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20th International Colloquium, SIROCCO 2013
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Revised Selected Papers

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Preface

The 20th International Colloquium on Structural Information and Communication Complexity (SIROCCO 2013) took place in Ischia, Italy, for three days starting July 1, 2013.

SIROCCO is devoted to the study of communication and knowledge in distributed systems from both qualitative and quantitative viewpoints. Special emphasis is given to innovative approaches and fundamental understanding in addition to efforts to optimize current designs. The typical areas include distributed computing, communication networks, game theory, parallel computing, social networks, mobile computing (including autonomous robots), peer-to-peer systems, communication complexity, fault-tolerant graph theories, and randomized/ probabilistic issues in networks.

This year, 67 papers were submitted in response to the call for papers, and each paper was evaluated by at least three reviewers. The Program Committee selected 28 papers for presentation at the colloquium and publication in this volume after in-depth discussions. The SIROCCO Prize for Innovation in Distributed Computing was awarded this year to Andrzej Pelc from the University of Quebec for his contributions to the understanding of distributed computing. A laudatio summarizing his many and important innovative achievements appears in these proceedings.

We further congratulate the recipients of the 2013 SIROCCO Best Student Paper award. This year, two papers were selected to share the award. Specifically, the 2013 SIROCCO Best Student Paper Award was given to Lakshmi Anantharamu for her paper "Broadcasting in Ad Hoc Multiple Access Channels" (with Bogdan Chlebus) and Sebastian Kniesburges and Andreas Koutsopoulos for their paper "A Deterministic Worst-Case Message Complexity Optimal Solution for Resource Discovery" (with Christian Scheideler).

The collaboration of the Program Committee members and the external reviewers enabled completion of the process of reviewing the papers and discussing them in less than four weeks. We thank them all for their devoted service to the SIROCCO community. We thank the authors of all the submitted papers; without them we could not have prepared a program of such quality. We thank Gennaro Cordasco for his assistance as publicity chair, and Yang Chen for serving as the submission chair. We also thank the keynote and invited speakers Andrea Richa, Cyril Gavoille, and Fabian Kuhn. The preparation of this event was guided by the SIROCCO Steering Committee, headed by Shay Kutten.

We are indebted to Luisa Gargano and Ugo Vaccaro for their assistance with local arrangements during the colloqium. We gratefully acknowledge the financial support of the Dipartimento di Informatica from Università di Salerno.

July 2013

Thomas Moscibroda
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Laudatio

2013 SIROCCO Prize for Innovation in Distributed Computing awarded to Andrzej Pelc

David Peleg
on behalf of the award committee

It is a pleasure to award the 2013 SIROCCO prize for innovation in distributed computing to Andrzej Pelc. The award is given for his significant contribution to communication paradigms for information dissemination. Let us briefly review this as well as some other major contributions and achievements of Andrzej, with a focus on those related to his many SIROCCO papers. (Notably, Andrzej coauthored 13 SIROCCO papers during the past two decades).

Much of Andrzej's research concentrated on algorithmic aspects of distributed computation and communication networks. In particular, he has contributed extensively to the study of communication paradigms designed to disseminate information in communication networks, such as broadcasting (i.e., sending a message from one source to every node in the network), gossiping (i.e., broadcasting from every node in parallel), multicasting and related paradigms. His work focused on developing algorithmic techniques for performing these tasks efficiently, by complexity measures such as time and (number and size of) messages, in different network architectures and under different assumptions, and while attempting to ensure a variety of desirable properties, most notably fault-tolerance. In addition, he studied the effects of having only partial knowledge of the network topology on the performance of broadcast algorithms in message passing networks and more recently in radio networks of different types (such as arbitrary topology, geometric graphs or unit disk graphs). Moreover, he recently published an authoritative book on these topics. Related to this line of work are Andrzej's SIROCCO papers [1–3], for example.

Another central theme of Andrzej's research involved the question of overcoming communication failures. He addressed this question in many different settings and under different assumptions on the nature of possible failures, such as random (dependent or independent) failures in nodes, links or transmissions, benign or malicious (Byzantine) faults, and globally or locally bounded faults. His studies served to broaden our knowledge and systematically organize the arsenal of tools available to us in this area. Related to this line of work are Andrzejs SIROCCO papers [4–6].

Andrzej was involved in studying fault-resilience in other contexts as well. Let me mention one area related to fault-tolerance where he made significant contributions, namely, the problem of system-level fault diagnosis in multiprocessor systems. This problem concerns a process where processors in the system can test each other for failures. It is assumed that fault-free testers correctly

identify the fault status of tested processors, while faulty testers can give arbitrary test results. The goal is to develop algorithms for identifying correctly the status of all processors, assuming that the number of faults does not exceed a given upper bound. Andrzej's work explored static and adaptive solutions attempting to minimize the number of tests or the probability of error for various system topologies and under different failure models. Related to this line of work is Andrzej's SIROCCO paper [7].

