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Harish Sharma
Mukesh Kumar Gupta
G. S. Tomar
Wang Lipo *Editors*

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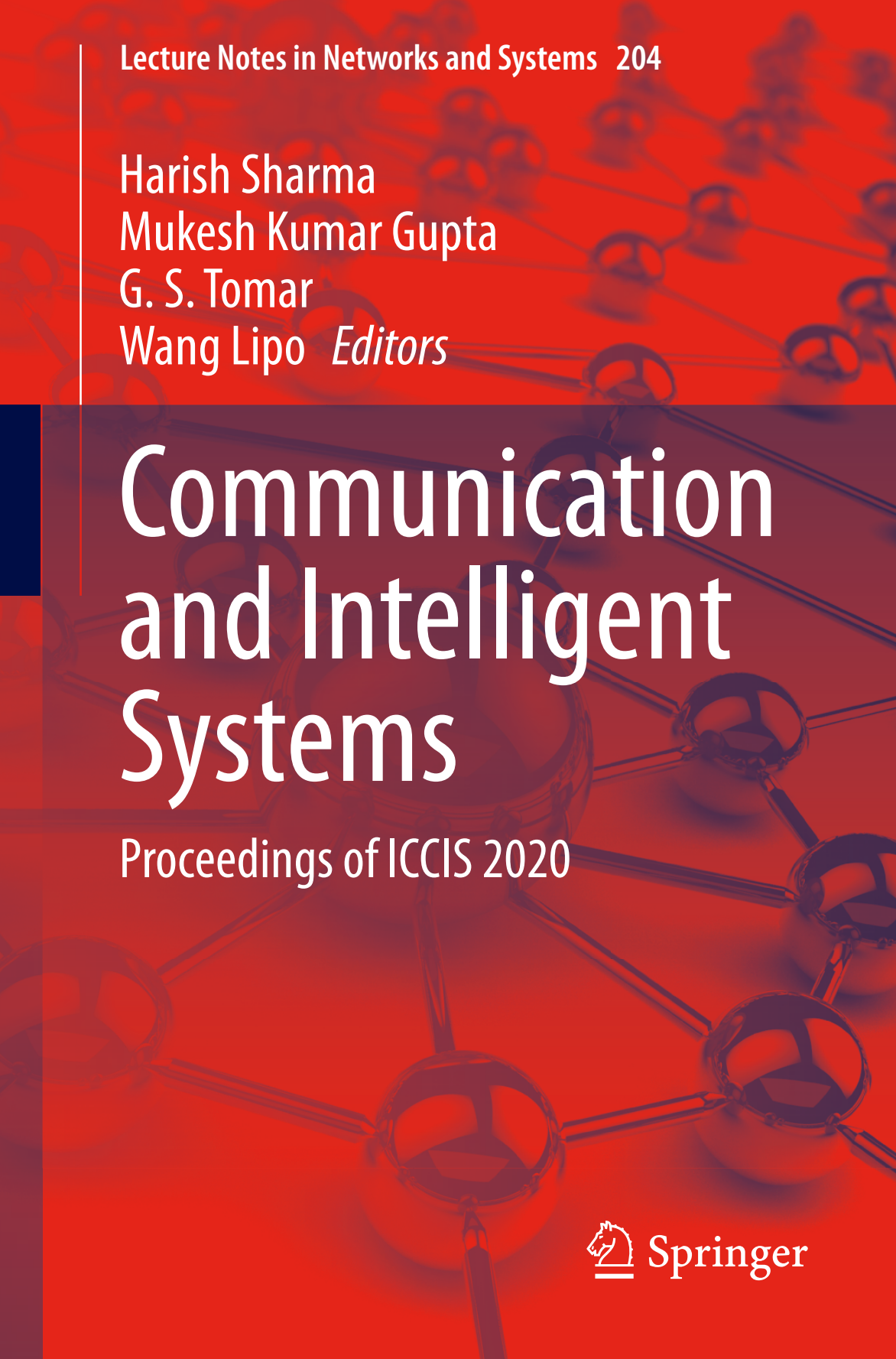

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Contents

Thermal Modeling of the GaN HEMT Device Using Decision Tree Machine Learning Technique

Niketa Sharma, Yogendra Gupta, Ashish Sharma, and Harish Sharma

Abstract In this paper, we have proposed electrothermal modeling of GaN-based HEMT devices. A data-driven approach has been implemented for a temperature range varying from 300 to 600 K, based on one of the core methods of machine learning techniques based on decision tree (DT). The performance of the proposed models was validated through the simulated test examples. The attained outcomes depicted that the developed models predict the HEMT device characteristics accurately depending on the determined mean-squared error (MSE) between the actual and anticipated characteristics. The paper also indicates that the decision tree technique could be specifically beneficial when data are nonlinear and multidimensional, with the different process parameters exhibited profoundly complex interactions.

Keywords AlGaN/GaN HEMT · Decision tree · Device modeling · Machine learning

1 Introduction

The gallium nitride-based HEMTs are considered as one of the most promising devices to realize the "high-power," "high-frequency," and "high-temperature" applications due to their inherent material properties such as wide band gap, high saturation velocity, and high thermal stability [1–4]. Technology enhancement in material science and devices in the last decade has led to the advancement in the performance of GaN-based HEMTs. Larger breakdown, electric field, and good thermal conductivity make it an interesting device for the high-temperature applications [5]. In comparison with other III–V semiconductor materials, GaN material devices can

N. Sharma (✉) · Y. Gupta
Swami Keshvanand Institute of Technology Management & Gramothan, Jaipur 302021, India
e-mail: drniketa@skit.ac.in

A. Sharma
Indian Institute of Information Technology, Kota 302021, India

H. Sharma
Rajasthan Technical University, Kota 324010, India

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