

# Medical visual information retrieval based on multi-dimensional texture modeling

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## Exploding medical visual data

- Medical images are important in teaching, diagnosis and treatment planning
  - Are produced in **increasing** quantities
  - Radiologists are facing large varieties of imaging modalities and organs
  - Tomographic data is by far the largest amount

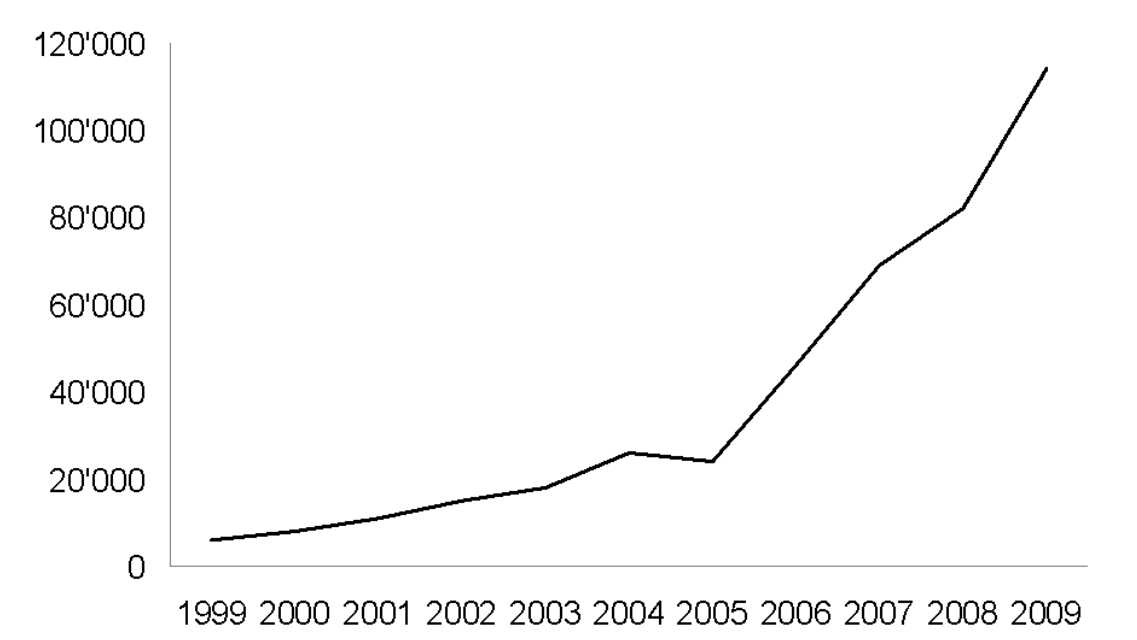


Fig. 1. Average number of images produced per day at the University Hospitals of Geneva.

New tools are needed to **manage visual data** and quickly deliver the right information to the right people

## Content-based indexing for efficient visual data management

- Content-based medical image retrieval (CBMIR) was proposed several times
- Does not require costly and error-prone image annotation
- Enables querying with images and **objectivizing** visual similarity



Fig. 2. The Gnu Image Finding Tool (GIFT) CBMIR system.

## Limitations of current CBMIR systems

- Mostly limited to 2D images and single image
- Based on visual features that do not correspond to the radiologists' intents (semantic gap)
- Do not allow using contextual clinical attributes such as age, gender, ...
- Have limited query **interfaces** that do not allow for proper query formulation (e.g., region of interest, multiple image, ...)

