

Great Discoveries and Improvements Invariably Involve the Cooperation of Many Minds

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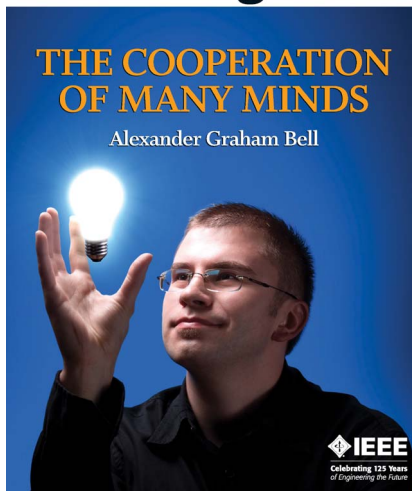
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It was Alexander Graham Bell who is credited with the saying: “Great discoveries and improvements invariably involve the cooperation of many minds.” It is fitting to consider these words of Bell as we approach the end of our celebration of the 125th Anniversary of the IEEE. (As many of you know, Bell was President of the AIEE in 1891.) As we look forward to what will be published in the PROCEEDINGS in 2010, we hope that you will consider these words. No individual can make progress and flourish in their professional engineering careers today without the assistance of those other minds who also strive for innovation and progress. What is even more extraordinary about Bell is that he reached success outside of his chosen field of being a very successful teacher of the deaf. It is truly an early example of the concept of cross-pollination of ideas that we steadfastly believe is one of the important missions of this JOURNAL. Progress made and new ideas conceived by specialists in one area should be easily and readily available to technologists who are seeking answers

January 2010 | Volume 98 | Number 1
Proceedings OF THE **IEEE**



in other areas of specialization. Truly, Alexander Graham Bell would be proud of what our editorial board, guest editors, and authors are striving to do each day through their service to this publication.

Let us now take a look at what we have planned for the upcoming year of 2010.

I. DIRECTIONS 2010

Where are we headed in the year ahead?

We are planning several areas of focus for 2010, including coverage of energy and the environment, advances in several areas of circuit technology, and a variety of additional topics. Let us take a closer look at each of these issues.

A. Focus on Energy and the Environment

The global energy structure is rapidly changing, and environmental issues are at the forefront of changes in this field. We will begin 2010 with three issues covering the changing energy picture and the importance of monitoring the Earth's environment.

We will begin with *Device and Circuit Technology for Ultralow Power (ULP)*. The global energy picture is forcing the electrical engineering community to look at energy usage efficiency in high-performance systems. However, doing so requires careful engineering to overcome a variety of limitations. This Special Issue will cover the work that is being done in ULP design and what is being done to

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mitigate the deleterious effects of subthreshold operation. This issue will highlight the new ideas being explored to drastically reduce the power required for a range of sensor, computing, and communications systems.

In another energy-related issue, we will cover *Networked Systems for Meeting the Energy and Environmental Future*. The world's energy outlook is in a period of rapid evolution both on and off the traditional energy grid structure. (And who has not heard the term "smart grid" in the media?) This Special Issue is motivated by huge changes taking place in the electric energy industry. These changes include the novel technologies that promise to transform the electric power grids into the first man-made cyberphysical systems with lots of distributed intelligence and communications and to support the sustainable electricity services of the future. This issue will cover fundamental challenges, including the state-of-the-art methodologies in related fundamental disciplines, including control, communications, sensing, network systems, and power systems engineering.

In addition, we will have an issue on *Satellite Remote Sensing Missions for Monitoring Water, Carbon, and Global Climate Change*. This Special Issue will provide a tutorial treatise on some of the new or recent satellite missions that are intended to monitor water, carbon, and global climate change. The papers will describe the purpose of the scientific mission; the technology of the measurements; the modeling of the physics; and the data, image, and signal processing. The new satellite missions will include missions from the United States, Europe, and Asia.

B. Focus on Circuit Technology and Sensor Networks

We will publish two issues on new developments in circuit technology and in sensor network applications. The first special issue will be titled *Nanoelectronics Research for Beyond CMOS Information Processing*. It is well known that the scaling of CMOS eventually will approach fundamental dimensional limits. Therefore, the International Technology Roadmap for Semiconductors, recognizing the potential value of alternative computational paradigms, is moving ahead to address this situation. This Special Issue will include a discussion of major international programs focused on this subject and a mapping of these programs against 13 research vectors to illustrate research topics of intense investigation. This issue will address the many challenges associated with developing a new paradigm technology for information processing. This includes an overview of the scaling and power-dissipation limits of all charge-based devices. Major topics related to nanoelectronics memory technologies and architectural approaches will also be treated.

Next, we will have a Special Issue on the subject of *Challenges and Opportunities in GaN and ZnO Devices*. At this time, GaN and ZnO are being feverishly explored for emitters, detectors, field-effect transistors, and sensors of various kinds. What makes these semiconductor types so

interesting is that several key areas of importance to the future of these devices are being studied and discussed. This Special Issue will provide an overview of many of the key issues in this field, including the current progress and challenges in these areas. It will also provide a mixture of theoretical information as well as application examples.

