Design a Robust Sliding Mode Controller Based on the State and Parameter Estimation for the Nonlinear Epidemiological Model of Covid-19

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Abstract

In this research, the vital problem of Covid-19 mitigation is looked at from an engineering point of view. At first, the behavior of coronavirus in society is expressed by a set of ordinary differential equations. In the proposed model, the control input signals are vaccination, social distance, and medical treatment. The unknown parameters of the system are estimated by Long Short-Term Memory (LSTM) algorithm. In the LSTM algorithm, the problem of long-term dependency is prevented. The uncertainty and measurement noise is an inherent characteristic of the epidemiological models. For this reason, an extended Kalman filter (EKF) is developed to estimate the state variables of the proposed model. In the rest of paper, a robust sliding mode controller is designed to control the spread of coronavirus under vaccination, social distance, and medical treatment. The stability of the closed-loop system is guaranteed by the Lyapunov theorem. The official confirmed data provided by the Iranian ministry of health authorities are employed to simulate the proposed algorithms. It is understood from simulation results that global vaccination has the potential to produce herd immunity in long-term. Under the proposed controller, daily Covid-19 infections and deaths become less than 500 and 10 people, respectively.

Full Text

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