Prevention of drug resistance as a therapeutic goal in cancer treatment

Piotr Bajger[1], Mariusz Bodzioch[2], Urszula Foryś[3]
[1] Inter-Faculty Individual Doctoral Studies in Natural Sciences and Mathematics, University of Warsaw, Banacha 2c, 02-097 Warsaw, Poland
p.bajger@uw.edu.pl
[2] Faculty of Mathematics and Computer Science, University of Warmia and Mazury in Olsztyn, Sloneczna 54, 10-710 Olsztyn, Poland
mariusz.bodzioch@matman.uwm.edu.pl
[3] Institute of Applied Mathematics and Mechanics, Faculty of Mathematics, Informatics and Mechanics, University of Warsaw, Banacha 2, 02-097 Warsaw, Poland
urszula@mimuw.edu.pl

Keywords: optimal control, cancer chemotherapy

One of the most important and fundamental questions in cancer treatment is the question of drug dosing. It often happens in clinical scenarios that the chemotherapy resistant cell population grows as the treatment progresses, which results in a reduced effectiveness of the therapy. This process is a result of a strong selective force imposed by the chemotherapeutic agent and is often of disastrous consequences to the patient. From a point of view of optimal chemotherapy planning, the following question may be therefore posed: is it possible to design a chemotherapy schedule which would delay (or prevent) the onset of drug resistance?

Given the quantitative nature of the above question, it seems natural that medical doctors and experimentalists could benefit from feedback generated by mathematical models of tumor growth. Chemotherapeutic agent dosage may be thought of as a control, which allows us to apply the optimal control framework to the problem of finding the best therapeutic schedule.

The mathematical model considered in this study is intentionally chosen to be as simple as possible. This oversimplification is due to the fact that this study, rather than focusing on the details of the underlying dynamics, aims to investigate how the structure of optimal control is affected by a modification of the objective functional.