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# APPLICATION OF ADJOINT SENSITIVITY ANALYSIS TO OPTIMIZATION OF THE RADIOTHERAPY TREATMENT PLAN

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## ABSTRACT

Modern techniques of radiotherapy like the Intensity Modulated Radiation Therapy (IMRT) can precise deliver the radiation dose to a tumor while minimizing the dose to a surrounding healthy tissue. The IMRT method is a special type of conformal radiation therapy in wherein the shapes of radiation beams are closely approximated to the shape of the tumor. Practically it means to deliver different radiation doses to different points of the patient body. In most cases the plan of IMRT used to treat tumor for particular patient is constructed upon the current state of the tumor. There are only very few studies which try to use mathematical model of the tumor to construct a plan for the IMRT. For example, in work [1] authors used a spatial mathematical model of tumor growth to predict the response to a dose of different shape. With this information they optimized the treatment plans for different patients by using evolutionary algorithm.

In this work we present a novel approach to IMRT treatment planning by using a mathematical model of the tumor and a concept of the adjoint sensitivity analysis. With this method of sensitivity analysis we can efficiently calculate the spatiotemporal gradient of the predefined scalar objective function (characterizing the model's solution) with respect to the spatiotemporal radiation dose distribution. This gradient can be used to optimize the IMRT plans for particular patients.

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## REFERENCES

[1] D Corwin, C Holdsworth, RC Rockne, AD Trister, MM Mrugala, JK Rockhill, RD Stewart, M Phillips, and KR Swanson: *Toward Patient-Specific, Biologically Optimized Radiation Therapy Plans for the Treatment of Glioblastoma*, PLoS ONE **8(11)** (2013), e79115.