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Optical Color Computing: Fuzzy Logic and Digital Calculations

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This River Publishers Rapid monograph explores recent advances in intelligent technologies and optical computing methods for real-time decision-making systems handling large arrays of fuzzy input data. Developed through long-term collaboration between scientists in Ukraine and the United States—including teams from the University of Texas at El Paso, Admiral Makarov National University of Shipbuilding, Petro Mohyla Black Sea National University, and the Institute of Artificial Intelligence Problems—this work is presented in two focused chapters: Fundamentals of Optical Computing and Optical Color Computing Architecture in Digital Support Systems.

The book examines the principles of optical computing, fuzzy data processing, and logical operations based on color representation as an information set. It introduces an innovative approach that uses light radiation of specific colors as fuzzy variables—enhancing the efficiency and speed of logical systems through optical parallelism.

Practical implementation of this architecture is demonstrated through a decision support model for managing intensive sea and air traffic, illustrating how real-time multifactorial fuzzy color databases can improve operational decision-making. Performance evaluations show that optical computation delivers higher processing speed due to fewer required operations and parallel data structures.

These results have broad applications for higher education, large enterprises, and infrastructure facilities—such as airports, seaports, and oil and gas terminals—where artificial intelligence systems support automated control and decision-making.

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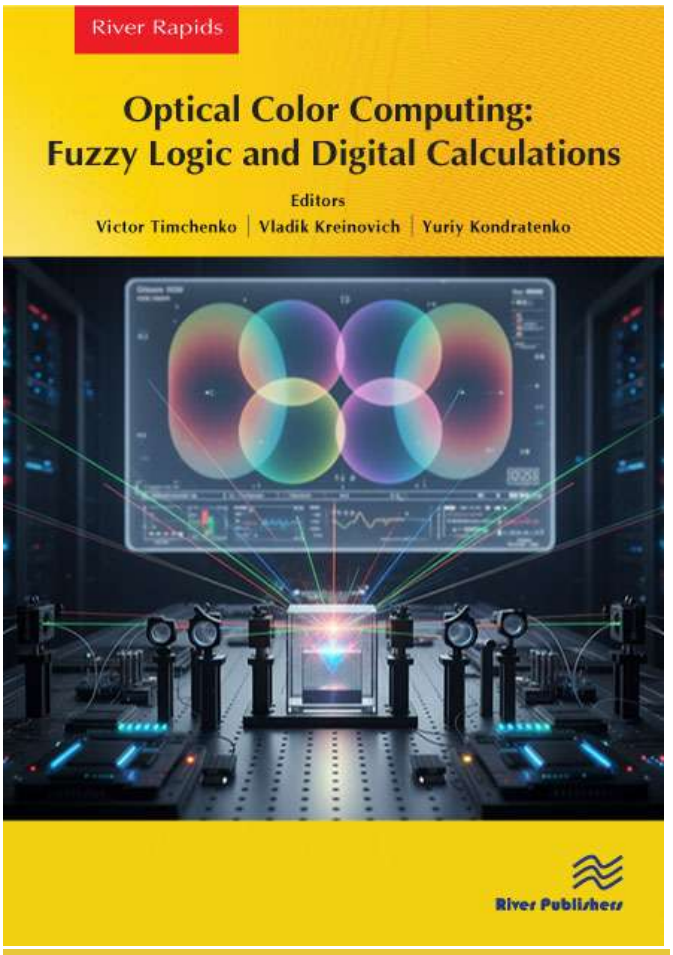

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