Preface

The study of this special issue was conceived by the Editor of ELEKTRIK, Kemal Leblebicioglu as early as September 2000 and is the product of more than 18 months of intensive collaborative labor. I got very excited when Prof. Leblebicioglu first proposed the idea. At that time, Dr. Akleman, Prof. Felsen and I had been working on a tutorial paper (which appears in February 2002 issue of the IEEE Antennas and Propagation Magazine) dedicated to James R. Wait (who died in October 1998), one of the early contributors to terrestrial wave propagation. It was really regrettable to do such dedications after one *fades away* and I was discussing this matter with my colleagues in the IEEE community trying to persuade them to do these kinds of recognition when the person *is still around*. I was also experiencing difficulty in the conceptualization of computational electromagnetics for the candidates of internet-oriented, computer-weaned young researchers. Some think that computers do everything and they usually neglect to look for the physical explanation behind the numbers. Others believe that computing numbers and drawing a graph from a simple equation with a computer is the substance of computational electromagnetics. Establishing an intelligent balance between these two extremes requires a new perspective in engineering education. Therefore, I accepted the proposal and decided to make both items a reality. This special issue is dedicated to Professor Leopold B. Felsen, for his 75^{th} birthday, for his pioneering work in, and outstanding contributions to the international electromagnetic community. Its focus is "Complex electromagnetic problems and numerical simulation approaches".

Professor Felsen was born in Munich, Germany, on May 7, 1924. He received the B.E.E., M.E.E, and D.E.E. degrees from the Polytechnic Institute of Brooklyn, Brooklyn, NY, in 1948, 1950, and 1952, respectively. He emigrated to the United States in 1939 and served in the U.S. Army from 1943 to 1946. After 1952 he remained with the Polytechnic (now Polytechnic University), gaining the position of University Professor in 1978. From 1974 to 1978 he was Dean of Engineering. In 1994 he resigned from the full-time Polytechnic faculty and was granted the status of University Professor Emeritus. He is now Professor of Aerospace and Mechanical Engineering and Professor of Electrical and Computer Engineering at Boston University, Boston, MA (part time).

He is the author or coauthor of over 300 papers and of several books, including the classic *Radiation and Scattering of Waves* (Piscataway, NJ: IEEE Press, 1994, reissue). He is an associate editor of several professional journals and an editor of the *Wave Phenomena Series* (New York: Springer-Verlag). His research interests encompass wave propagation and diffraction in complex environments and in various disciplines, high-frequency asymptotic and short-pulse techniques, and phase-space methods with an emphasis on wave-oriented data processing and imaging.

Professor Felsen is a member of Sigma Xi, a life fellow of the IEEE and a Fellow of the Optical Society of America and the Acoustical Society of America. He has held named Visiting Professorships and Fellowships at universities in the United States and abroad, including the Guggenheim in 1973 and the Humboldt Foundation Senior Scientist Award in 1981. In 1974 he was an IEEE/APS (Antennas and Propagation Society) Distinguished Lecturer.

He was awarded the Balthasar van der Pol Gold Medal from the International Union of Radio Science (URSI) in 1975, a honorary doctorate from the Technical University of Denmark in 1979, the IEEE Heinrich Hertz Gold Medal for 1991, the APS Distinguished Achievement Award for 1998, the IEEE Third Millenium Medal in 2000 (nomination by APS), three Distinguished Faculty Alumnus Awards from

Polytechnic University, and an IEEE Centennial Medal in 1984. Also, awards have been bestowed on several papers authored or coauthored by him. In 1977 he was elected to the National Academy of Engineering.

He has served on the APS Administrative Committee from 1963-1966, and as Vice Chairman and Chairman for both the United States (1966-1973) and the International (1978-1984) URSI Commission B.

It is interesting to note that we have had a three-generation collaboration with Prof. Felsen, initiated by Prof. Ercan Topuz (my Ph.D. advisor) in 1970s, continued by me in late 1980s and early 1990s, and finally by Dr. Akleman (my Ph.D. student) nowadays.

