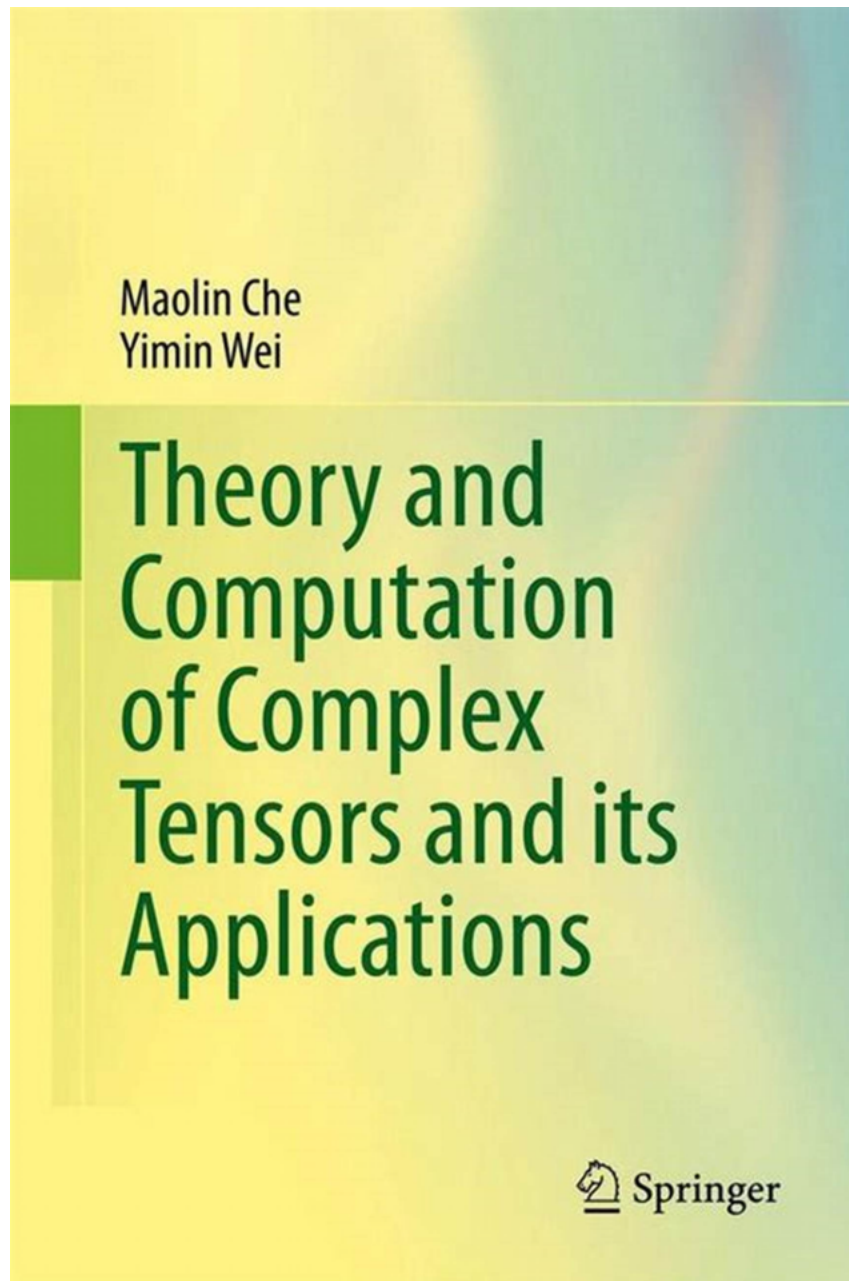# "Unveiling the Mind-boggling World of Complex Tensors: Theory, Computation, and Surprising Applications"

Making Sense of the Mysteries of Complex Tensors: A Deep Dive into Theory and Computation

Maolin Che
Yimin Wei

Theory and Computation of Complex Tensors and its Applications

Have you ever heard of complex tensors? They may sound like an abstract concept you'd expect in a science fiction movie, but believe it or not, complex tensors are real! In this article, we will explore the theory and computation behind these mind-boggling structures, as well as some surprising applications that go far beyond the realm of our imagination.

What Are Complex Tensors?

Let's start with the basics. In mathematics, tensors are mathematical objects that generalize vectors and matrices to higher dimensions. They can be thought of as multidimensional arrays with a set of transformation rules that define their behavior under coordinate transformations. While tensors can be defined over any mathematical field, in this article, we will focus on complex tensors, which have complex-valued elements.
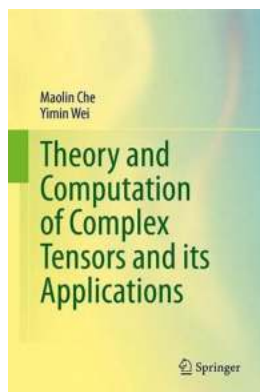
Theory and Computation of Complex Tensors and its Applications

by Nicola Bellini (1st ed. 2020 Edition, Kindle Edition)

★★★★☆ 4.9 out of 5

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Screen Reader	: Supported
Print length	: 262 pages
Paperback	: 48 pages
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Theory of Complex Tensors

The theory behind complex tensors is a fascinating field in its own right. It combines concepts from linear algebra, multilinear algebra, and complex analysis to study the properties and behavior of these intricate mathematical objects. One of the key aspects of complex tensors is their rank, which determines their complexity and the number of indices required to describe them.

