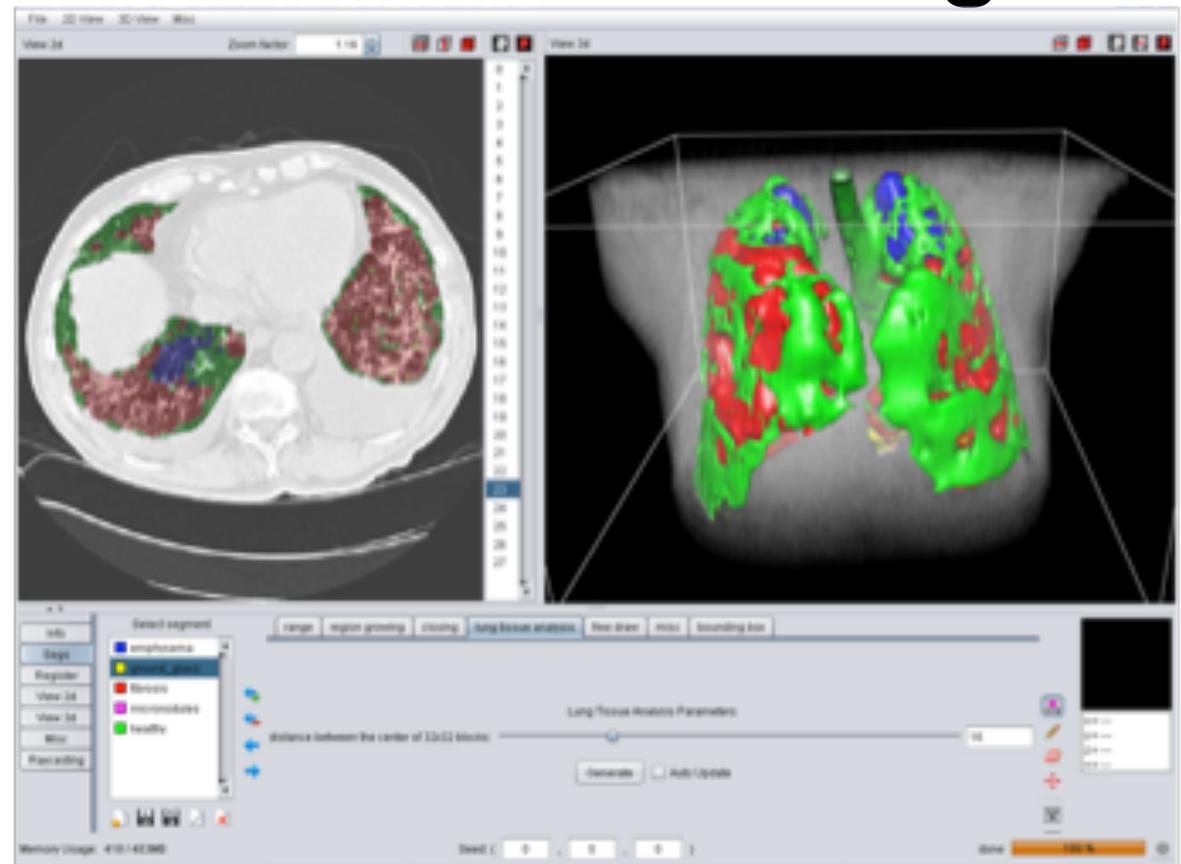


# Information Access to Medical Image Data: from Big Data to Semantics - Academic and Commercial Challenges

Adrien Depeursinge  
Henning Müller



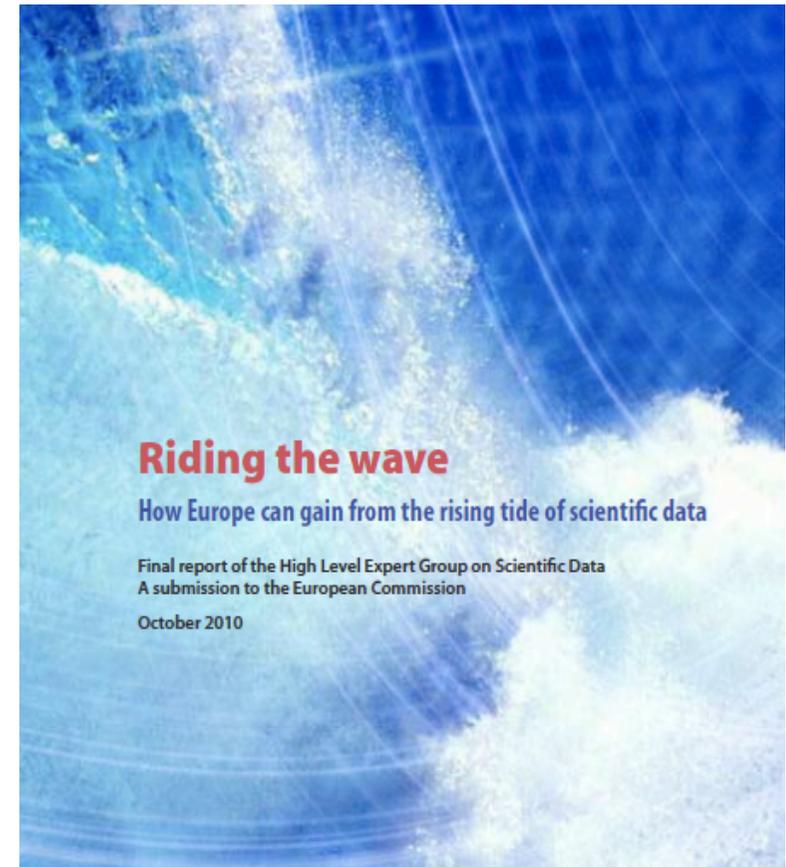
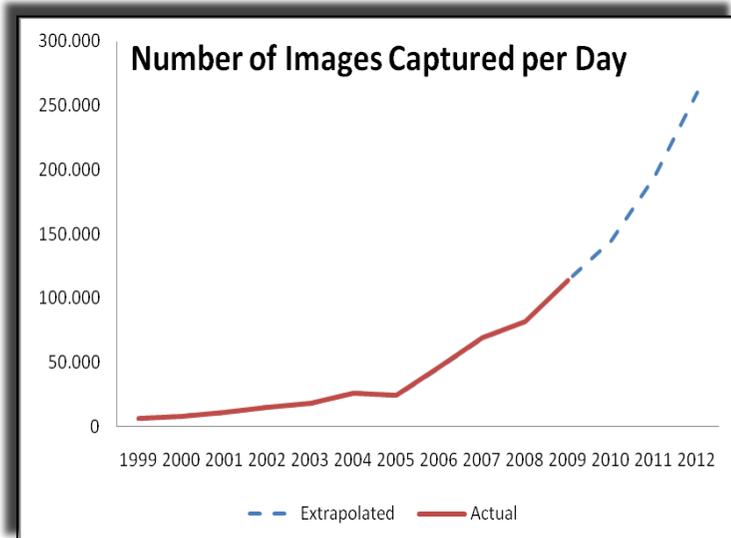
# Overview

