Methods of Optimal Control Applied to Mathematical Methods for Combination Therapy

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Tumor anti-angiogenesis is an indirect cancer treatment approach that targets the vasculature of the tumor, but by itself does not kill the cancer cells. It therefore needs to be combined with other mechanisms, such as chemotherapy or radiotherapy, in order to simultaneously attack both the tumor cells and the vasculature that supports it.

In this talk, we shall show how methods of optimal control can be used to analyze mathematical models for combination treatments of anti-angiogenic and chemotherapy. Mathematically these generally become challenging multi-input optimal control problems. But in this case the optimal solution for the anti-angiogenic monotherapy problem allows to build on this previous solution and in fact it becomes fundamental for the structure of the optimal solutions for the combination therapy problems as well. Both analytical and numerical results will be presented that show that the administration of a vessel disrupting anti-angiogenic agent follows the same pattern as in the monotherapy problem (i.e., after a full dose initial segment, anti-angiogenic agents are administered following a time-varying scheme of partial doses, the optimal singular control, until they run out) and the chemotherapeutic agent is administered at a specific optimal time in a single full dose session towards the end of treatment.

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