بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

OPTIMIZED RECEIVER STRUCTURE FOR POINT TO POINT FREE SPACE OPTICAL COMMUNICATION OVER ORBITAL ANGULAR MOMENTUM

By

Alaa El-Din ElHilaly Mohamed Ahmed Eid

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
Electronics and Communications Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Optimized Receiver Structure for Point to Point Free Space Optical Communication over Orbital Angular Momentum

Key Words:
Orbital Angular Momentum; Aggregate capacity; Free Space Optical Communication;

Summary:

This study focuses on some practical aspects that enable the free space optical communication system over orbital angular momentum modes, specifically the receiver structure and modes selection. Three contributions are introduced. The first one is the space filtering approach where the partial-pattern receiver for transmitted orbital angular momentum (OAM) multi-modes is explored. The modes are included in the Laguerre-Gaussian beam propagating under non-Kolmogorov weak-to-moderate turbulence. The partial pattern effect is studied on the achievable capacity and the error rates. Controlled parameters are derived as well. The second one is a simple iterative algorithm to determine the optimum (in terms of the system capacity) set of multiple orbital angular momentum (OAM) modes. The modes are propagating over Free space optical (FSO) communication beam for a given receiver radius. The algorithm is derived using generalized channel efficiency matrix. The new algorithm has complexity reduction in the order of $\left(2^{\breve{N}}\right)/\breve{N}^{2}$ where $\breve{N}$ is the number of available modes. Based on the above, a third contribution includes a deep learning detection mechanism for Multiple-Input-Single-Output (MISO) application is proposed and proved superior performance.

Disclaimer

I hereby declare that this thesis is my own original work and no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all resources and have cited them in the reference section.

Name: Alaa El-Din ELHilaly Mohamed Ahmed Eid Date:

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Dedication

To the soul of my father Prof. El-Hilaly Mohamed Ahmed Eid.

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