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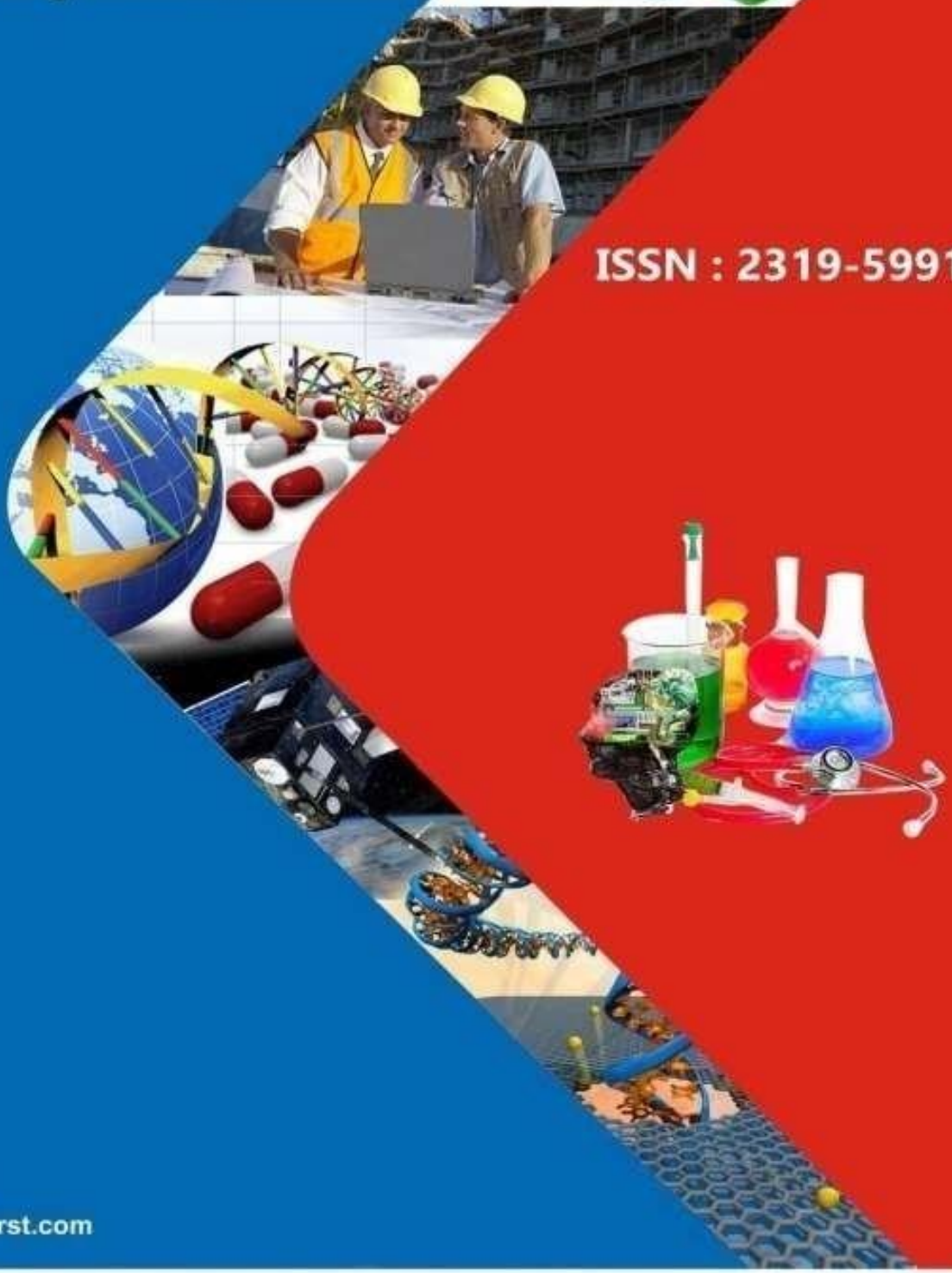