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- Motivation & objectives
- eHealth research at the HES-SO in Sierre
- **VISCERAL**
  - ETHZ vs. HES-SO
- **Khresmoi**
  - HES-SO vs. ATOS, Ontotext, (ELDA, HON, GAW)
- Conclusions

# Motivation for image management

- “An image is worth a thousand words”
- Medical imaging is estimated to occupy **30% of world storage capacity** in 2010!
- **Mammography** data in the US in 2009 amounts to **2.5 Petabytes**



Riding the wave – how Europe can gain from the rising tide of scientific data, *report of the European Commission, 10/2010.*

# Objectives of our work

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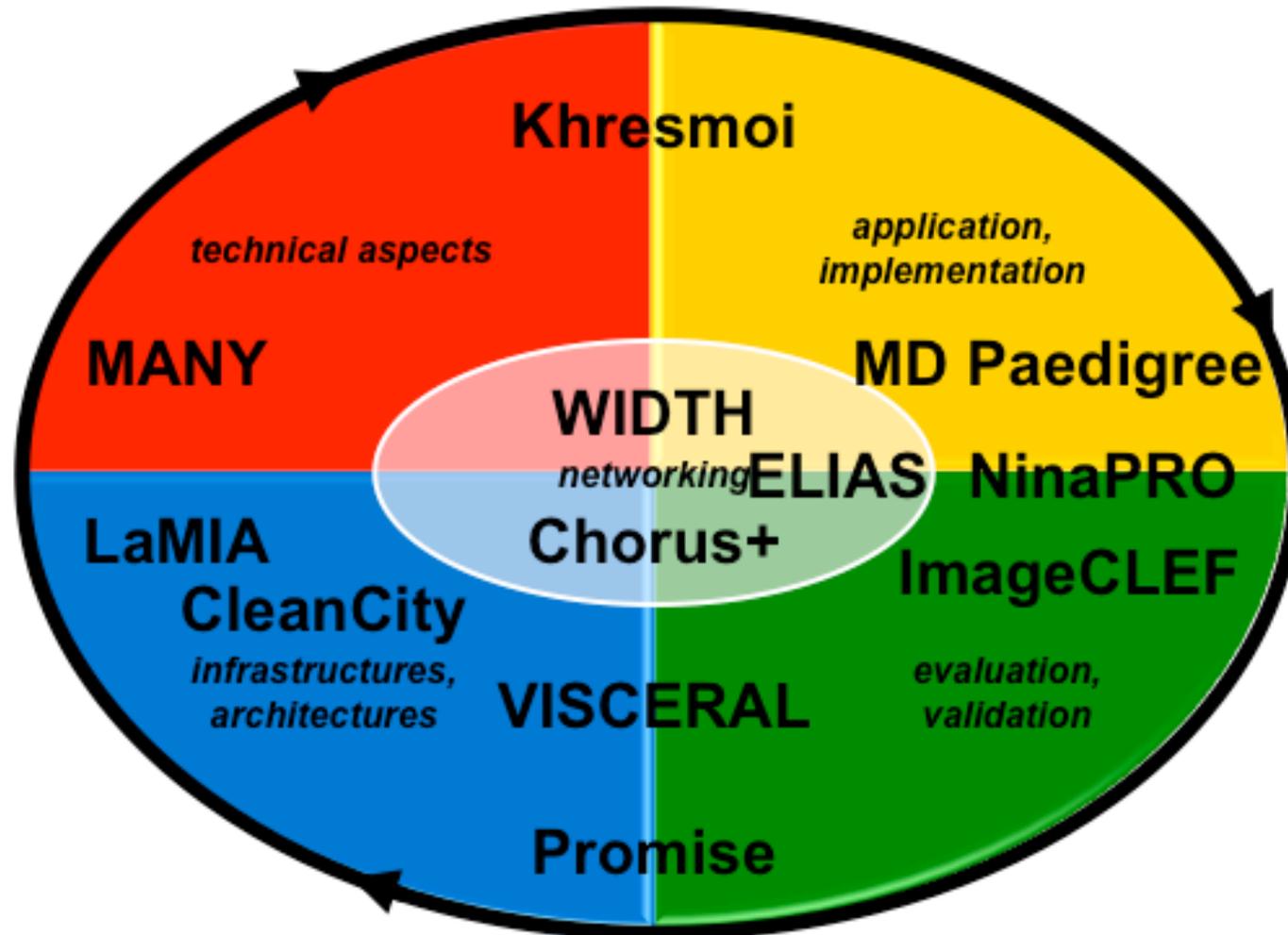
- Better **exploit visual information** in medical imaging for decision support
- Find **similar cases**, use these including outcomes for diagnosis support
- Develop scalable solutions that allow treating the volumes produced in hospitals
  - **Detect small regions of interest** in medical images
  - Map images to semantics, store only regions of interest
- Link information in reports with image data
  - Make work of radiologists more **efficient**

# eHealth at the HES-SO in Sierre

- Many **eHealth activities** since 2007
  - eHealth unit since 2010
  - 20 persons and three professors
  - Michael Schumacher, Henning Müller
- Several types of **projects**
  - EU FP7 projects (Khresmoi, PROMISE, WIDTH, VISCERAL, MD-Paedegree, Commodity I2, ...)
  - FNS projects (MANY, NinaPro, ...)
  - CTI, Hasler, COST, HES-SO, NanoTerra, mandates



