Abstract

In the present study, we formulated an epidemic prediction model to imprint the spread of an infectious disease (COVID-19). To understand the transmission dynamics and to control the spread of disease, the basic $SEIR$ model is extended to include hospitalization, diagnosed and quarantine compartments. To make model more realistic, we also subdivide the infected compartment into asymptomatic infected and symptomatic infected compartments. We not only compute the reproduction number $\mathcal{R}_0$ but also analyze the local as well as the global stability at disease free equilibrium and endemic equilibrium points. We also study the effect of parameters on $\mathcal{R}_0$ by performing sensitivity analysis. To restrict the spread of the disease, we formulate two optimal control problem with two different control strategies. As a first strategy, we adjust a quarantine compartment in the proposed model and study the importance of this addition by performing an optimal control analysis. For second strategy, three parameters representing the non-pharmaceutical measures (educating people to take precautionary measures, providing intensive medical care with medication, utilization of resources by government) are added in the model and study their contribution in restricting the spread of disease optimally. Pontryagin's maximum principle is applied to set up optimality conditions for optimal solutions of the two control problem. At the end, graphical solutions are presented and discussed.