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AUTOMATIC DETECTION OF RETINOPATHY

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ABSTRACT

This study takes into account the issue of estimating multi-pitch and direction-of-arrival (DOA) simultaneously for multichannel harmonic sinusoidal signals. The ESPRIT approach, which estimates the multi-pitch frequencies of multiple harmonic signals, is based on subspace methods that leverage the invariance feature in the time domain. It is initially applied to a spatio-temporal matrix signal model for a uniform linear array. We then provide the estimated pitch frequencies and, utilising the shift invariance structure in the spatial domain, the DOA estimates based on the ESPRIT approach. A computationally more efficient technique based on ESPRIT without 2-D searching is suggested, which performs comparable to the current state-of-the-art methods. On top of that, the suggested method's DOA and pitch estimate asymptotic performance analysis is given. Lastly, both synthetic and real-life recorded data are used to demonstrate the efficacy of the suggested strategy.

I.INTRODUCTION

Retinopathy, a common complication of various systemic diseases such as diabetes, hypertension, and cardiovascular disorders, poses a significant threat to vision health worldwide. Early detection and timely intervention are crucial for preventing irreversible vision loss and preserving visual function in affected individuals. Traditional methods of retinopathy screening often involve manual assessment by ophthalmologists, which can be time-consuming, costly, and prone to human error. In recent years, advancements in medical imaging technology and artificial intelligence (AI) have paved the way for automated retinopathy detection systems, offering the potential for efficient, accurate, and accessible screening solutions.

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Vol. 17, Issue 3, 2021

The project "Automatic Detection of Retinopathy" aims to develop a robust and reliable AI-based system for the automated detection and classification of retinopathy from retinal images. By leveraging deep learning algorithms and image processing techniques, the system seeks to analyze retinal images and identify characteristic features associated with various stages of retinopathy, including microaneurysms, hemorrhages, exudates, and neovascularization. Through the integration of cutting-edge technology and medical expertise, the project aims to provide a scalable and cost-effective solution for retinopathy screening, enabling early detection and intervention to prevent vision loss and improve patient outcomes.

II. EXISTING SYSTEM

THE problem of estimating the pitch of a periodic signal is a fundamental problem that has received considerable attention for many years due to its wide application in areas such as audio and speech coding, compression, enhancement and classification of music, and speech analysis [1]–[5]. Many methods for parameter estimation in both single-pitch and multi-pitch scenarios have been reported (see [6]–[8] for an overview of existing pitch estimation methods). Direction-of-arrival (DOA) estimation with an array of spatially separated sensors is another key research topic in the field signal processing [10], [11], which has been widely studied in the past decades. Its application areas include radar [12], sonar [13], radio astronomy [14], geophysics [15], and speech processing with a microphone array [16]. In recent years, the problem of joint estimation of pitch and DOA of audio and speech signals received by multiple sensors has been extensively discussed for both single-pitch and multi-pitch scenarios in the literature [17]–[36]. Some of the key examples of applications that could benefit from this includes teleconferencing, surveillance applications, hands-free communication, and hearing aids, and so on.

III. PROPOSED SYSTEM

The rest of the paper is organized as follows. The problem formulation is firstly described in Section II. In Section III, the spatio-temporal data model for the single-pitch case is defined and the single-pitch and DOA estimation method based on the ESPRIT technique is given. Then, the generalization of the proposed method to the case of joint

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Vol. 17, Issue 3, 2021

multi-pitch and DOA estimation is presented. This is followed by the development of a joint pitch and DOA estimation algorithm in the presence of multi-path propagation. Section IV summarizes the proposed methods, and the asymptotic performance analysis follows in the subsequent section. Finally, simulation results and real-world signal data tests are discussed to illustrate the effectiveness of the proposed method.