# Projet loop in MedGIFT



# Big data challenges and opportunities

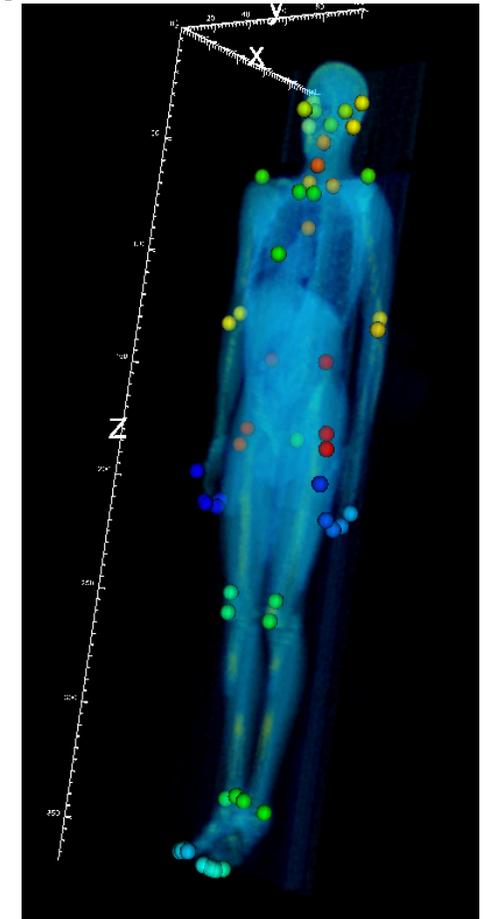
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- **Signal** data in the images needs to be mapped **to** semantic **information**
  - Reduce amount of data to be kept accessible
  - Get information for decision support
  - Regions of interest can be extremely small
- Simple and efficient tools are required
  - And these might work better on big data (and need to be scalable)
- Many **rare diseases** could be analyzed
  - These are difficult as people do not know them, they are missed and incorrectly treated
  - Use all data instead of small scale studies
  - Use data across hospitals, quality is important

# VISCERAL



- EU funded project (2012-2015)
  - HES-SO, ETHZ, UHD, MUW, TUW, Gencat
  - Coordination action, so not research in itself
- Organize competitions on medical image analysis on big data (**10-40 TB**)
  - All computation done in the **cloud**, collaboration with Microsoft
  - Identifying landmarks in the body
  - Finding similar cases
- Annotation by medical doctors

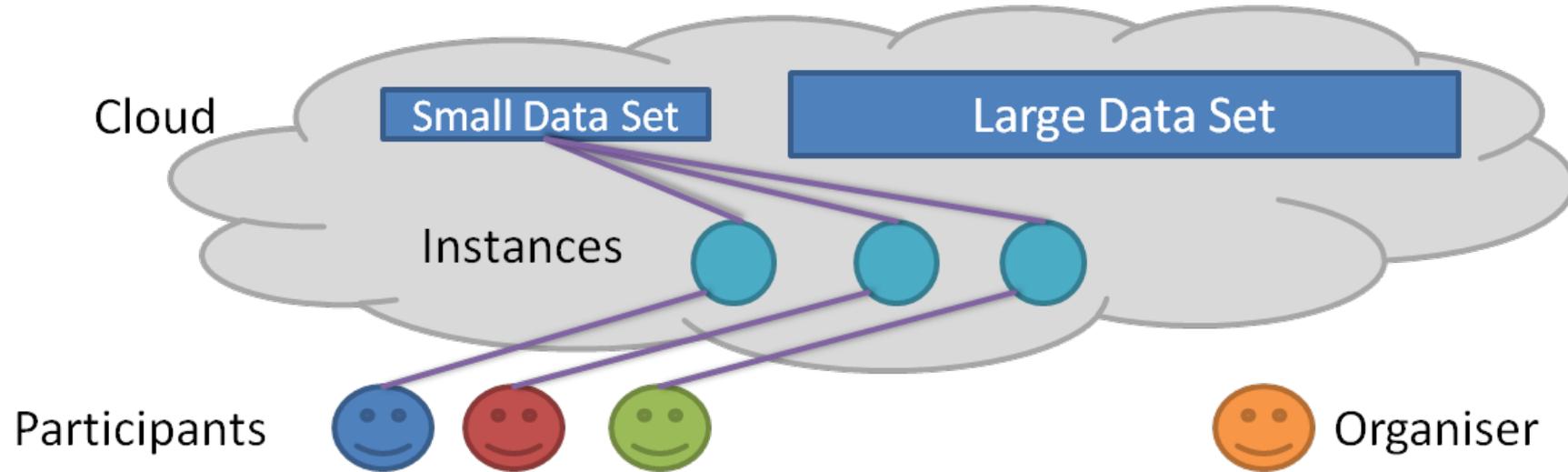


# Objectives of VISCERAL

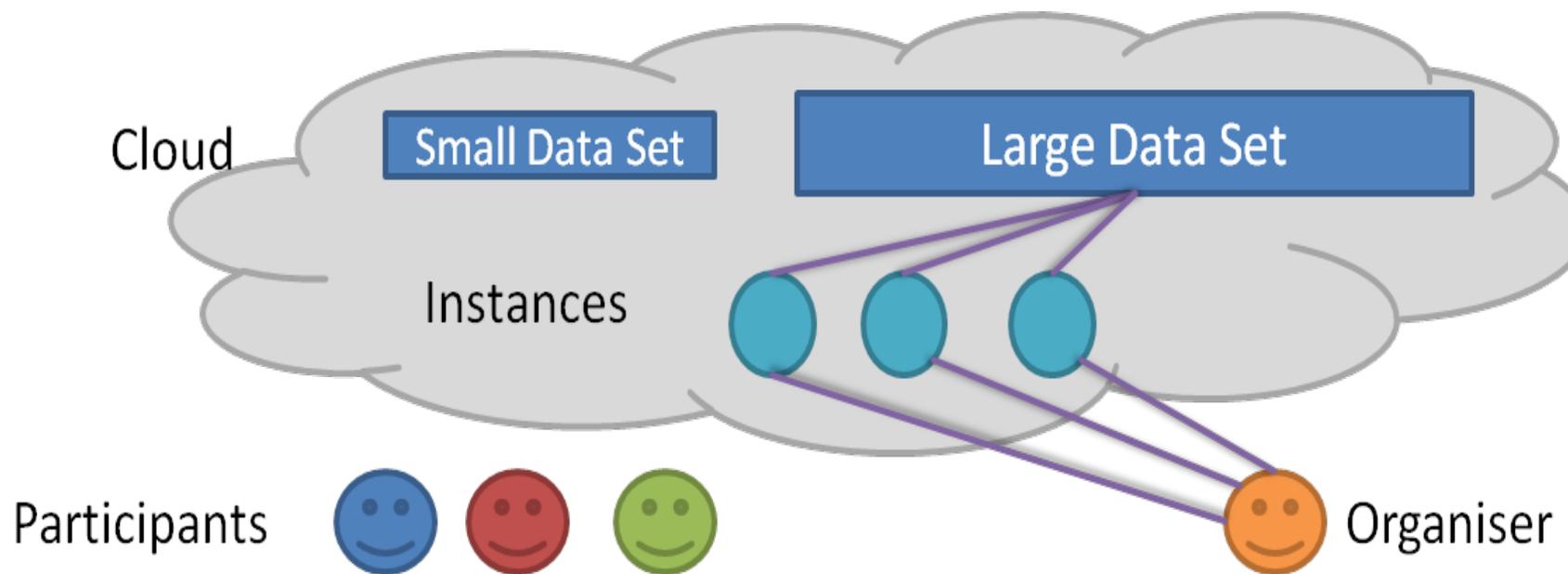
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- Create a cloud-based infrastructure to test algorithms on **big** and potentially **confidential** data
- **Annotate** large amounts of medical image data for system evaluation (annotate once, reuse)
  - Annotation in Hungary to keep costs limited
  - 3D annotation and labels in the RadLex terminology
- Support the **coordination of research work** on relevant objectives in medical imaging
  - Including academic groups and companies such as Microsoft, Siemens, Toshiba, etc.

