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FRACTIONAL-ORDER MATHEMATICAL MODELING OF THE INTERACTION BETWEEN TUMOR GROWTH AND THE IMMUNE SYSTEM

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Abstract. In this paper, we propose a fractional-order mathematical model to describe the complex interaction between tumor cells and the immune system. The model is formulated using Caputo fractional derivatives to capture the memory and hereditary characteristics that naturally arise in biological phenomena. We first establish the existence and uniqueness of the solution of the system as well as the local stability of its

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equilibrium points. Furthermore, the effects of both the fractional order and system parameters on tumor-immune dynamics are analyzed in detail. Numerical simulations are performed via an Adams-Bashforth-Moulton (ABM) predictor-corrector approach to validate the analytical findings. The obtained results demonstrate that fractional derivatives provide a more realistic and flexible framework for modeling tumor-immune interactions, which emphasizes the significant role of immune response and fractional order in controlling tumor progression.