Quick Method of Creation of 3D Treatment Volume Margin.

Zuzanna Krawczyk, Jacek Starzyński
Warsaw University of Technology
zuzanna.krawczyk@ee.pw.edu.pl, jstar@ee.pw.edu.pl

Ondřej Semmler, Petr Voleš
UJP Praha, a.s
osemmler@ujp.cz , osemmler@ujp.cz

Abstract

Accurate delineation of target volumes is crucial for proper radiotherapy planning that ensures delivery of the radiation dose to the entire tumor while protecting critical tissue structures (Organs at Risk – ORs). Safety margins are added to different target volumes for a number of reasons [1], for instance, in order to protect ORs or to take into consideration motion of the organs. Manual creation of a 3D margin is very time consuming. A few automated approaches to the task, applicable in some special cases, have been discussed in the literature. The method of margin creation presented in [2] is applicable only to the margins that are symmetrical with respect to the directions of the margin growth and methods in [2,3] are suitable for margin expansion only. We propose a method which allows to quickly create a 3D margin on the basis of six preset distances (provided by a program operator) in the positive and negative directions of the Cartesian coordinate system axes. In the first step, a surface mesh is created out of volume delineation and a normal vector is associated with each point of the mesh. Next, each point of the mesh is moved along its normal for a distance being a linear combination of the preset distances. In some instances, after the mesh transformation, the faces of the mesh intersect each other (this situation may happen in case of concave shapes or those with holes inside) causing the corruption of the margin volume. For this reason, in further steps of the procedure the number of intersections between each point of the mesh and the mesh triangles is computed and on the basis of this information it is decided whether the whole triangle is located inside the volume and should be removed or it belongs to the surface and it should be preserved. In case of triangles which are intersecting with each other, the intersection line is calculated and the corrected polygon is added to the mesh.

References

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