With this special issue, I aimed to (i) honor a well-known scientist who dedicates his life to science, (ii) bring international experts together in a Turkish journal, and (iii) emphasize the importance of physics-based electromagnetic numerical engineering approaches to new generations of computer-weaned academia and industry with internet access and globalized information. In this Special Issue of ELEKTRIK, I also endeavor to bring current status and future trends in computational electromagnetic engineering to the attention of ELEKTRIK readers. Electromagnetic waves play an increasingly important role in communication, remote sensing, multi-sensor integrated systems, identification and detection (signal processing), microwave hardware design, compatibility, bio-electromagnetics and many other applications in extremely complex natural and/or man-made environments. Although extremely valuable as reference and physical insights, analytical methods are mostly incapable of handling these challenging real-world problems. Luckily, most of these problems can be attacked by various numerical methods, which become extremely powerful with today's computer technology and intelligent parallel processing approaches. It should be noted that no single method, either analytic or numerical, is best suited for handling all possible cases; instead, a combination of methods is required to attain greatest flexibility and efficiency. Therefore, the trend is definitely toward "hybridization".

In their introductory paper "Electromagnetic Engineering in the 21^{st} Century: Challenges and Perspectives", L.B. Felsen and L. Sevgi present certain technological and educational challenges that confront wave-oriented electromagnetic engineering in the 21^{st} century in a complex computer and technology-driven world with rapidly shifting societal and technical priorities, and they give a kind of overview of simulation strategies for complex electromagnetic systems.

The first four papers thereafter are about development of existing numerical methods. P. Russer, in his paper "Network –Oriented Modeling of Radiating Electromagnetic Structures", discusses the application of network-oriented modeling for radiating electromagnetic structures. The paper entitled "Iterative Solution of Field Problems with a Varying Physical Parameter" by A.G. Tijhuis and M.C. van Beurden solves linear field problems with the conjugate-gradient FFT method and presents two simple examples. J. Paul, V. Podlozny, D.W.P. Thomas and C. Christopoulos present the design and implementation of digital filters for the time-domain simulation of electromagnetic wave interaction with thin material boundaries and thin panels – using the Transmission-Line Modelling (TLM) method – in their paper entitled "Time-Domain Simulation of Thin Material Boundaries and Thin Panels Using Digital Filters in TLM". Finally, the paper entitled "Novel Time Domain Radiowave Propagators For Wireless Communication Systems" by F. Akleman, M. O. Özyalçın and L. Sevgi is about novel time domain wave propagators which are used in path loss calculations for macro and micro cell coverage planning in wireless communication systems. Their recently introduced novel time domain propagators are based on the Transmission Line Matrix (TLM) and the Finite-Difference Time-Domain (FDTD) techniques.

The next three papers are essentially tutorials in their respective subject areas. The paper entitled

"Aspects of Radar Polarimetry" by E. Luneburg gives a tutorial introduction to the phenomenological theory of radar polarimetry for the coherent scatter case, emphasizing monostatic backscattering and forward scattering (transmission). Y. Naka and H. Ikuno, in their paper "Two-dimensional photonic crystal L-shaped bend waveguide and its application to wavelength multi/demultiplexer", propose a new type of two-dimensional photonic crystal L-shaped bend waveguide and simulate their characteristics via the FD TD method. In the last paper entitled "Discrete Array Representation of a Continuous Space-Time Source Distributions", A. Shlivinski and E.Heyman consider the realization of continuous space-time source distributions using a sparse non-uniform point-source array, and they apply the scheme to the realization of collimated short-pulse beam fields.

