A feedback model for leukemia including cell competition and the action of the immune system

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A mathematical model coupling the dynamics of short-term stem-like cells and mature leukocytes in leukemia with that of the immune system is investigated. The model is described by a system of nine delay differential equations with nine delays. Three equilibrium points $E_0 E_1 E_2$ are highlighted. The stability and the existence of the Hopf bifurcation for the equilibrium points are investigated. In the analysis of the model the rate of asymmetric division and the rate of symmetric division are very important.