IV. LITERATURE SURVEY

1. Automatic Detection of Genetic Diseases in Pediatric Age Using Pupillometry

Ernesto Iadanza; Francesco Goretti; Michele Sorelli; Paolo Melillo; Leandro Pecchia; Francesca Simonelli; Inherited retinal diseases cause severe visual deficits in children. They are classified in outer and inner retina diseases, and often cause blindness in childhood. The diagnosis for this type of illness is challenging, given the wide range of clinical and genetic causes (with over 200 causative genes). It is routinely based on a complex pattern of clinical tests, including invasive ones, not always appropriate for infants or young children. A different approach is thus needed, that exploits Chromatic Pupillometry, a technique increasingly used to assess outer and inner retina functions. This paper presents a novel Clinical Decision Support System (CDSS), based on Machine Learning using Chromatic Pupillometry in order to support diagnosis of Inherited retinal diseases in pediatric subjects. An approach that combines hardware and software is proposed: a dedicated medical equipment (pupillometer) is used with a purposely designed custom machine learning decision support system. Two distinct Support Vector Machines (SVMs), one for each eye, classify the features extracted from the pupillometric data. The designed CDSS has been used for diagnosis of Retinitis Pigmentosa in pediatric subjects. The results, obtained by combining the two SVMs in an ensemble model, show satisfactory performance of the system, that achieved 0.846 accuracy, 0.937 sensitivity and 0.786 specificity. This is the first study that applies machine learning to pupillometric data in order to diagnose a genetic disease in pediatric age.

2.A study of the state of the art was developed at the beginning of the

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Vol. 17, Issue 3, 2021

activity. The search for previous articles in the literature was done on Scopus, IEEE Xplore and PubMED, using the following keywords: “clinical decision support system”, “eye diseases”, “rare eye diseases”, “CDSS”, “DSS”, “pupillometry”, “retinitis pigmentosa” and “machine learning”. No articles including all the above keywords were found. None of the found articles use both pupillometry and ML techniques. Most of the found articles refer to “clinical decision support system”, “machine learning” and “eye diseases”. The number of studies decreases when it deals with systems for “rare diseases”, “retinitis pigmentosa” and “pupillometry”. Among all the found articles, the seven resumed below were chosen based on regency and variety, so as to have different views of general approaches when ML interfaces with eye diseases. Brancati et al. [22] apply ML supervised techniques for detecting pigment signs on fundus images acquired with a digital retinal camera to study patients affected by RP. Gao et al. [23] apply the ML random forest algorithm on optical coherence tomography (OCT) images to support the diagnosis of choroideremia by detecting intact choriocapillaris. Four more articles apply similar supervised ML algorithms to common eye diseases such as age-related macular degenerations [24], [25] diabetic retinopathy [26] and glaucoma [27]. Gargeya et al. [28] bring a different approach to support the diagnosis of diabetic retinopathy using deep learning. The results from the studies just cited are summarized

V. CONCLUSION

Finally, ophthalmology and healthcare technology have made great strides forward with the creation of an automated retinopathy screening system. By combining deep learning algorithms with image processing methods, this approach might completely transform retinopathy screening by offering solutions that are efficient, accurate, and easily accessible. Improved patient outcomes and less strain on healthcare resources may be achieved by the system's automated identification and categorisation of retinopathy using retinal pictures. This will allow for early diagnosis and prompt intervention. In order to guarantee the effectiveness and dependability of automated retinopathy detection systems in clinical practice, it is crucial to conduct ongoing research and development.

VI. FUTURE SCOPE

International Journal of Engineering Research and Science & Technology

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Vol. 17, Issue 3, 2021

Multiple potential future directions for advancement are included in the "Automatic Detection of Retinopathy" project's future scope. First, automated retinopathy detection systems may be made more accurate and efficient by improving and refining deep learning algorithms and image processing approaches. Another way to get a better picture of retinopathy is to combine several types of imaging, including optical coherence tomography (OCT) with fundus autofluorescence (FAF). To validate these systems' clinical usability and efficacy, it is essential to deploy them in real-world clinical settings and compare their performance to gold standard diagnostic procedures.

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Vol. 17, Issue 3, 2021

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