## Multi-dimensional texture characterization

- Imaging devices deliver visual information with **increasing resolution**
  - Enables **early detection** of small lesions
  - Early lesions often refer to changes in organ **tissue** and relate to texture
    - Lung tissue in computed tomography (CT)
    - Trabecular bone with osteoporosis in microCT
    - Diffuse white matter changes with Alzheimer's disease in magnetic resonance imaging (MRI)
    - Cirrhotic liver tissue in ultrasound

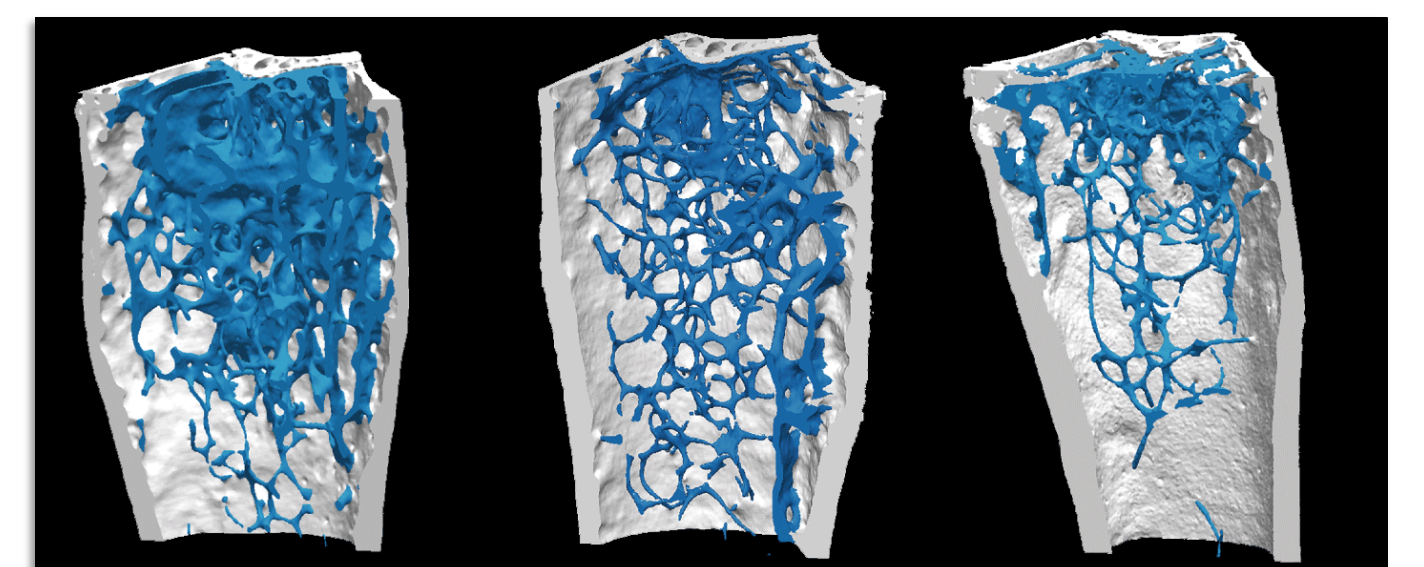


Fig. 3. 3D texture quantification of trabecular bone.

- Texture information plays a **major** role in radiology
  - Texture assessment is central in human vision
  - Taxonomy in radiology often refers to texture properties

## Texture-based indexing

- Carries **richer** information when compared to shape-based indexing
- Shows to correspond well to radiologists' needs in 2D
- Has been **little attempted** in 3D and N-D so far

