Editorial

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> "The beginning of knowledge is the discovery of something we do not understand."
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> *Frank F. Herbert*

In the first editorial of the new "century" of the PROCEEDINGS OF THE IEEE, let us begin by reflecting upon the scope of our journal. The PROCEEDINGS was officially born in January 1913 as the PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS. Its roots can be traced back even earlier, to 1909, as the earliest contributions came from prior submissions made to the Wireless Institute. Over the years, the journal has had the opportunity to publish the works of many visionaries of the past century. The journal strives to offer reviews of broad significance and long-range interest in all areas of electrical, electronics, and computer engineering, as well as in computer science, and to continue to be a tutorial and technical information source with an emphasis on applications-driven technologies. We hope that you, our readers, find the content stimulating and applicable to your everyday work and your overall professional success.

The latest electrical engineering journal citation reports indicate that this journal is the second most highly cited journal (by impact factor) in its category. More notably, it is the top ranked journal by Article Influence Score and fares quite well even when compared using other metrics, such as Eigenfactor. Keeping in mind that metrics such as these cannot be individually considered as an indicator of the quality of a journal, we believe that in combination, they do provide an understanding of the value that our journal offers. As with the past years, this journal will continue to provide broad and in-depth coverage that informs specialists from different areas of activities that are synergistic with their own.
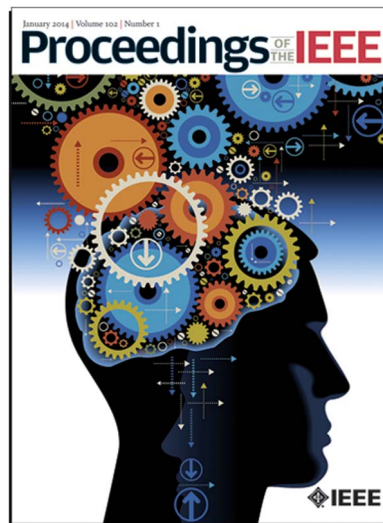
We hope that our journal also helps foster the increasing trend of interdisciplinary research with the cross-pollination of ideas. An increased collaboration between researchers, both around the globe and across disciplines, can lead to great advances. We believe that with our special issues and papers, our readers can stay informed about technologies outside their specialties and gain improved perspectives within their own.

To ensure that we are meeting the needs of our readers, we are eager to hear what you have to say. For this reason, we invite you to participate in our Reader Survey which will be conducted in the first two weeks of November. Your feedback is very important to us and we promise to share more information about the survey, and the resulting new initiatives, in an editorial next year.

I. UPCOMING SPECIAL ISSUES

Now let us take a closer look at what we have planned for Volume 102 in 2014.

Special Issue Contents: During 2014, we will be publishing a total of 12 issues that will cover a diverse range of important topics, from applications of augmented reality to the impact of social networks, and issues touching upon energy storage technology, the future of radio spectrum access, and many other interesting topics.

A. Applications of Augmented Reality Environments

Mobile augmented reality is a new approach to visualizing cyber information on top of physical imagery. In mobile augmented reality systems, a mobile device's camera, such as an iPhone or Android phone camera, is used to capture imagery, which is fused with virtual information, such as highlighted regions of the image, and displayed on the device's touchscreen. Users can see the virtual information directly rendered on top of the imagery captured by the camera.

Mobile augmented reality is showing significant promise to overcome cyber–physical visualization challenges in numerous domains, such as medicine, construction, advertising, manufacturing, and gaming. Despite the promise of mobile augmented reality and its early application to many domains, there are still significant research challenges related to sensor noise, indoor localization, social information sharing, information fusion, complex information visualization, and computational complexity. This special issue will explore both cutting-edge research applications of mobile augmented reality and advances in the underlying computer vision, indoor/outdoor localization, and human–computer interaction techniques that make it possible.