Next, we have a follow-up issue on *Sensor Network Applications*. Research in sensor networks has grown dramatically since our last issue on this subject published in 2003. What trends and perspectives do we see today that will perhaps shift in the next decade? This Special Issue provides an application focus on the current state-of-the-art in the field. This issue will show how applications are using sensor networking research, detail technologies for sensor networks that enable current and future applications, and be a retrospective on the past decade of sensor network research and, in particular, what has changed since our last Special Issue on this subject.

C. Internet Vision, Software Applications, and Swarming Robots

We will also publish an issue on the subject of *Internet Vision*, which is a new field at the intersection of the Internet and computer vision. Multimedia content on the Internet is ever increasing, whether on video and photosharing sites, on geomapping sites, or in the form of video ads or live video feeds of sporting events. For the field of computer vision (the automated analysis of images and video), the existence of the Internet has stimulated the development of a variety of new problems and applications. This huge growth in the volume of available image and video data is also stimulating rapid progress in classical computer vision and solving image problems. This Special Issue highlights a number of significant recent advances by top researchers.

Software is of growing importance in engineering, and we will take a look at recent advancements in a Special Issue on *Aerospace and Automotive Software*. In recent decades, software has enabled and defined the processes and products of the aerospace and automotive industries and of the associated transportation, defense, and space systems businesses. In these systems, the role of software has grown in at least three ways—1) augmenting existing hardware (mechanical and electronic) systems and 2) replacing or 3) redefining existing hardware systems, creating a new role that could not have been previously played by hardware alone. This Special Issue will describe the progress of the past decades and present an objective view of the future of aerospace and automotive software engineering, architecture, components, systems, and systems-of-systems.

The natural world will be the focus of a Special Issue entitled *Swarms: Biological Inspiration of Robotic Systems*. Biology has shown how simple decentralized behaviors in unidentified individuals (for example, insects and birds exhibiting swarming behaviors) can highlight a wide array

of seemingly intelligent group behaviors. Similarly, even though individual robots may not be sophisticated, if robots can communicate and cooperate with each other, it should be possible for networked robots to provide a range of intelligent behaviors that are beyond the scope of our current robot capabilities. In this Special Issue, we will cover topics ranging from artificial intelligence, control theory, robotics, systems engineering, and biology. We will cover applications of biologically inspired models of swarm behaviors to large networked groups of autonomous vehicles. The Special Issue will highlight organizational principles for groups in nature and help establish a framework and methodology for the analysis of swarming behavior.

D. Neural Engineering, RFID, and Sparse Representation

Three additional special issues will round out our publishing year. The first will cover *Advances in Neural Engineering*. Neural and cognitive engineering is a new discipline whose objective is to study the behavior dynamics and complexity of neural systems in nature. This issue will focus on the representation of sensory and motor information, the electrical stimulation of the neuromuscular system to the system levels to understand the underlying mechanisms, the development of novel electronic and photonic devices and techniques for experimental probing, neural simulation studies, the design and development of human-machine interface systems, and artificial vision sensors and neural prostheses to restore and enhance impaired sensory and motor systems and functions.

The next Special Issue will cover *RFID: A Unique Radio Innovation for the 21st Century*. The Special Issue will focus on the research and technical innovations in RFID hardware, middleware/software, applications, and systems. On the reader side, system on a chip is a new paradigm that is allowing smaller, more efficient, and faster readers. Mobile readers are being developed for newer applications such as healthcare and pharmaceuticals, where doctors can carry such readers on their belts. Research innovations in software-defined radios are also making their way into reader designs that allow for reading of multiple frequency/protocol/standard tags. Our goal is to cover all of the key innovations and new applications of this rapidly changing field.

A very important topic will be covered in our Special Issue on *Applications of Sparse Representation and Compressive Sensing*. In the past several years, there have been exciting breakthroughs in the study of sparse representation of high-dimensional signals. (That is, a signal is represented as a linear combination of relatively few base elements in an overcomplete dictionary.) Much of the excitement centers around the discovery that a sufficiently sparse linear representation can be correctly and efficiently computed by convex optimization or greedy algorithms. These new results and the general mathematical principles behind them are of great interest to communities far beyond signal processing. The theme of this Special Issue is to introduce to the entire electrical engineering community highlights of these new theoretical results, their likely future extensions, and their far-reaching impact on many engineering applications, including but no longer limited to signal processing.

II. A PEEK AHEAD AT 2011

We expect some additional exciting special issues to be published in 2011. Please refer to our Web page at <http://www.ieee.org/web/publications/procieee/spsch.html> for additional information.

During 2010, there will be an emphasis on invited papers for this journal. The ultimate goal is to publish a wide selection of informative tutorial and survey papers in issues of regular papers, which will provide insight into other technologies, both inside and outside of readers' specialties. Each regular paper will continue to be highlighted by an introductory prolog to provide added informational value to our readers.

Today, every engineer is under increasing competitive pressure to be informed about the major trends in technologies in order to flourish in their chosen profession. And we hope that you, as dedicated readers of this publication, will continue to rely on the PROCEEDINGS as one way to remain informed about better ways of doing in our complex and ever-changing world. As Bell said, it takes the cooperation of many minds.

We hope that our readers will enjoy what we have planned for next year, and we strongly encourage you to share your opinions by sending your feedback. By contributing to our "Your Comments" feature, your thoughts will become part of the unique legacy of the PROCEEDINGS. ■