

# Guest Editorial

## Special Section on the 2007 IEEE AUTOTESTCON

**I**N 2007, the IEEE AUTOTESTCON came to Baltimore, MD, to provide an open forum in the area of automated and computer-controlled test systems and software for leaders in design, development, procurement, applications, and operations to exchange information relative to their specific needs and disciplines. Our theme for the conference was “Transforming Maintenance: Closing the Loop Between ATE and Integrated Diagnostics.” In this Special Section, we highlight several of the key significant results that were presented at this conference by presenting nine papers, each of which highlights the theme of the conference and has been technically extended beyond the conference version. Thus, we are sharing new and updated results and advances in automatic testing. It is also exciting to note that these papers exhibit strong collaboration between academia and industry, thus leading to a strong balance between theory and practice in their contributions.

The nine papers in this Special Section have been organized into three general categories that have strong interest within the automatic testing community. We begin by discussing advances in test and diagnosis technology. The first paper, by *Kim et al.*, focuses on dynamic performance testing of high-speed analog-to-digital converters in RF systems. The focus of their work is on improving the verification test of these types of systems while simultaneously controlling the cost of the testing process. We follow this with a paper by *Abdelwahed et al.* that presents the results of applying timed failure propagation graphs (TFPG) as a method of fault diagnosis on aircraft systems. Their paper includes a case study of applying the TFPG approach to an aircraft fuel system. Finally, we include the paper by *Scott*, which focuses on condition monitoring of electromechanical systems. This paper discusses the use of finite-element analysis to support vibration and modal analysis of the components of these types of systems.

The second group of papers focuses on results in the emerging field of prognostics and health management (PHM). PHM extends the problems that are addressed by fault diagnosis and condition monitoring to attempt to predict future state and time to failure of systems. This group of papers starts with one by *Zhang et al.* that, similar to Prof. Scott’s, focuses on using vibration analysis in condition monitoring. This paper, however, applies a denoising process via blind deconvolution to vibration data from a helicopter gearbox to predict the progression of a crack on a plate in the gearbox. The paper by *Saha et al.* presents the application of Bayesian state estimation via relevance vector machines (RVMs) and particle filters to battery health prognostics. The authors show that when the RVM is combined with a Rao–Blackwellized particle filter,

the resulting estimates effectively balance bias and variance in predicting remaining useful life. This group of papers ends with one by *Baybutt et al.* on combining data-driven models, damage-accumulation models, and physics-of-failure models to detect incipient faults in digital electronic systems and to model fault-to-failure progression through the process of applying accelerated failure testing.

In recent years, the promise and the potential of “synthetic instruments” have generated excitement in the automatic testing community. The promise and the potential are that synthetic instrumentation can provide substantial cost reduction and improved flexibility in testing complex systems. Thus, the final group of papers focuses on recent work in the area of synthetic instrumentation for automatic test. The first paper in this group by *Hunter et al.* presents the results of developing a new wide-band digital down converter, which is proposed as a new digital signal processing front end of synthetic signal analyzers. The main result of their paper is in developing a simplified sample rate conversion algorithm, resulting in an over two orders-of-magnitude reduction in computational burden. The paper by *Lowdermilk and harris* then discusses a synthetic vector signal analyzer (VSA) and focuses on the development of an approach to extract time-dependent amplitude and phase information from the input time signal. They also describe the relationship between the synthetic VSA and a software-defined radio (SDR) by arguing that the synthetic instrument essentially becomes a smart SDR. We conclude this group and the Special Section with a paper by *Andersen et al.*, introducing an interesting application of synthetic instrumentation to improving the performance of legacy RF systems. Specifically, they develop an approach to synthesizing RF signals by focusing on intermediate frequency synthesis that is then up-converted to RF. This results in narrower bandwidth but provides a cleaner RF signal than traditional approaches based on in-phase/quadrature modulation.

The IEEE AUTOTESTCON has emerged as the preeminent conference on automatic test technology. The papers presented in this Special Section represent some of the best papers of the 2007 conference, and we hope you find them informative and valuable. I would like to thank the authors and all of the reviewers who devoted considerable time to provide valuable feedback, thus ensuring that the high-quality standards of the TRANSACTIONS are maintained. Special thanks go to Ms. Cam Ingelin and Prof. Reza Zoughi for their support.

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He started his career as a Research Computer Scientist with ARINC, where he attained the rank of Fellow. He was recently named The Right Now Technologies Distinguished Professor of computer science with Montana State University, Bozeman. He also holds an appointment as an Associate Research Professor of computer science with Johns Hopkins University. He has over 100 publications on artificial intelligence and diagnostics, including an authored book and an edited book. His research interests include algorithms for diagnostic and prognostic reasoning, machine learning and data mining in temporal systems, and reinforcement learning.

Dr. Sheppard currently serves as the Vice Chair of the IEEE Standards Coordinating Committee 20 (SCC20) on Test and Diagnosis for Electronic Systems, the Secretary and the Past Chair of the Diagnostic and Maintenance Control subcommittee of SCC20, and the Official Liaison of the Computer Society Standards Activities Board to SCC20. He was the Technical Program Chair for the 2007 IEEE AUTOTESTCON. He was the recipient of the 2007 IEEE AUTOTESTCON Frank McGinnis Professional Achievement Award.