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A New Study on Mathematical Modelling of COVID-19 with Caputo Fractional Derivative

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Abstract : The new coronavirus disease or COVID-19 still poses an alarming situation around the world. Modeling based on the derivative of fractional order is relatively important to capture real-world problems and to analyze the realistic situation of the proposed model. Weproposed a mathematical model for the investigation of COVID-19 dynamics in a generalized fractional framework. The new model is formulated in the Caputo sense and employs a nonlinear time-varying transmission rate. The existence and uniqueness solutions of the fractional order derivative have been studied using the fixed-point theory. The associated dynamical behaviors are discussed in terms of equilibrium, stability, and basic reproduction number. For the purpose of numerical implementation, an effcient approximation scheme is also employed to solve the fractional COVID-19 model. Numerical simulations are reported for various fractional orders, and simulation results are compared with a real case of COVID-19 pandemic. According to the comparative results with real data, we find the best value of fractional orderand justify the use of the fractional concept in the mathematical modelling, for the new fractional modelsimulates the reality more accurately than the other classical frameworks.

Keywords : fractional calculus, modeling, stability, numerical solution
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