Cambridge University Press
978-1-107-12248-2 - Soft Computing in Electromagnetics: Methods and Applications
Balamati Choudhury and Rakesh Mohan Jha
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Soft Computing in Electromagnetics

Better communication systems demand high performance electromagnetic structures along with accurate, reliable and fast techniques to solve electromagnetic (EM) problems. A novel computing technique, called soft computing, is gaining popularity in a multitude of EM applications in order to tackle computationally intensive problems. It differs from conventional computing techniques by not relying on strict mathematical formulations. Soft computing techniques often seek to emulate biological systems like neural networks, swarm behaviour, etc. Fast-converging algorithms that mimic animal and human behaviour are currently emerging as the choice for replacing computationally intensive, time consuming, three-dimensional EM simulations; this development has simplified the process of EM design immensely.

Characterized by their ability to provide quick, robust and economically viable solutions despite imprecision, uncertainties and approximations in the formulation, soft computing methods such as genetic algorithm (GA), artificial neural network (ANN) and fuzzy logic have been widely used for microwave design. Similarly, they also play an important role in design and optimization applications in electromagnetics, such as EM design and performance enhancement of antennas, frequency selective surfaces (FSS), radar absorbing material (RAM) and metamaterials. This book emphasizes the suitability of soft computing techniques such as particle swarm optimization (PSO), bacterial foraging optimization (BFO) along with GA and ANN, for various EM design and optimization applications.

The application of soft computing concepts in the field of metamaterial antennas, radar absorbers, transmission line characterization and optimized radar absorbing material (RAM) is discussed in detail along with their usage for optimizing fault detection, EM propagation and path loss prediction. This book also introduces systematic implementation of soft computing tools in a relatively new area of metamaterials. Soft computing is presented here as an effective tool to minimize computations in a CAD package for quick and accurate solutions. The development of two such CAD packages for design of metamaterial split ring resonators (SRR) and path-loss prediction is presented. Numerical examples and MATLAB codes are provided to facilitate understanding of the principles of soft computing techniques by a wider readership.

Balamati Choudhury works as a Scientist at the Centre for Electromagnetics, CSIR-National Aerospace Laboratories, Bangalore. Her areas of interest include soft computing techniques, computational electromagnetics, and novel applications of metamaterials. She was recipient of the CSIR-NAL Young Scientist Award for the year 2013–2014 for her contribution in the area of Computational Electromagnetics for Aerospace Applications.

Rakesh Mohan Jha heads the Centre for Electromagnetics, CSIR-National Aerospace Laboratories, Bangalore. He worked as an SERC (UK) Post-Doctoral Research Fellow at Dept. of Engg. Sci., University of Oxford, England (in 1991–1992), and as Alexander von Humboldt Fellow at the Institute for High Frequency Techniques and Electronics of the University of Karlsruhe, Germany (in 1992–1993 and 2007). He was a warded Sir C.V. Raman Award for Aerospace Engineering for the Year 1999. Dr Jha was elected Fellow of INAE (FNAE) in 2010, for his contributions to the EM Applications to Aerospace Engineering.

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CAMBRIDGE
UNIVERSITY PRESS

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4843/24, 2nd Floor, Ansari Road, Daryaganj, Delhi - 110002, India

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It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9781107122482

First published 2015

Printed in India

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing-in-Publication data

Choudhury, Balamati.
Soft computing in electromagnetics: methods and applications / Balamati Choudhury, Rakesh Mohan Jha.
pages cm
Includes index.
Summary: "Discusses application of soft computing concepts in the field of metamaterial antennas, radar absorbers, transmission line characterization and optimised radar absorbing material (RAM)"-- Provided by publisher.
ISBN 978-1-107-12248-2 (hardback)
1. Electromagnetic waves--Data processing. 2. Antenna radiation patterns--Data processing. 3. Radar--Data processing. 4. Electromagnetic devices--Materials--Data processing. 5. Absorption spectra--Data processing. 6. Soft computing. I. Jha, R. M. (Rakesh Mohan), 1959- II. Title.
TK7864.C44 2015
006.3--dc23
2015016642

ISBN 978-1-107-12248-2 Hardback

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To

Professor Satya N. Atluri