Semigroups of operators in cell cycle models

Ryszard Rudnicki[1]

Modeling of cell cycle is one of the fundamental subject of mathematical biology because it could help to solve such problems as synchronization of cell division in cancer therapy and allows to understand dynamics of growth of cellular populations (e.g. tissues). There are many different models of cell cycles – some of them are based on application of semigroups of operators. In this talk I am going to give some introduction to this subject, in particular, I will briefly discuss the models that I have studied: a model given by partial differential equations of the first order with time delay and space variable retardation [1], a model of maturity structured population [2], and two-phase models of the cell cycle [3]. The main subject of my talk will be a new age-size structured model based on the cell cycle length [4]. The model is described by a first order partial differential equation with initial-boundary conditions, which leads to a positive semigroup on some L^1 space. We establish new criteria for an asynchronous exponential growth of solutions to such equations. The discussion on model generalizations will be a good excuse to present some new challenges in the study of asymptotic behaviour of semigroups of operators.

References

[1] M.C. Mackey, R.R., Global stability in a delayed partial differential equation describing cellular replication, J. Math. Biol. 1994.

[2] J. Banasiak, K. Pichór, R. R., Asynchronous exponential growth of a general structured population model, Acta Appl Math. 2012.

[3] K. Pichór, R.R., Applications of stochastic semigroups to cell cycle models, Discrete Contin. Dyn. Syst. B 2019.

[4] K. Pichór, R.R., Cell cycle length and long-time behaviour of an age-size model, accepted in Math. Methods Appl. Sci.

[1]Institute of Mathematics, Polish Academy of Sciences, Katowice, Poland. Email: rudnicki@us.edu.pl