconditionally secure quantum bit commitment protocols are impossible.

Keywords: Quantum Cryptography, Key distribution, Protocol

SCHEMA CONVERSION FROM RELATION TO XML WITH SEMANTIC CONSTRAINTS

This paper studies the schema conversion from relational schemas to XML DTDs.

As functional dependencies play an important role in schema conversion process, the concept of functional dependency for XML DTDs is proposed to preserve the semantics implied by functional dependencies and keys of relational schemas.

A conversion method called NeT-FD (Nesting- Based Translation with Functional Dependencies) is proposed to convert relational schemas to XML DTDs in the presence of functional dependencies and keys.

The method presented here can preserve the semantics implied by functional dependencies and keys of relational schemas and can convert multiple tables to XML DTDs at the same time.