Recently, Andrzej started studying algorithmic problems in systems of autonomous mobile agents or robots, which involve identical memoryless units residing in the nodes of a network or a terrain. Most notable is his work on the task of network exploration, which requires a mobile agent with small memory to explore an unknown network, i.e., traverse all its nodes and edges (possibly returning to the starting node), with no a priori knowledge of the network topology. The feasibility of this task, and the efficiency of exploration algorithms, depend on the model assumptions and on the class of allowed graph topologies. Andrzej studied this problem in different settings on trees and general graphs, paying attention mostly to the issues of memory requirements and resilience to failures. A second central problem studied extensively by Andrzej in this area is the rendezvous problem in networks, where two mobile agents, located in nodes of an unknown network, have to meet at some common location. Other problems he studied include the tasks of gathering the agents in one place and of searching for a "black hole" (namely, a destructive node) in the network. Related to this line of work are Andrzej's SIROCCO papers [8–11].

In summary, Andrzej's impressive technical achievements, his numerous influential contributions to efficient and failure-resistant algorithms in communication networks, and his leadership role in the research community in the field, make him a most highly deserving candidate for the prize.

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Meeting in Networks
(Abstract of Award Lecture)

Andrzej Pelc

Université du Québec en Outaouais
Canada

Abstract. Two or more mobile entities, called agents or robots, starting at distinct initial positions, have to meet. This task is known in the literature as rendezvous and has many applications, both in everyday life and in computer science. Among many alternative assumptions that have been used to study the rendezvous problem, two most significantly influence the methodology appropriate for its solution. The first of these assumptions concerns the environment in which the mobile entities navigate: it can be either a terrain in the plane, or a network modeled as an undirected graph. The second assumption concerns the way in which the entities move: it can be either deterministic or randomized. In this talk we survey recent results on deterministic rendezvous in networks.

Adversarial Models for Wireless Communication
(Abstract of Keynote Lecture)

Andrea Richa

Arizona State University, U.S.A.

Abstract. In this talk, we present some recent work on adversarial modeling of wireless communication. We use an adaptive adversary to model the hard to predict physical interference, as well as other disruption in communication caused by temporary obstacles, mobility, background noise, co-existing networks, jammers, etc.

In particular, we focus on adversarial models for jamming. We present simple, local-control medium access control (MAC) protocols for wireless networks that are provably robust against adaptive adversarial jamming. Our protocols are orthogonal to physical layer protocols that rely on a broad spectrum, and can be used in conjunction with those or in networks where a broad spectrum is not available (e.g., sensor networks). We present a summary of our work in this area, going from single-hop wireless networks to multihop wireless networks modeled under SINR (signal-to-noise ratio model), and from more standard adaptive adversarial models for the jammer(s) to a more realistic adversarial model where, in addition to knowing the protocol and its entire history, the jammer also has some knowledge about the action of the nodes at the current time step. Our protocols are energy efficient, and require only very limited amount of knowledge about the jammer and the network. We also present simulation results that further validate our theoretical bounds.

We also address other recent work by the theoretical community on applications of adversarial modeling in wireless computing that focus on different paradigms (e.g., broadcasting, etc.).

The work on adversarial modeling of wireless jamming is joint work with Christian Scheideler (U. of Paderborn, Germany), Stefan Schmid (TU Berlin Telekom Labs), Jin Zhang (Google), Adrian Ogierman (U. of Paderborn) and Baruch Awerbuch (John Hopkins University).

Labeling Schemes with Forbidden-Sets
(Abstract of Invited Talk)

Cyril Gavoille

Université of Bordeaux, France

Abstract. The goal of labeling schemes is to understand how much information must be attached to the nodes of a network (formalized as labels) to solve a graph problem assuming the answer can be determined solely on the basis of the labels of the nodes invoked in the query. In this talk, I give a short survey on an extension of labeling schemes that can answer graph problems where some of the nodes may be turn off (or forbidden).

Distributed Computation in Directed and Dynamic Networks
(Abstract of Invited Talk)

Fabian Kuhn University of Freiburg, Germany

Abstract. We consider simple distributed data aggregation and information dissemination problems such as computing the minimum or the sum of a bunch of values or broadcasting multiple messages to all nodes in a network. In standard, undirected networks, these tasks are well studied and can be solved by simple distributed algorithms in time proportional to the diameter of the network. In my talk, I will discuss the complexity of such fundamental problems in networks with unidirectional links and in networks with dynamic topology. We will see that in absence of stable, bidirectional links, also the most basic distributed computation and information dissemination tasks become challenging, leading to a number of fascinating new research questions.

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