# Evaluations in VISCERAL

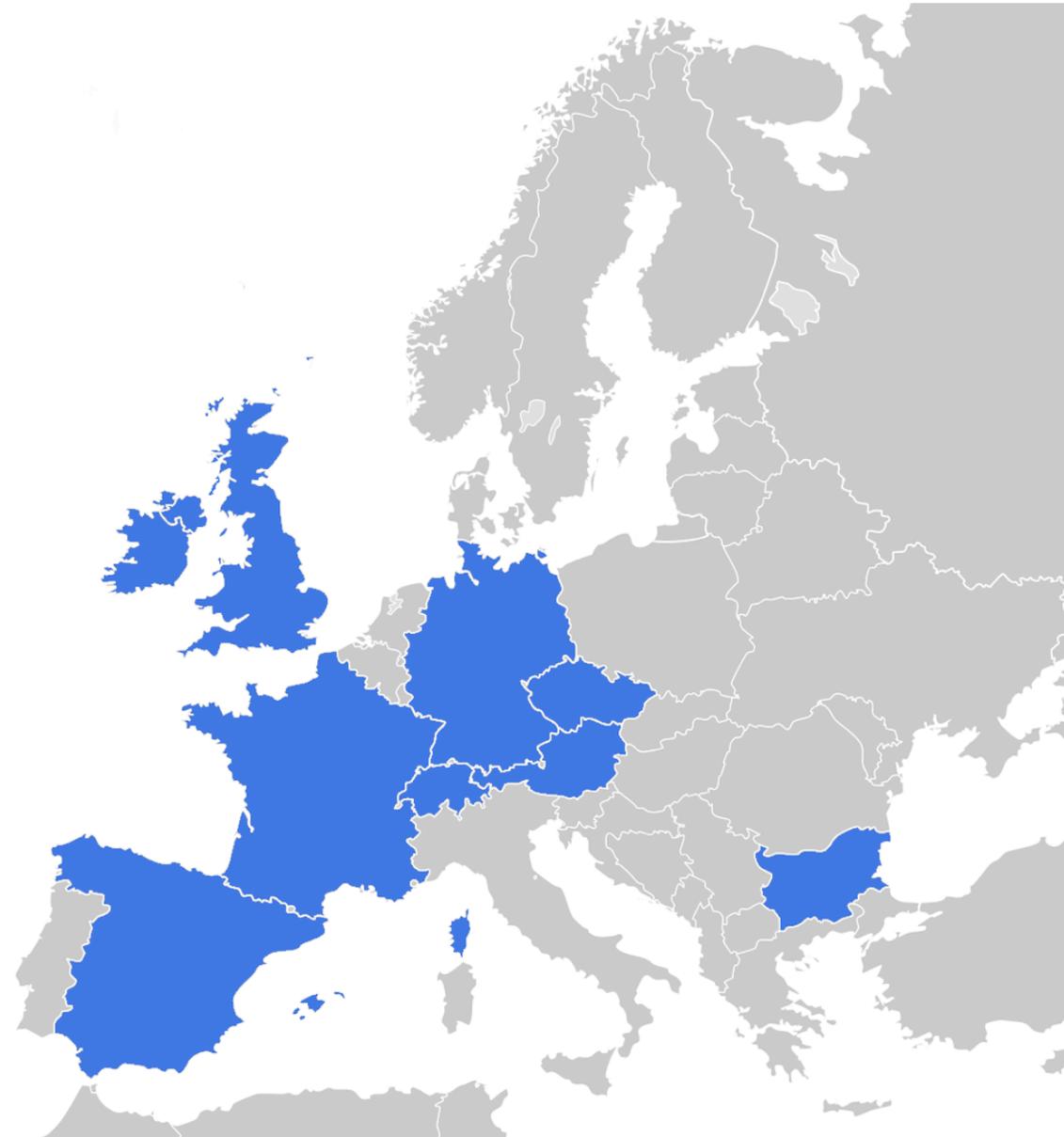


Test



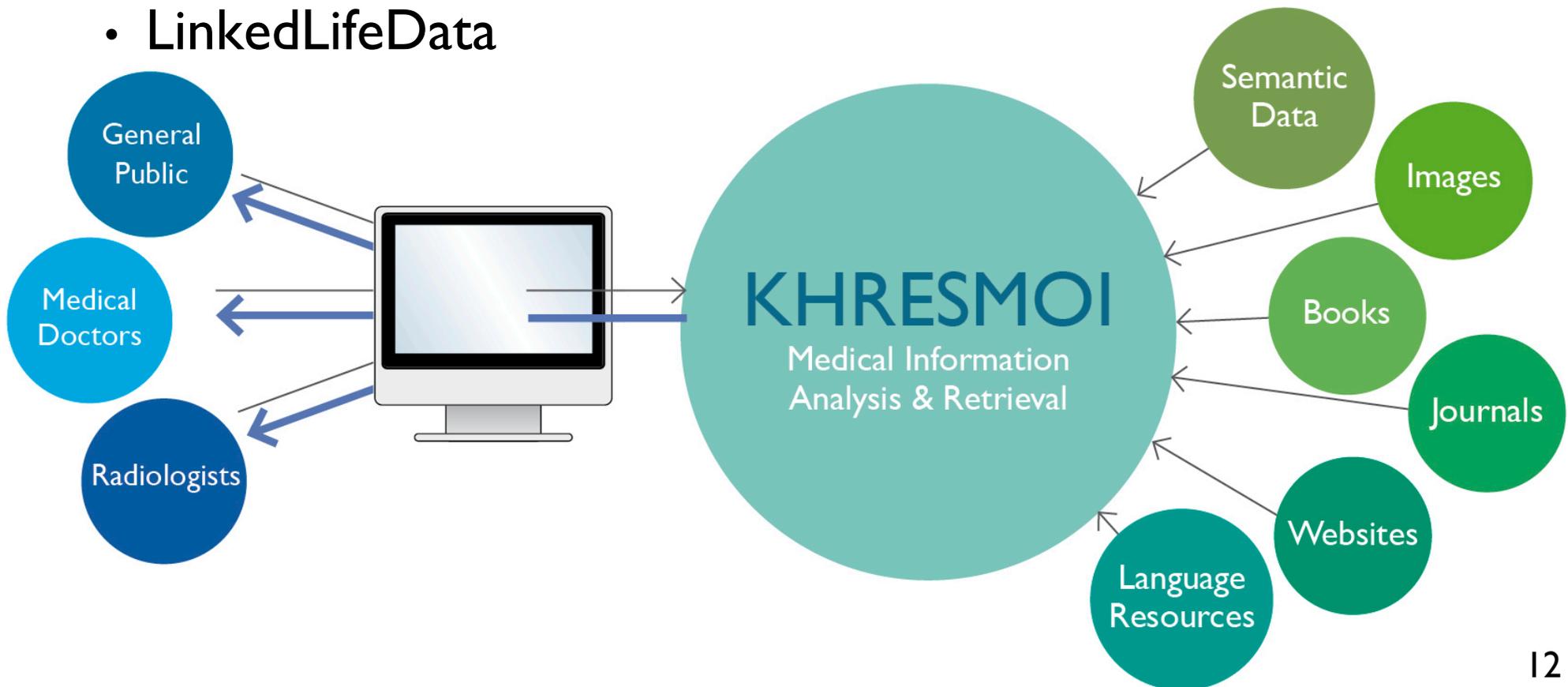
# KHRESMOI

- 4 year, 10'000'000 € budget



# Khresmoi goals

- **Trustable** information adapted to each user group
  - All tools as open source
- Extract **semantic** information from all sources
