PSO-Optimized CoVID-19 MLP-NARX Mortality Prediction Model

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2021 IEEE Industrial Electronics and Applications Conference (IEACon) | 978-1-7281-9253-6/21/$31.00 ©2021 IEEE | DOI: 10.1109/IEACON51066.2021.9654684

***Abstract*— Mortality prediction models localized for Malaysia is limited, warranting a research gap to study further. A predictive model for CoVID-19 mortality prediction is presented in this paper. The model utilized the MLP-NARX structure. Parameters for the model were optimized using PSO. Prediction results yielded average MSE value of $8.1141\times10x^{-7}$ with acceptable validation results.**

Keywords—Nonlinear Auto-Regressive with Exogeneous Inputs (NARX), Particle Swarm Optimization (PSO), Multi-Layer Perceptron (MLP), CoVID-19

I. Introduction

The 2019 novel coronavirus (CoVID-19) belongs to a large family of coronaviruses that is transmissible and infect animals or humans. It causes mild to severe respiratory infections [1], sometimes resulting in death.

The pandemic beginnings were traced to Wuhan, China in December 2019. The coronavirus rapidly spreads through respiratory droplets. The rapid spread CoVID-19 is caused by ease of transmission, mutations into new variations, and relatively benign symptoms infections quickly spread to global proportions, and in February 2020, the World Health Organization (WHO) officially named the virus CoVID-19 [1].

The effects of CoVID-19 has strained public healthcare globally [2]. This has led government around the world to impose closing of public places, travel restrictions, limitation of public gatherings, and emergency allocations to public healthcare [2]. Despite these measures, the economic, human cost, and death toll continues to increase [2]–[4].

The first reported CoVID-19 infection in Malaysia was reported on 25th January 2020 were from three Chinese nationals entering Malaysia from Singapore. February 14th saw 22 confirmed cases, and the number of cases has exacerbated due to a combination of mass public gatherings and poorly-regulated cross-district / cross-state travels especially during public holidays. However, the government has improved preventive measures by imposing stricter regulations through a series of Movement Control Orders (MCO).

The death rate of CoVID-19 varies according to several factors – namely age, gender and pre-existing medical conditions [1], [5]. Mortality is difficult to predict and is subject to investigation in this paper.

Prediction models assist decision makers to formulate evidence-based policies to decrease mortality and evaluate the efficacy of their healthcare policies [6]. Research is currently limited to a few countries [6], [7].

Attempting to address this issue from a localized perspective, this paper presents an MLP-NARX model for CoVID-19 mortality prediction in Malaysia. The model predicts the mortality based on the number of historical positive CoVID-19 cases. The Particle Swarm Optimization (PSO) algorithm was used to optimize four MLP-NARX parameters to construct the optimal model.

The rest of this paper is organized as follows: a review of recent literature is presented in Section II, followed by research methodology (Section III). Results and discussions are presented in Section IV. Finally, concluding remarks are presented in Section V.

II. Literature Review

This section presents several recent research related to CoVID-19 predictions.

In [6], Multi-Gene Genetic Programming, a Genetic Algorithm-based method to autonomously search and define programs prediction models, was used to create prediction models based on CoVID-19 historical cases in Italy, Singapore, USA, Iran, Korea, and China with good accuracy.

A data-driven regression model to predict the end of CoVID-19 in many countries was presented in [8]. Prediction utilized regression models based on characteristics of life cycle of other previous pandemics.

In [7], Artificial Neural Network was used to predict CoVID-19 cases using a curve-fitting based method. The model was used to forecast infections in USA, UK, France and India until May 2020. The model anticipates that the pandemic will continue for two to 10 months.

Another Artificial Intelligence (AI)-based method (using Deep Learning was presented in [5] to predict CoVID-19 confirmation, recoveries and deaths in Australia and Jordan. Three types of algorithms were tested, namely Prophet Algorithm (PA), Auto-Regressive Integrated Moving Average (ARIMA) and Long Short-Term Memory (LSTM).