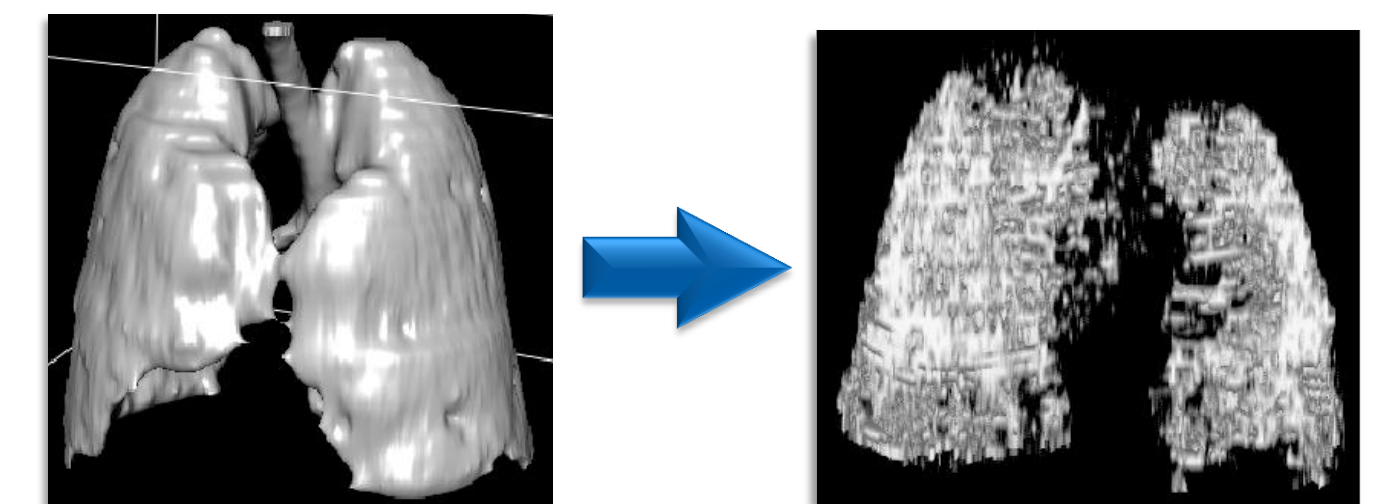
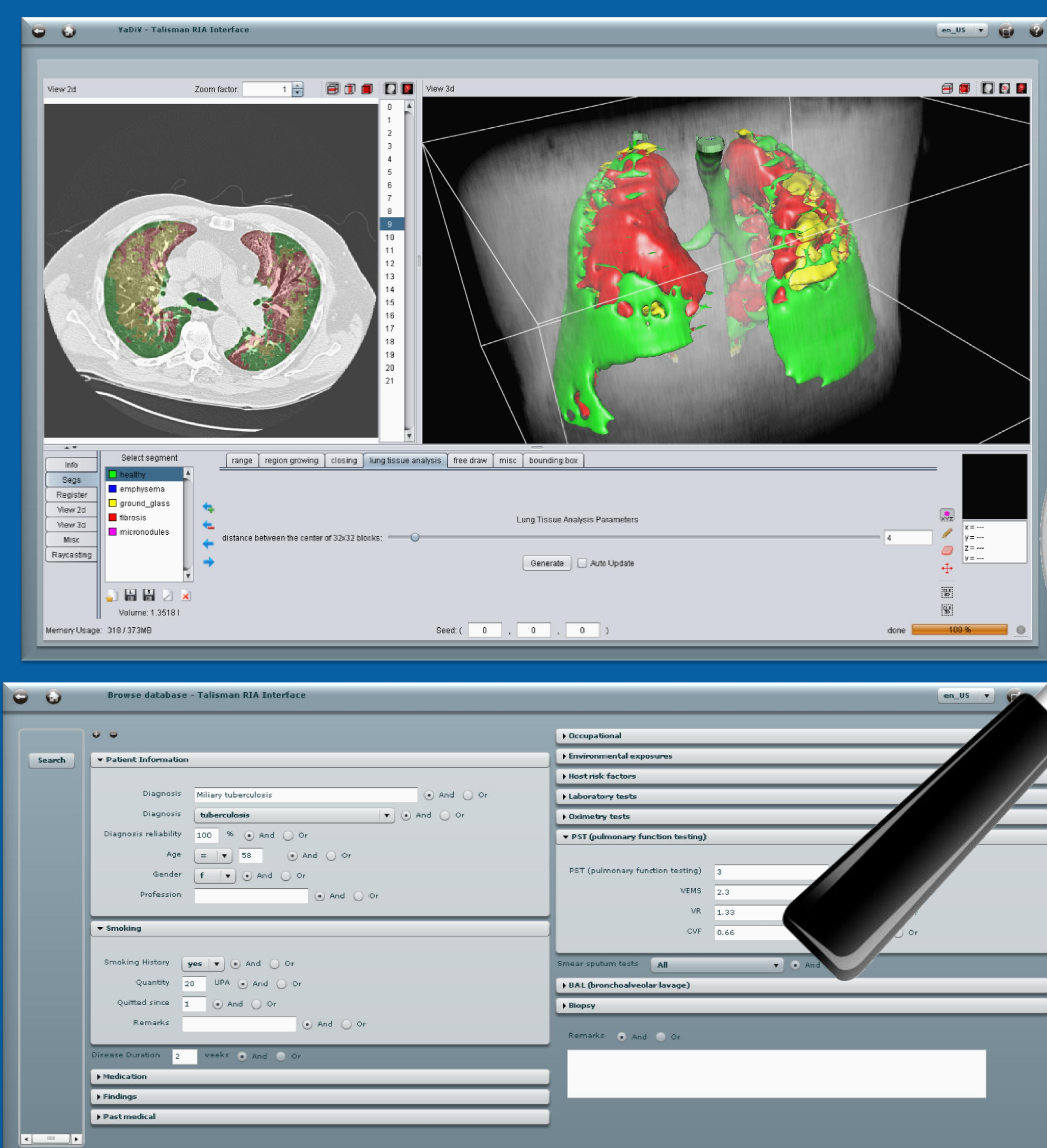


