Nonlinear signal processing methods continue to grow in popularity and use. This growth is due to one factor—performance. While it is true that linear methods continue to dominate in practice, nonlinear methods are making steady progress in moving from theoretical explorations to practical implementations. Clearly, the advances in computing performance have accelerated this progress by making nonlinear methods more practical. Additionally, nonlinear theory continues to grow and is yielding a firm foundation upon which nonlinear methods can be developed, optimized, and analyzed. Nonlinear methods are thus being applied to address many of the most interesting and challenging signal processing problems.

The evolution in nonlinear methods is also demonstrated by the growth of the IEEE-EURASIP Nonlinear Signal and Image Processing (NSIP) workshop. This biennial workshop was most recently held in the Inner Harbor of Baltimore, Maryland, USA, on June 3–6, 2001. The workshop attracted nearly 200 participants from around the globe and outstanding contributions from authors working on a wide array of topics. The workshop papers were exceptional in both breadth and depth.

To make the results of the NSIP workshop more widely available, the EURASIP JASP has dedicated two issues to the topic of Nonlinear Signal Processing. These issues feature expanded versions of NSIP papers. This first issue features 11 papers covering topics that include adaptive filters, communications, and biomedical applications and that build upon the theories of morphology, higher order statistics, and fuzzy relations. Although a full appreciation for the contributions in each paper can only be obtained through a careful reading of the article, a brief summary of the respective contributions is given next.

The first two papers consider nonlinear filtering theory. In the contribution by Tareq Y. Al-Naffouri and Ali H. Sayed, a unified approach to the mean-square analysis of adaptive filters with arbitrary error nonlinearities in their update equations is presented. The method, based on a fundamental energy conservation relation that holds for a large class of adaptive filters, offers new stability and convergence results in addition to the general advantages of a unified approach. The second paper considers the generalization of nonlinear filters through the use of fuzzy relations. In their contribution, Kenneth Barner, Yao Nie, and Wei An utilize fuzzy ordering and fuzzy order statistics to include information on sample spread in median, weighted median, and RCRS filters. The results show that the more general fuzzy ordering leads to improved performance in image noise smoothing applications.

The next two papers continue the theme of image processing. The first of these papers utilizes morphological methods to address image filtering and segmentation. By using morphological residues and the concept of granulometry,
The wide array of theories, methods, and problems addressed in these papers demonstrates the wide applicability of nonlinear methods. Next month in the second special issue on Nonlinear Signal Processing and Applications, an additional set of papers will further substantiate the depth and performance of nonlinear methods. We hope that you find these papers instructive and enjoy reading them as much as we have enjoyed putting the special issues together.

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**Editorial 191**

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