  - LinkedLifeData



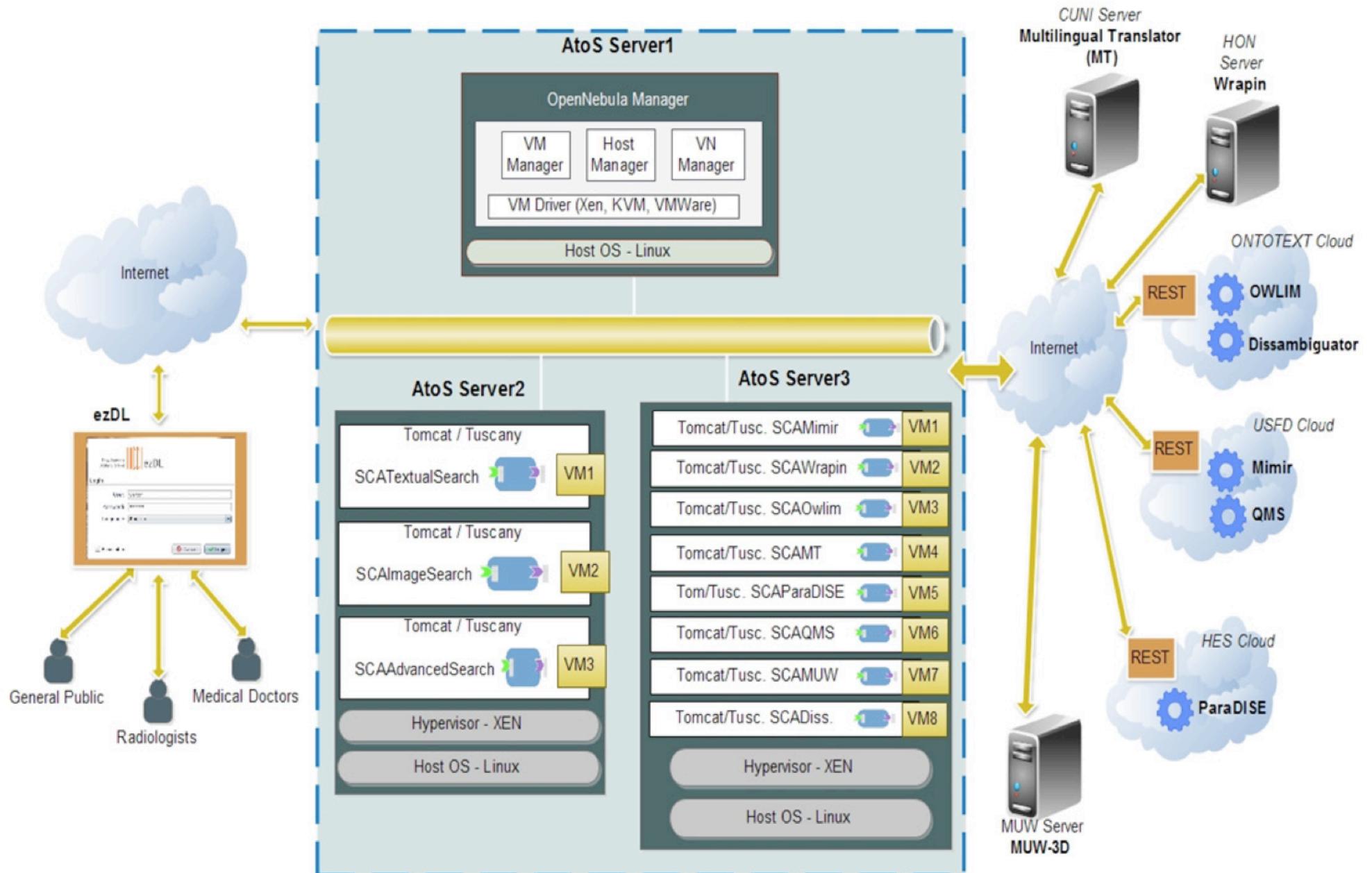
# Current status

- Project at the beginning of year 3 of 4 years
  - Half-time
- User tests have started among the three user groups (much feedback on prototypes expected)
  - Different types of interfaces
  - Eye tracking
- Implement changes to adapt to the user groups

