Section: **Segmentierung, Registrierung**

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Abstract-Title:
SPATIO-TEMPORAL MOTION ANALYSIS OF LUNG TUMORS IN 4D CT IMAGE SEQUENCES WITH HIGH TEMPORAL RESOLUTION

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Abstract-Text:
Purpose
Respiratory lung tumor motion is a significant source of error in radiotherapy treatment planning. With an artefact-reducing reconstruction method developed at our department high resolution (3D+t) CT images are generated in improved quality showing the respiratory changes at 10 time steps. Based on this 4D CT image data the spatio-temporal behavior of lung tumors is analysed during the respiratory cycle. Method
Spatio-temporal CT image scans were generated at the Mallinkrodt Institute of Radiology, St. Louis with a MSCT scanner in cine mode during free breathing. At the Department of Medical Informatics in Hamburg a method for artifact reduced reconstruction of 4D CT image data from the measured spatio-temporal data segments was developed. In our approach an optical flow based non-linear registration method is applied for structure-perserving interpolation and reconstruction of 10 3D CT data sets from multislice CT scans at different user-defined tidal volumes. The reconstructed 4D CT data sets are used for studying the motion of lung tumors and inner organs during the respiratory cycle. After segmentation of the tumor, the lungs, the skin and the bronchial tree their 4D motion behaviour can be visualised (Fig. 1). The segmented 4D data sets are the basis of motion analysis. Using a non-linear registration method velocity fields and trajectories of selected points on organ surfaces are approximated. Results
The evaluation of the reconstruction method developed showed that in comparison to standard techniques artifacts can be reduced, significantly. The reconstructed 4D data sets of four patients with lung tumors were used to quantify and visualize the individual tumor and organ movements during a breathing cycle. Based on the computed trajectories of selected points the maximum displacement of any surface point can be calculated and regions with large respiratory motion are identified. The lung tumor's mass center is traced at different time steps to analyze the tumor's mobility (Fig. 2) . Furthermore, probabilities of appearance are computed in 3D for the lung tumors visualizing tumor movement during the respiratory cycle in one static image (Fig. 3). Conclusion
The 4D CT reconstruction method developed opens up the possibility to analyze motion of tumors and inner organs in artifact-reduced images with high temporal and spatial resolution. Furthermore, our approach has the potential to preserve image quality by reducing the number of CT scans needed for 4D therapy planning. Acknowledgement
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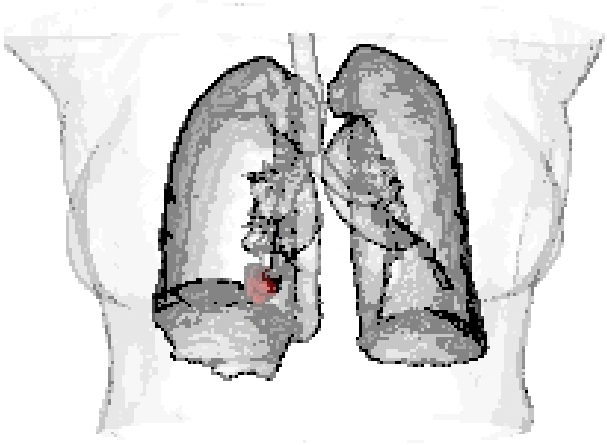
Bild 1/JPG



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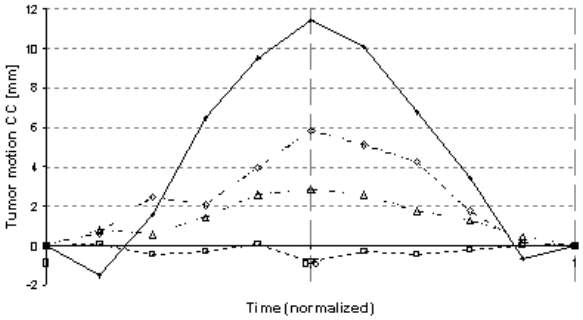

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