Computation of Complex Tensors

Now that we understand the theory, let's dive into the computation of complex tensors. As you can imagine, working with high-dimensional arrays is no easy

task. However, thanks to advancements in computer science and numerical algorithms, we now have powerful tools and techniques to handle complex tensor operations efficiently.

One such technique is the Tucker decomposition, which allows us to approximate a high-dimensional tensor by a much smaller tensor of lower rank. This reduction in complexity enables us to perform various computations on complex tensors more efficiently. Additionally, tensor networks, such as the matrix product state (MPS) and the tensor train (TT) representation, have proven to be valuable tools for computations involving complex tensors.

Applications of Complex Tensors

Complex tensors find applications in a wide range of fields, from physics to computer science and beyond. Let's explore some captivating applications that highlight the power and versatility of complex tensor formalism.

Quantum Mechanics

In quantum mechanics, complex tensors play a crucial role in representing entangled states of multiple particles. They help describe the behavior of quantum systems and enable the computation of observable quantities, such as energy levels and transition probabilities.

Image Processing and Computer Vision

Complex tensors have found applications in image processing and computer vision tasks, such as image denoising, segmentation, and object recognition. By leveraging the rich multidimensional information captured by complex tensors, these algorithms can achieve impressive results in analyzing and interpreting visual data.

Machine Learning and Data Analysis

Complex tensors offer exciting possibilities in machine learning and data analysis. They can be used to model and analyze complex relationships in high-dimensional data, leading to improved predictions and insights in fields such as recommender systems, natural language processing, and bioinformatics.

Network Analysis

Complex tensors provide a powerful framework for analyzing complex networks, such as social networks or neural networks. By representing network structures as tensors, we can study network properties, identify key nodes, and analyze network dynamics more effectively.

Signal Processing

In signal processing, complex tensors enable the analysis and synthesis of multi-dimensional signals, such as audio or seismic data. By leveraging the unique properties of complex tensors, signal processing algorithms can extract valuable information and reveal hidden patterns in the data.

Complex tensors bring a new level of mathematical sophistication to the world of multidimensional data. Through a blend of theory and computation, we can unlock their potential and harness them for a range of practical applications. This article has only scratched the surface of this captivating field. So, are you ready to embark on a journey into the fascinating realm of complex tensors?

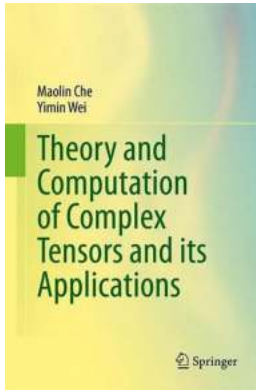### Theory and Computation of Complex Tensors and its Applications

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The book provides an of very recent results about the tensors and mainly focuses on the authors' work and perspective. A systematic description about how to extend the numerical linear algebra to the numerical multi-linear algebra is also delivered in this book. The authors design the neural network model for the computation of the rank-one approximation of real tensors, a normalization algorithm to convert some nonnegative tensors to plane stochastic tensors and a probabilistic algorithm for locating a positive diagonal in a nonnegative tensors, adaptive randomized algorithms for computing the approximate tensor decompositions, and the QR type method for computing U-eigenpairs of complex tensors.

This book could be used for the Graduate course, such as to Tensor. Researchers may also find it helpful as a reference in tensor research.
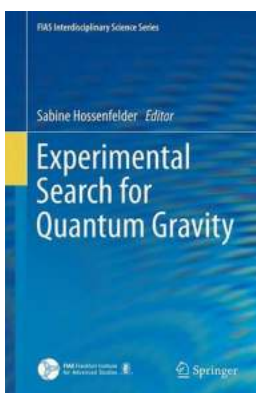
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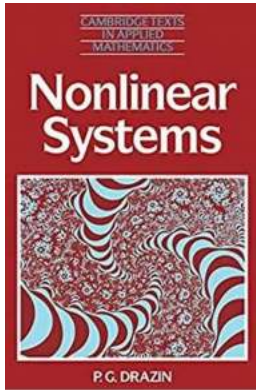
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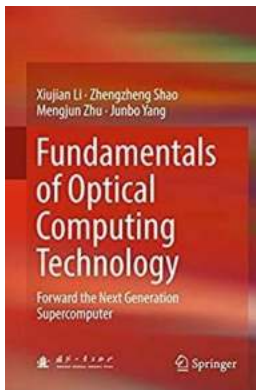
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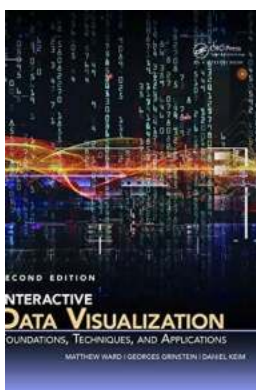
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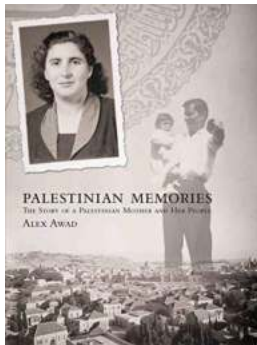
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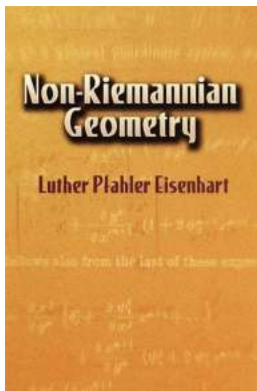
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