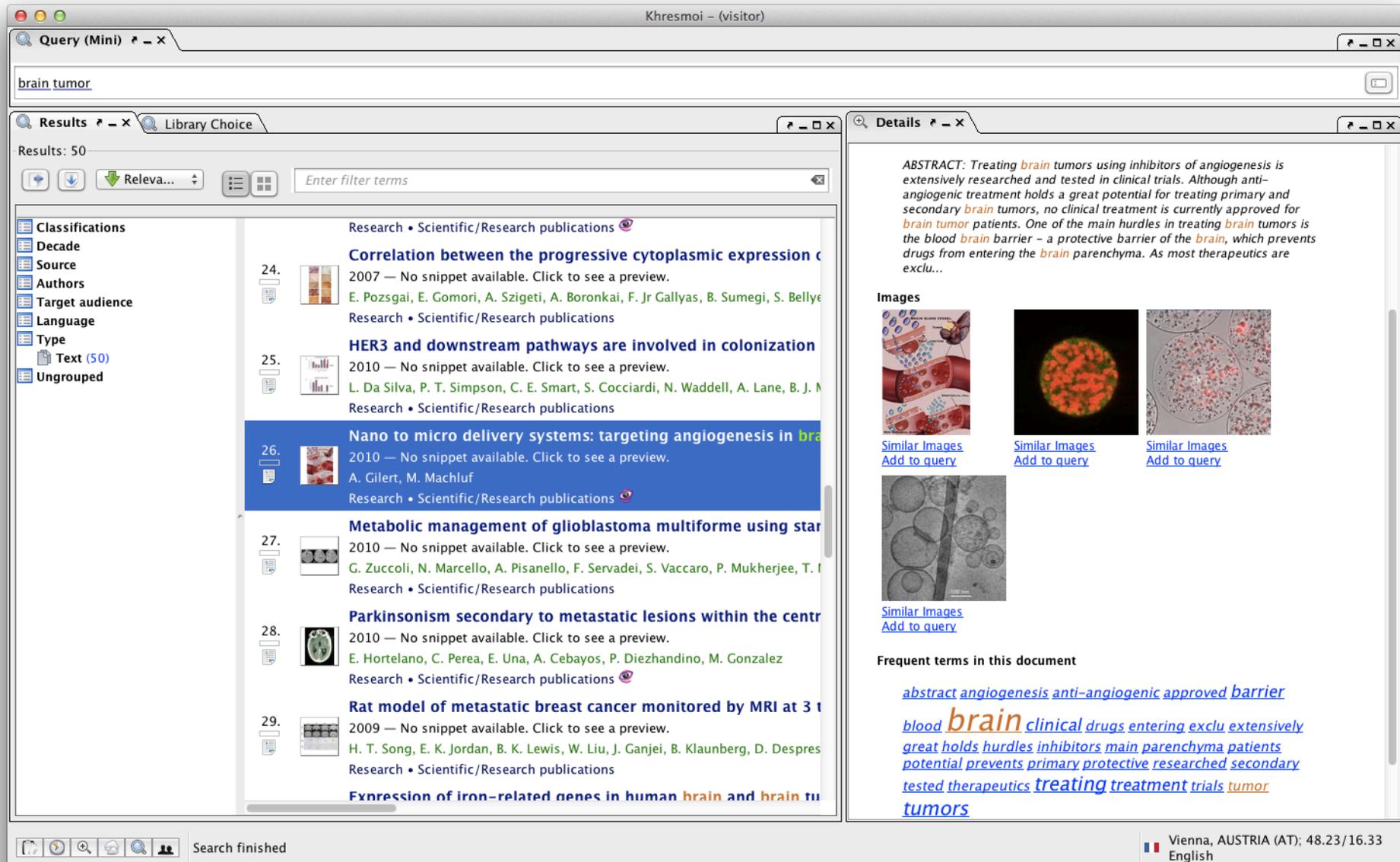


"I'M SORRY DOCTOR, BUT AGAIN I HAVE TO DISAGREE."

# Software architecture



# User interfaces



The screenshot displays the Khresmoi web application interface. At the top, the search bar contains the query "brain tumor". Below the search bar, the "Results" tab is active, showing 50 results. A left sidebar contains classification filters such as "Decade", "Source", "Authors", "Target audience", "Language", "Type", and "Un grouped". The main results area lists several scientific publications, with the 26th result, "Nano to micro delivery systems: targeting angiogenesis in brain tumors", highlighted in blue. The "Details" tab on the right shows the abstract for this selected article, which discusses the use of angiogenesis inhibitors in treating brain tumors. Below the abstract, there are three image thumbnails with "Similar Images" and "Add to query" links. At the bottom right, a section titled "Frequent terms in this document" lists various keywords extracted from the text.

Query (Mini)

Results: 50

Releva...