Physics-based approximations are taken into account in the next four papers. First, the paper entitled "Floquet Wave Diffraction Theory for Tapered Planar Strip Array Green's Function" by F. Capolino , F. Mariottini, S. Maci and L. B. Felsen discusses the derivation and physical interpretation of a uniform high frequency representation of the Green's function for a planar phased array of dipoles, where the authors use an asymptotic representation based on Floquet wave edge diffraction theory and extend it to accommodate slowly varying tapered amplitude illumination with possible inclusion of dipole amplitudes that tend to zero at the edge. This geometry permits study of diffraction phenomena occurring at the tapered edge of a rectangular array when the observation point is far from its vertexes. Then, M. Albani and S. Maci, in their paper entitled "An Exact Line Integral Representation of the PO Radiation Integral for Flat Perfectly Conducting Surfaces Illuminated by Elementary Electric or Magnetic Dipoles", consider the illumination from an arbitrarily oriented elementary electric or magnetic dipole, which accelerates the numerical PO integration for electrically large surfaces. The paper entitled "Development of a Cylindrical Waveguide Antenna Array with a High Isolation Between Receive - Transmit Sub arrays: Theory and Experiment" by V.I. Okhmatovsky, K.S. Nikita, S. Koulouridis and N.K. Uzunoglu presents the operation of two peripheral open waveguide arrays placed on a cylindrical surface, being isolated with a radial line operating as a space filter with comparisons of theoretical and experimental results. Last in this portion is the two-part paper entitled "2D Complex Point Source Radiation Problem: I. Complex distances and Complex Angles, II. Complex Beams" by E.G. Ribas and M.J. G. Morales, which discusses a kind of new methodology based on the complex space analysis, and allows a generalization of the study of electromagnetic radiation and scattering problems. They take a 2D radiation problem due to a complex point source in Part I and present its analysis in Part II.

The last five papers are application oriented. V.V.S. Prakash and R. Mittra, in their paper "An Efficient Preconditioner For Iterative Solvers" introduce an application of Multi-Frontal Preconditioners (MFPs) for the Krylov projection methods for efficient solution of the dense system of linear equations. The paper entitled "A Note on the Poisson Summation Formula and its Application to Electromagnetic Problems Involving Cylindrical Coordinates" by A.H. Panaretos, H.T. Anastassiu and D.I. Kaklamani deals with a modified version of the Poisson Summation Formula that can be applied to problems in cylindrical coordinates P. H. Pathak and P. R. Rousseau present a paper entitled "A TD-UTD for Slope Diffraction by a Perfectly Conducting Curved Wedge", where the time domain UTD technique is applied to an interesting canonical diffraction problem. N. Yener and E. Topuz introduce an accurate and efficient full-wave method for optical rib waveguides in their paper entitled "A Novel Method for Obtaining Benchmark Solutions for the Modest of Optical Rib Waveguides". Their method is based on MoM and aims to compute modal fields in integrated optical waveguides to serve as benchmark solutions. Finally, the paper "SAR Simulations in Wireless Communication and Safety Discussions in the Society" by M. O. Özyalçın, F. Akleman and

L. Sevgi discusses numerical simulation studies of cellular phone - human tissue interaction with powerful time domain techniques: the transmission line matrix (TLM) and the finite-difference time-domain (FDTD) methods. The paper also brings the effectiveness of the SAR parameter in determination of the exposure limits for human health and environmental pollution into consideration.

It is my hope that the papers in this special issue illustrate current complex electromagnetic problems and numerical simulation approaches, including future trends in electromagnetic engineering from both technological and educational aspects. I strongly believe that these kinds of efforts and special issues will bring ELEKTRIK to the broader attention of the international technical community. I express my deep gratitude to Prof. Leopold B. Felsen for being honorary guest editor. I would also like to thank Dr. Funda Akleman (my editorial assistant), all contributing authors, the reviewers, and especially Prof. Kemal Leblebicioglu, editor-in-chief who extended his kind invitation. Last, but by no means least, I express my appreciation to Mr. Mustafa Ertan Atakan and Mr. Abdullah Can, from the Department of Scientific Journals of TUBITAK, for their efforts during the preparation of the Issue for publication.

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Doğuş University, Feb. 2002