Approach to simulate tumour displacements in lungs with mass spring system.

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1 Abstract

Our team gathers medical, physical and computer science researchers to develop a personalised simulation of lungs in order to predict tumour displacements and deformations during cancer treatment with ionising.

In this context, a mass spring system model, which is monitored by breathed volume is presented.

The shape of the simulated lungs is based on segmented computer tomography (CT) scans performed while the patient's respiration is blocked by an active breath control (ABC) system [2]. After data acquisition and segmentation, the volume is meshed with tetrahedrons. The elasticity is obtained from a global measurment of the lung resistivity to volume expansion, the compliance [1]. A realistic behaviour should be expected adding constraints defined by *a priori knowledges* on the lung environment.

The simulation consists in applying forces due to the organ activity or interaction with its environment and then to solve the dynamic equations on each node of the mesh. The forces can be calculated from the compliance and the volume variation of the organ. As a control parameter, the volume variation monitor the model. In parallel, studies are proceeded by medecines to prove that volume is a parameter for geometry reproductibility.

Our results show a meshed lung inflated and deflated according to a sinusoidal breathed volume. The lung volume well follows the imposed volume variation. The displacements from the rest position, for each node of the mesh are obtained. As no environmental constraints were applied, this displacements do not have any meaning. However, this illustrates how one can estimate every displacement in the lung and in tumours in the future.

A medical protocol is already defined to provide us with data of three different volumes of the lungs in order to verify our model. In parallel, to verify accuracy, a complementary model based on continuous mechanics is developped. The future work will be to incorporate environmental structures, heterogeneity and anisotropy and to compare our results with data obtained from our partners.

2 Aknowledgement

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References

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