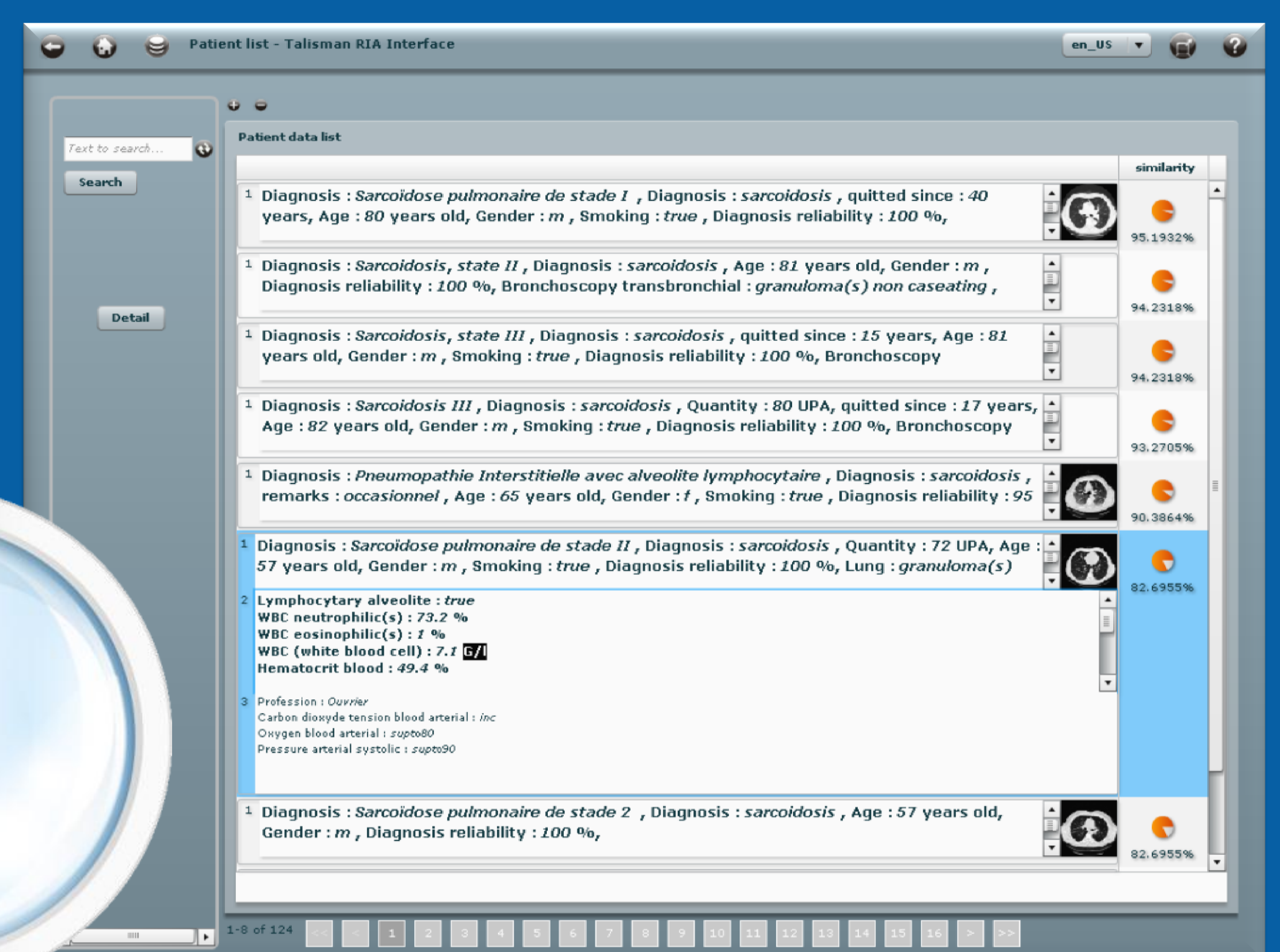
Fig. 4. 3D shape versus 3D texture.