B. Future Radio Spectrum Access

Wireless systems have proven to be a major productivity tool for every sector of the economy, and an important contributor to economic growth in developing countries. Emerging applications, enabled by enhanced Internet connectivity and fueled by user demands and advanced technology, promise continuing productivity growth for society. However, these applications will also undoubtedly place greater demands on precious spectrum resources. This poses a considerable challenge for regulators who manage the spectrum. Regulators must try to anticipate these developments and designate appropriate spectrum allocations in ways that consider the needs and balances of all stakeholders, including public, commercial, scientific, and government interests. This task is complicated further because the impact of new applications in many regions of the spectrum may have unknown technical issues and uncertain economic impact. Fundamentally, the goal of flexible and efficient spectrum access is the maximization of utility across the dimensions of public access and safety, economic growth, scientific discovery, and national security. How will future wireless applications and services gain access to radio spectrum resources in a manner that allows for effective and equitable use by all? This question is explored in this special issue by focusing on the principal technical and technical–regulatory considerations in fostering improved efficiency of radio spectrum utilization. The issue summarizes where we are today and outlines the challenges and opportunities in moving toward a spectrum environment that can more efficiently accommodate the vast array of current and future wireless applications.

C. Cognitive Dynamic Systems

Cognition, inspired by the human brain, is not only a new interdisciplinary field, but above all, cognition is a new way of thinking about information processing as the basic for tackling engineering problems, old as well as new. A cognitive dynamic system (CDS) is a system that processes information over the course of time by performing the following functions: 1) *sense* the environment; 2) *learn* from the environment and adapt to its statistical variations;

and 3) build a *predictive model* of prescribed aspects of the environment and thereby develop *rules of behavior* for the execution of prescribed tasks, in the face of environmental uncertainties, *efficiently and reliably in a cost-effective manner*. From an engineering perspective, we already have well-developed applications of CDS, exemplified by cognitive radio, radar, control, auditory systems, and many more on the way such as cognitive cars and energy systems.

The papers in this special issue will focus on cognitive aspects of CDS, as well as, engineering applications. They will describe some important aspects of cognition and its relevance to engineering aspects wherever it is appropriate. The engineering-oriented papers on cognition will also emphasize how the use of cognition can make a difference to specific applications such as radio, radar, control, and self-organized memory.

D. Challenges and Opportunities for Nanoscale S&T in the Forensic Sciences

This special issue serves as an initial intellectual bridge by bringing together research from traditional nanoelectronics (and supporting nanotechnologies) and traditional forensic science. Forensic science research, which spans the major areas of legacy forensic sciences, forensics enabled intelligence, and forensic authentication of records & historical materials, will be included to define the state of the art in capabilities and to define new challenges for those working in nanoscale science and technology. Similarly, cutting-edge research from nanoelectronics that more naturally incorporates multidisciplinary contributions (e.g., nanoscience, nanomaterials, nanofabrication, nanoengineering, and nanomedicine) will be included to illustrate a host of potential innovative solutions to sensing and characterization that have direct relevance to forensic-type applications. Therefore, this special issue will illustrate both present challenges and future opportunities for nanoscale science and technology in the forensic sciences, and should serve as a venue of high interest to both communities.

E. Engineering Intelligent Electronic Systems Based on Computational Neuroscience

This special issue is quite timely as there has been tremendous progress recently in the field of computational neuroscience, specifically enabled by electrical, electronic, and computer engineers. Computational neuroscience is a broad interdisciplinary field, and its practitioners have diverse objectives, such as seeking understanding about the origins of mental disorders in neural circuit pathologies, designing biomedical interfaces between brains and computers, and proving mathematical theorems about neuronal information capacity. This special issue focuses on aspects that are most closely related to the objectives of engineers, namely the design of applications that either support computational neuroscience, or that partially emulate its findings. It reviews the research, development, and

commercialization efforts in aspects of computational neuroscience that demonstrate its rapidly growing intersection with electrical, electronic, and computer engineering, and the prospects for interaction in the near and long-term future.

F. The Impact of Changing Technology on Social Networks

For much of human history, social networks were small and geographically localized. Power and influence were concentrated in a small subset of the population. However, the rise of the World Wide Web—and the invention of powerful search technologies, social media, and novel file-sharing technologies—has led to an explosive growth in social network size and connectivity as well as the development of new kinds of reputation-based barter systems and underground economies. Standard geographic definitions of population now compete for causal relevance with definitions that group people together based on behavioral criteria. The rise of these technologies has made it possible for individuals to track events as they unfold in real time, to coordinate relatively rapidly over long distances and wide areas, and to access semiglobal and global information to make decisions. This means that individuals and subgroups without much power in the traditional sense can potentially serve as instruments of large-scale social change. The growth of social networks on digital media also means that it is possible to collect big, reliable data sets on human behavior, as human behavior on digital media leaves a data trail.

