Neural network controller vs pulse control to achieve complete eradication of cancer cells in a mathematical model

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Abstract. In this work, we explore two strategies for the application of adoptive cellular immunotherapy to control the cancer cells population described by a mathematical model of three first-order ordinary differential equations formulated by de Pillis *et al*. These strategies are applied by means of a pulse train and a neural network controller. Through the Localization of Compact Invariant Sets and Lyapunov's Direct Method, we establish sufficient conditions on the immunotherapy treatment to ensure the elimination of cancer cells, then with *in silico* experimentation we derive a protocol for the treatment application by pulses that successfully eradicate the tumor. The neural controller proposed is a one-layer functional-link neural net designed by applying the universal function approximation property of neural networks, this controller estimates an immunotherapy dose capable of eliminating the tumor cells population without a previous training. Our results are illustrated by *in silico* experimentation allowing us to compare the performance of both strategies.

Keywords. Cancer, Global Stability, Immunotherapy, *In silico*, Neural network, ODEs.