**Texture-based** image search engines with innovative user interfaces enabling **multi-dimensional visual queries** with contextual information are expected to **drastically enhance** management of medical visual information

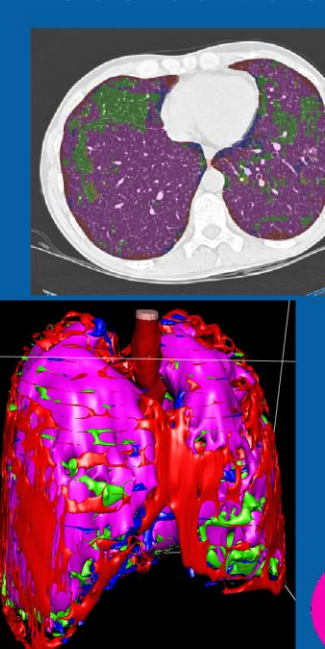
## Query interfaces



## Visualizing results



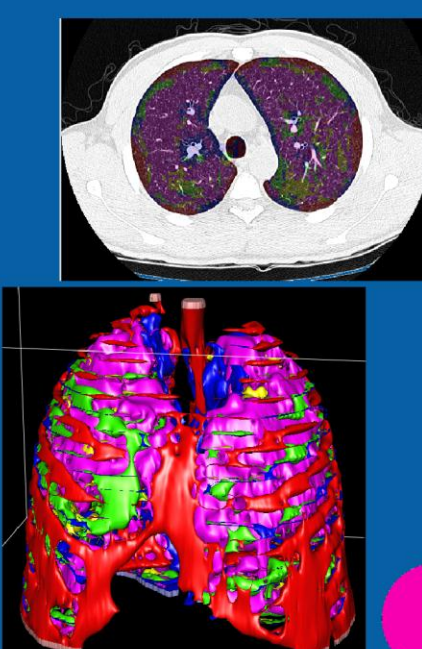
query case:  
tuberculosis



