Tutorial on Medical Image Retrieval - application domains-

Medical Informatics Europe 2005
28.08.2005

Henning Müller, Thomas Deselaers

Service of Medical Informatics
Geneva University & Hospitals, Switzerland
Aachen Technical University, Germany
Overview

- Current applications
- Tools to manage archives
  - Semi-automatic coding, DICOM header correction, ...
- Teaching
  - Access to teaching files for lecturers
  - ... and for students
- Research
  - Find good examples, quality control
  - Include visual features into studies
- Diagnostic aid
  - Very focused domain, evidence-based medicine, case-based reasoning
  - Example systems and fields
- Others
Current applications

- This should rather be **empty**
- No programs for visual information retrieval are currently used in clinical routine, at least to my knowledge
  - Assert on lung image retrieval
  - IRMA in image classification and semi-automatic coding
- **Research applications** and large number of projects
  - Melanoma
  - Pathology slides
  - Mammography, lung CTs
  - PACS-like databases
Tools to manage archives

- **Navigation** in large archives
  - Find lost images (without/with wrong annotations)
  - DICOM is not enough
- **Semi-automatic coding**
  - Propose codes of visually similar images
- **Quality control**
  - Control the codes and find images with abnormal codes based on visual similarity
  - DICOM headers contain errors (~16% in anatomic region) that can be corrected
Semi-automatic annotation (IRMA)
Teaching

- Manage teaching files
  - myPACS.net, MIRC (Medical Imaging Resource Center, RSNA), HEAL, PathoPic, ...

- Resource for **students** to find and explore databases and cases
  - Casimage (used for exams, teaching CDs, ...)

- Resource for **lecturers** to find optimal images for teaching
  - Share images among lecturers
  - Find visually similar images with varying diagnoses
myPACS (http://www.mypacs.net/)

Create Your Own Teaching Files

Join radiologists from 400 institutions in 75 countries who are using MyPACS to create their cases online. Users have contributed 5000 radiology teaching files containing 20,000 images, and new cases are being added every day. All you need is a free account and your web browser, and you can start creating cases right now.

This is a free service to the international community, funded in part by the National Institutes of Health. We also offer custom enterprise teaching file solutions.
• http://mirc.rsna.org/
• Radiological Society North America
• Ten+ databases are made available for text-based search in database fields or as free text
  • Based on Internet standards
  • Software is open source
• Goal is to create a worldwide repository of cases for teaching
• Visual retrieval would be a good complement to the text
  • Multi-lingual retrieval is currently impossible
CasImage (http://www.casimage.com/)
Optimize the selection of cases for research
- Find visually similar cases
- Browse databases through example cases
- Find misclassified cases

Include visual features into research studies
- Find unknown connections
- Features need to have a rather high levels
  - Correspond roughly to diseases
- Visual data mining
- Visual knowledge management
Diagnostic aid

- Case-based reasoning
- Evidence-based medicine
- Supply similar cases as a help for practitioners
  - Has shown to help inexperienced practitioners
  - Aisen et al., Radiology
- This is possible in fields where visual low-level similarity is important
  - High resolution lung CT
  - Dermatology, Pathology, Mammography
  - Fractures (treatment planning)
- Problem: Advances in medical imaging equipment
Example: case-based reasoning

- Emphysema
- Macro nodules
- Micro nodules
• Diagnostic aid on lung CTs
• **ABCD** rule (Asymmetry, Border, Color, Differential structures)

• Hair removal, boundary detection, texture analysis, ...
Mammography

- Less image retrieval, but rather detection of regions with abnormal characteristics
  - micro calcifications
- Local analysis is important
- Large databases with preclassified image regions exist
  - England: Mammogrid
Case-based rather than image-based retrieval

- Currently the input is mostly one image
- MD might have several images (RX, CT, ...) for a same patient
- Cases stored in the patient record also often have more than one image
  - Plus other data: text, numerical values (lab)
- Also, entire series (CT, MRI) as an input and not selected images
  - Slice selection based on what a “normal” image would be like
Other applications

- **Parameter settings** for segmentation, etc.
  - Based on a large number of known, well-segmented cases
- Show me if this case needs further attention, **dissimilarity** retrieval against healthy cases
  - Needs a large number of healthy cases
  - Create a model for a “healthy” image
- ...

©2005 Hôpitaux Universitaires de Genève
Conclusions

• Image retrieval is at the moment mainly an academic problem
• Information explosions is happening in the medical domain (multimedia in digital form)
• We need tools and we need to imagine how to use them
• There are many applications for image retrieval
• We need to start the clinical integration
• Visual systems will not replace text but complement it