Multimodal Virtual Bronchoscopy Using PET/CT- Images

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Objective: To develop a virtual bronchoscopy system for morphofunctional images. In cooperation with the department of nuclear medicine of the RDI, TU Munich we demonstrated the possibilities, advantages and limitations of virtual bronchoscopy using data sets from positron emission tomography (PET) and computed tomography (CT).

Materials and Methods: 8 consecutive patients with non-small cell lung cancer (NSCLC) underwent PET/CT. PET was performed with a glucose analogue, 2-[fluorine-18]-fluoro-2-deoxy-D-glucose (18F-FDG) using a state-of-the-art full-ring Pico-3D PET scanner. CT was performed with a venous-dominant contrast-enhanced phase using a 16-slice CT. Based on these image data sets we developed a segmentation procedure to delineate the tracheobronchial system, the lung and the heart, as well as the primary tumour and the lymph node. The structures of interest were visualized with a color-coded shaded-surface rendering and volume rendering method.

Results: PET/CT imaging has proven as a highly valuable oncological diagnostic modality. CT and virtual CT-bronchoscopy respectively facilitates primarily the anatomical details of the tracheobronchial system and the detection of anatomical/morphologic structure changes of the diseases. PET/CT and virtual hybrid bronchoscopy or virtual PET/CT-bronchoscopy respectively is superior to virtual CT-bronchoscopy, because it uses the CT information and the molecular/metabolic information of the disease from PET. However, it is expected to improve the diagnostic accuracy in identifying and characterizing of malignancies, verifying of infections, differentiation of viable tumor tissue from atelectases and scare, and assessment of tumor staging, therapeutical response and in detecting of an early stage of recurrence that are not detectable or are misjudged in comparison to virtual CT-bronchoscopy.

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Objective

- Registration of functional Images with anatomical information
- Visualisation of morpho-functional coherences in virtual reality
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Material, Method

- Image acquisition with PET-CT
- Image processing (filtering, segmentation, image registration, 3-d reconstruction)
- Visualisation with hybrid visualisation (surface, volume) and virtual endoscopy

PET-CT-system Biograph 16 (Siemens) of the department of nuclear medicine, TUM
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Result

Registered 3D volume rendered PET-CT image
Showing the lung surface (blue), heart, brain, tumour and lymph node metastases (red)

Registered Virtual bronchoscopy in transparent mode showing the localisation of the tumour
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Discussion, perspective

- Morphofunctional 3d-visualisation improves diagnosis and staging of malignant modifications
- Hybrid visualisation in virtual reality facilitates the localisation of pathologic modifications
- Intuitive user interfaces are necessary