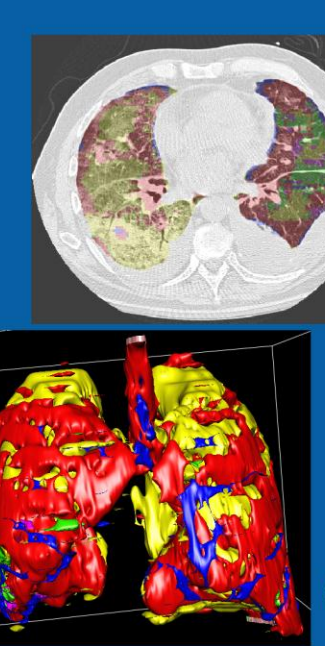
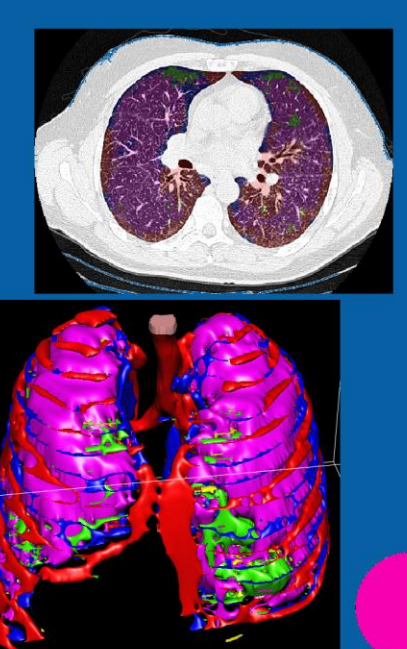
1) tuberculosis



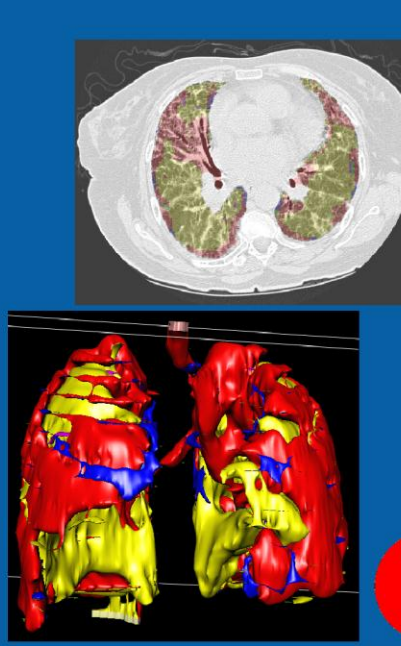
2) tuberculosis



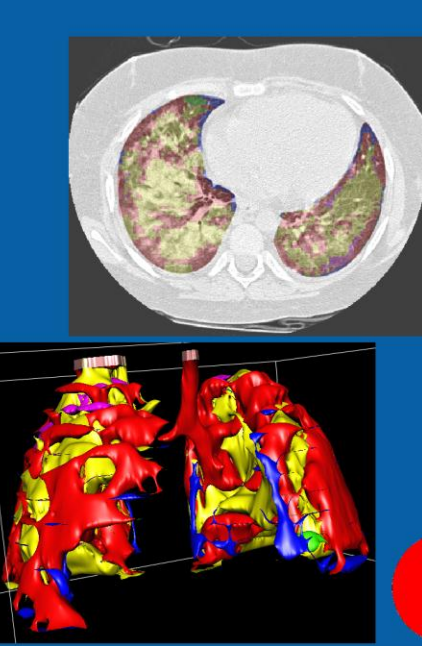
3) sarcoidosis



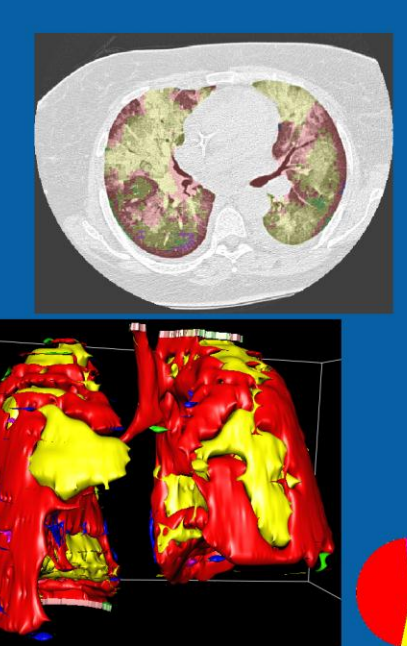
query case:  
pneumocystis  
pneumonia



1) pulmonary  
fibrosis



2) pneumocystis  
pneumonia



3) pneumocystis  
pneumonia