Baker, C. T. H.; **Bocharov, G. A.**; **Paul, C. A. H.**

Mathematical modelling of the interleukin-2 T-cell system: A comparative study of approaches based on ordinary and delay differential equations. (English) Zbl 0904.92022

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Summary: Cell proliferation and differentiation phenomena are key issues in immunology, tumour growth and cell biology. We study the kinetics of cell growth in the immune system using mathematical models formulated in terms of ordinary and delay differential equations. We study how the suitability of the mathematical models depends on the nature of the cell growth data and the types of differential equations by minimizing an objective function to give a best-fit parameterized solution. We show that mathematical models that incorporate a time-lag in the cell division phase are more consistent with certain reported data. They also allow various cell proliferation characteristics to be estimated directly, such as the average cell-doubling time and the rate of commitment of cells to cell division.

Specifically, we study the interleukin-2-dependent cell division of phytohemagglutinin stimulated T-cells – the model of which can be considered to be a general model of cell growth. We also review the numerical techniques available for solving delay differential equations and calculating the least-squares best-fit parameterized solution.

MSC:

92C30 Physiology (general)
92C50 Medical applications (general)
34K99 Functional-differential equations (including equations with delayed, advanced or state-dependent argument)

Keywords:

interleukin-2; immunology; tumour growth; cell biology; delay differential equations; time-lag; cell proliferation; least-squares

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