These technological changes, the new social structures they seem to be producing, and the data being generated permit empirical study of how macroscopic social properties arise from microscopic interactions among individuals. As progress is made on this front, large-scale intervention into human behavior and demographics will no longer be restricted to coarse manipulation of environmental variables. Precision interventions into microscopic social dynamics will become increasingly feasible. These interventions will allow the influence of individual decision making and might ultimately permit modulation of macroscopic properties of social systems.

Hence social media, search, and data extraction technologies are not only changing the structure and dynamics of social networks but are also potentially changing how controllable these changes are. The purpose of this special issue is to review what is currently known about how these technologies are changing social networks and what the consequences will be for human social dynamics. This special issue will bring together the computer scientists and engineers behind the technology, the mathematicians and economists working on mechanism design and game theory, and the behavioral and cognitive scientists who study strategic decision making, collective behavior, and social structure. It hopes to establish the foundations of a science of social engineering.

G. Advances in Stationary Electrical Energy Storage Systems

Electricity storage is a key enabler for large-scale deployment of renewable energy sources. Storage is increasingly becoming important to ensure the stability and reliability of the electric grid as transmission and distribution infrastructure expansion has not kept pace with the growth of renewables. While there are no quick solutions for transmission and distribution bottlenecks, significant deployment of energy storage can postpone or suspend the need for new infrastructure and better manage variability caused by renewables. In addition, rapid growth of distributed renewable generation enabled by lower cost solar and wind technologies is creating customer-side demand for storage, especially in the developing world. This special issue covers recent advances in energy storage systems with reviews of energy storage technologies, distributed energy storage systems, power electronics, and control systems for grid and off-grid storage, application of stationary energy storage systems in improving the stability and reliability of the electric grid, and demonstration and implementation of energy storage in the electric energy supply chain.

H. Trustworthy Hardware

The emergence of a globalized, horizontal semiconductor business model raises several concerns involving the security and trust of the information systems on which modern society is increasingly reliant for mission-critical functionality. These security and trust issues span a broad range, including threats related to the malicious insertion of trojan circuits designed (for example, to act as a silicon time bomb to disable a chip), to intellectual property (IP) and integrated circuit (IC) piracy, to untrusted third party IPs, to attacks designed to extract encryption keys and IP from an IC, and to malicious system disruption and diversion.

Hardware security and trustworthy hardware are on the brink of a revolution, and this special issue seeks to showcase the latest advances in state-of-the-art trustworthy hardware and identify the most promising research frontiers in IC and system security. The scope of this special issue spans all aspects of IC and system security, ranging from theoretical and conceptual foundations, synthesis, testing and verification, to modeling and optimization to case studies. The papers in the special issue will highlight the different perspectives of the hardware security and trust challenges and assurance approaches.

II. REGULAR PAPERS

During 2014, there will be a continued emphasis on invited papers for this journal. We have a diverse lineup of tutorial and survey papers, which will provide insight into a broad range of areas and applications. Each regular paper will continue to be highlighted by an introductory prolog to provide added informational value to our readers.

III. A PEAK AHEAD AT 2015

We will publish some more exciting issues in 2015. This will include an issue on energy harvesting and scavenging, which will focus on recent advances and reviews of numerous "renewable" transducer technologies, highlighting research challenges as well as emerging applications; another exciting issue on informatics for nanoscience will cover new approaches to computational and experimental materials science, specifically as related to nanosciences and nanotechnology.

IV. CONCLUSION

We trust that you will enjoy what we have planned for next year and we welcome your feedback. Today, every engineer is under increasing competitive pressure to be informed about major trends in other technologies in order to flourish in their chosen profession. The discovery of something we do not understand is indeed the first step to gaining knowledge about it. We hope that you, our dedicated readers, will continue to rely on our journal to discover this unknown, and thus find better ways of contributing to your profession in our complex and ever-changing world. ∎