Classifications

- Decade
- Source
- Authors
- Target audience
- Language
- Type
- Text (50)
- Un grouped

24. **Correlation between the progressive cytoplasmic expression of...**  
2007 — No snippet available. Click to see a preview.  
E. Pozsgai, E. Gomori, A. Szigeti, A. Boronkai, F. Jr Gallyas, B. Sumegi, S. Bellye  
Research • Scientific/Research publications

25. **HER3 and downstream pathways are involved in colonization of...**  
2010 — No snippet available. Click to see a preview.  
L. Da Silva, P. T. Simpson, C. E. Smart, S. Cocciardi, N. Waddell, A. Lane, B. J. M...  
Research • Scientific/Research publications

26. **Nano to micro delivery systems: targeting angiogenesis in brain tumors**  
2010 — No snippet available. Click to see a preview.  
A. Gilert, M. Machluf  
Research • Scientific/Research publications

27. **Metabolic management of glioblastoma multiforme using star...**  
2010 — No snippet available. Click to see a preview.  
G. Zuccoli, N. Marcello, A. Pisanello, F. Servadei, S. Vaccaro, P. Mukherjee, T. I...  
Research • Scientific/Research publications

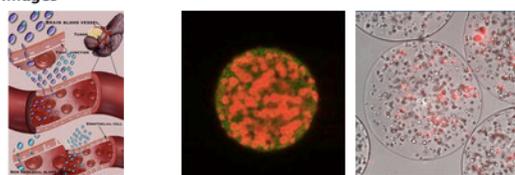
28. **Parkinsonism secondary to metastatic lesions within the centr...**  
2010 — No snippet available. Click to see a preview.  
E. Hortelano, C. Perea, E. Una, A. Cebayos, P. Diezhandino, M. Gonzalez  
Research • Scientific/Research publications

29. **Rat model of metastatic breast cancer monitored by MRI at 3 t...**  
2009 — No snippet available. Click to see a preview.  
H. T. Song, E. K. Jordan, B. K. Lewis, W. Liu, J. Ganjei, B. Klaunberg, D. Despres  
Research • Scientific/Research publications

**Expression of iron-related genes in human brain and brain tu...**

**ABSTRACT:** Treating brain tumors using inhibitors of angiogenesis is extensively researched and tested in clinical trials. Although anti-angiogenic treatment holds a great potential for treating primary and secondary brain tumors, no clinical treatment is currently approved for brain tumor patients. One of the main hurdles in treating brain tumors is the blood brain barrier – a protective barrier of the brain, which prevents drugs from entering the brain parenchyma. As most therapeutics are exclu...

**Images**



[Similar Images](#)  
[Add to query](#)

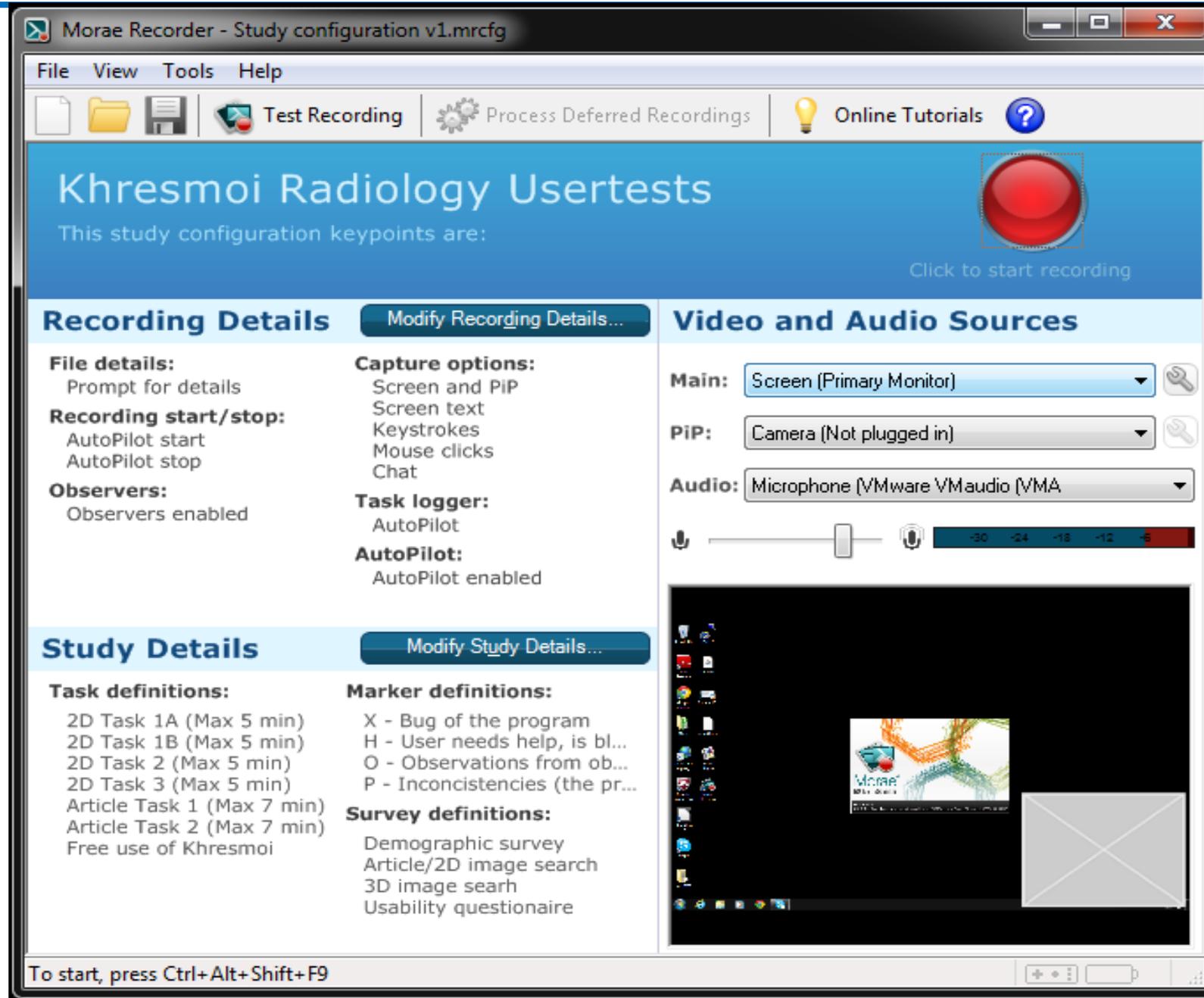
**Frequent terms in this document**

[abstract](#) [angiogenesis](#) [anti-angiogenic](#) [approved](#) [barrier](#)  
[blood](#) [brain](#) [clinical](#) [drugs](#) [entering](#) [exclu](#) [extensively](#)  
[great](#) [holds](#) [hurdles](#) [inhibitors](#) [main](#) [parenchyma](#) [patients](#)  
[potential](#) [prevents](#) [primary](#) [protective](#) [researched](#) [secondary](#)  
[tested](#) [therapeutics](#) [treating](#) [treatment](#) [trials](#) [tumor](#)  
[tumors](#)

Search finished

Vienna, AUSTRIA (AT); 48.23/16.33  
English

# User tests



Morae Recorder - Study configuration v1.mrcfg

File View Tools Help

Test Recording Process Deferred Recordings Online Tutorials ?

## Khresmoi Radiology Usertests

This study configuration keypoints are:

Click to start recording

### Recording Details [Modify Recording Details...](#)

**File details:**  
Prompt for details

**Recording start/stop:**  
AutoPilot start  
AutoPilot stop

**Observers:**  
Observers enabled

**Capture options:**  
Screen and PIP  
Screen text  
Keystrokes  
Mouse clicks  
Chat

**Task logger:**  
AutoPilot

**AutoPilot:**  
AutoPilot enabled

### Video and Audio Sources

**Main:** Screen (Primary Monitor)

**PIP:** Camera (Not plugged in)

**Audio:** Microphone (VMware VMaudio (VMA

-30 -24 -18 -12 -6

### Study Details [Modify Study Details...](#)

**Task definitions:**  
2D Task 1A (Max 5 min)  
2D Task 1B (Max 5 min)  
2D Task 2 (Max 5 min)  
2D Task 3 (Max 5 min)  
Article Task 1 (Max 7 min)  
Article Task 2 (Max 7 min)  
Free use of Khresmoi

**Marker definitions:**  
X - Bug of the program  
H - User needs help, is bl...  
O - Observations from ob...  
P - Inconcistencies (the pr...

**Survey definitions:**  
Demographic survey  
Article/2D image search  
3D image search  
Usability questionnaire

To start, press Ctrl+Alt+Shift+F9

# Public/private & academic collaborations

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- Close **collaboration** between actors is **beneficial**
  - Different view points on the same problems
  - Different ways of being evaluated (publications, projects, \$)
  - For larger projects the best partners are necessary
- **Interdisciplinary** work is enriching
  - Creates new ideas (and sometimes frustrations)
  - Is needed in most fields of computer science
- **Innovation** is often the goal of funding
  - HES has developers, PhD students and senior researcher collaborating on the same problems

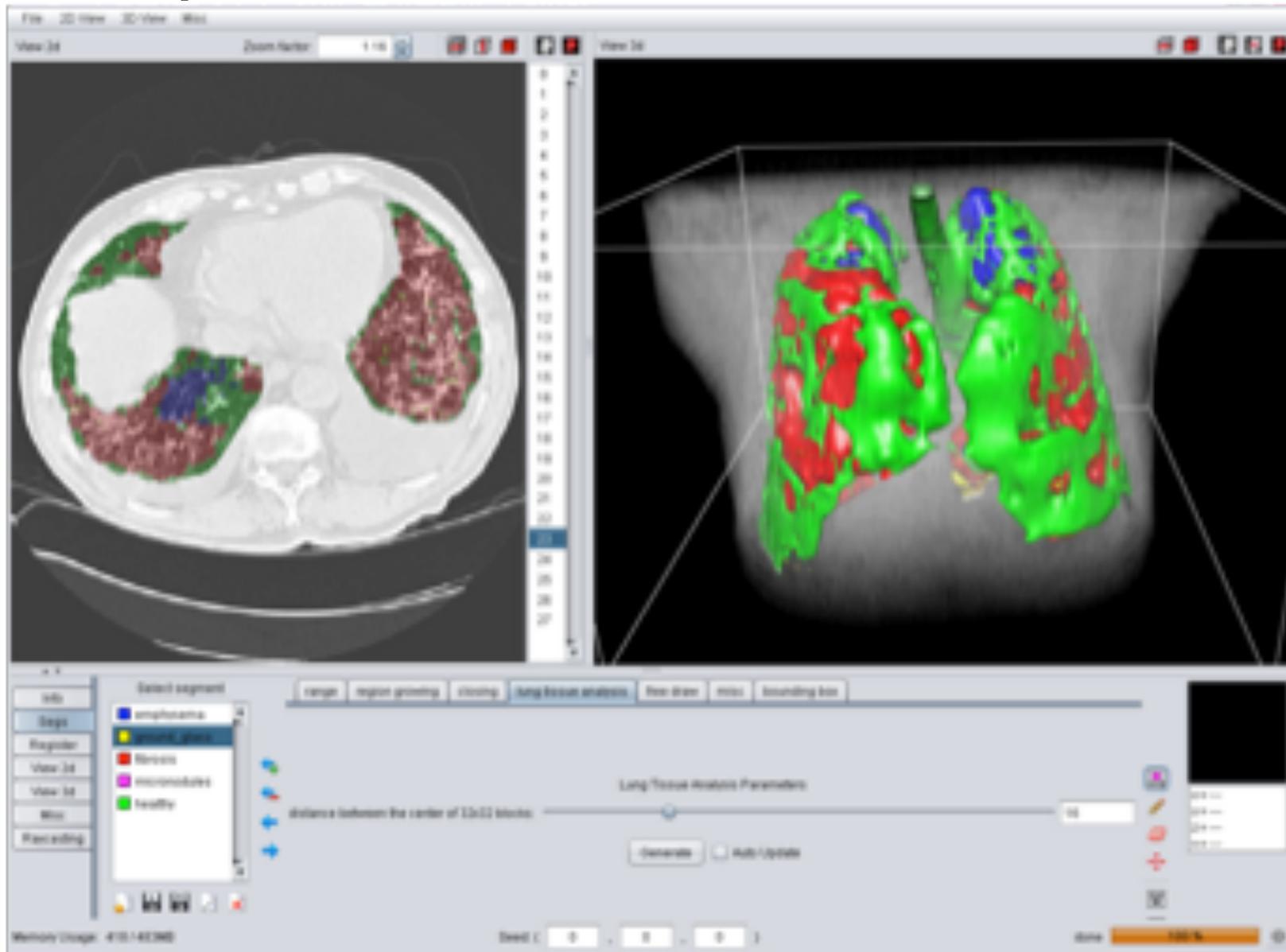
# Eye tracking

- <http://www.youtube.com/watch?v=YWoICx3jdOo>



# Demo

- [www.youtube.com/watch?v=cMoONC0Tz2c](http://www.youtube.com/watch?v=cMoONC0Tz2c)



# Questions?

- More information can be found at
  - <http://medgift.hevs.ch/>
  - <http://publications.hevs.ch/>
  - <http://khresmoi.eu/>
  - <http://visceral.eu/>
- Contact:
  - [Henning.mueller@hevs.ch](mailto:Henning.mueller@hevs.ch)

