

**Imperial College**  
London

# **Visual Features for Content-based Medical Image Retrieval**

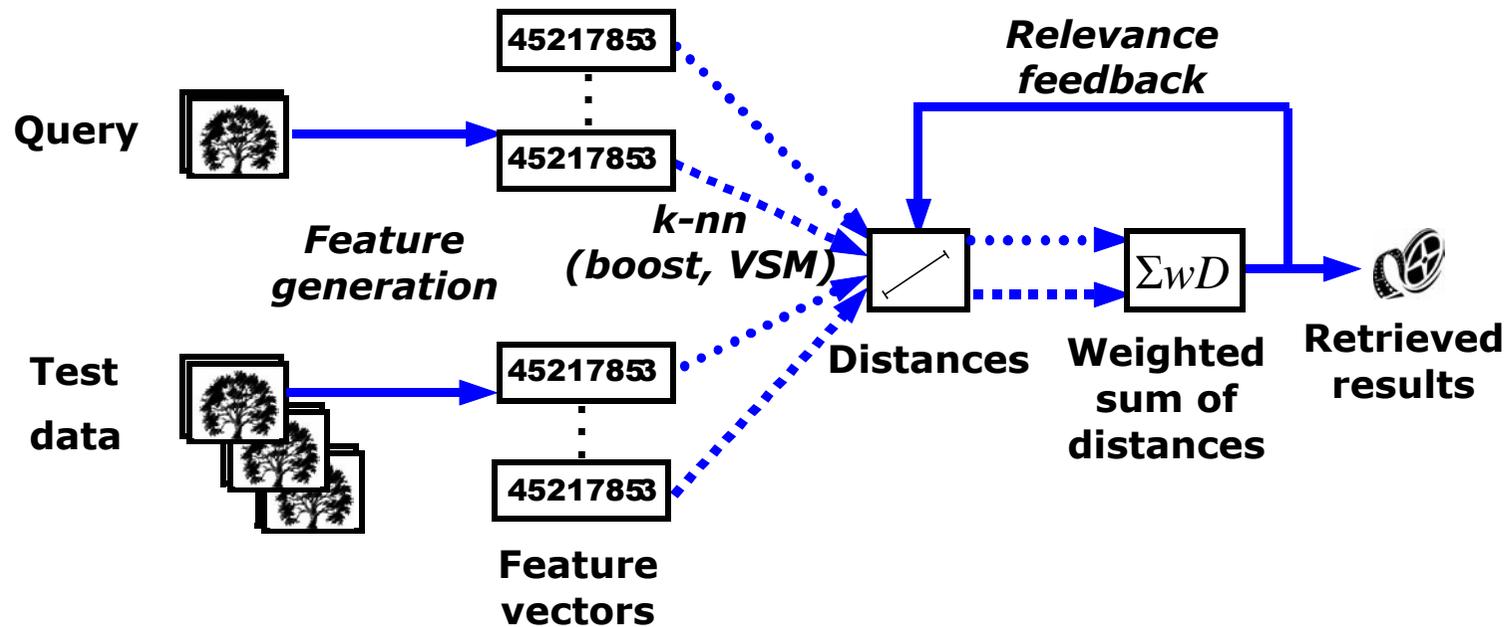
Peter Howarth, Alexei Yavlinsky,  
Daniel Heesch, Stefan Ruger

<http://km.doc.ic.ac.uk>

# Outline of presentation

- CBIR
- Feature selection
- Texture
- Results and implications
- Conclusion

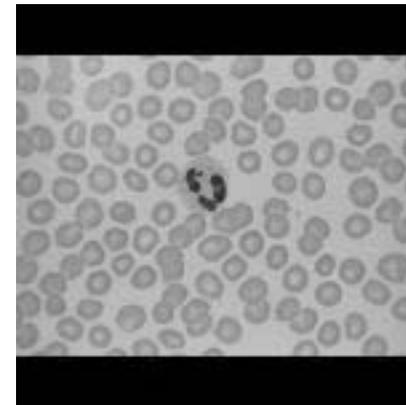
# A CBIR system



# The task

Cross Language Evaluation Forum 2003  
2004

- Medical image collection, 8725 images, 25 single image queries
- No training data
- 1<sup>st</sup> stage, automatic visual query

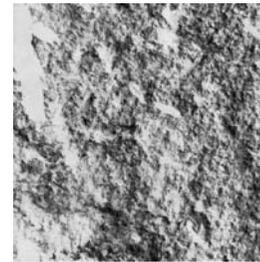
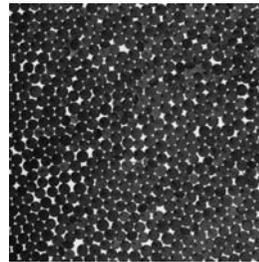
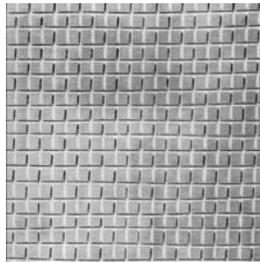
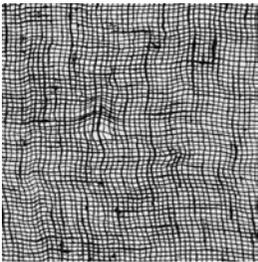


# Feature choice

- **Dataset**
  - High proportion monochrome
  - Precisely composed
  - Textures and structural elements
- **Layout**
  - Thumbnail
- **Structural features**
  - Convolution
  - Colour structure descriptor
- **Texture features**
  - Co-occurrence
  - Gabor
- **Tiling**

# What is texture?

- Can it be defined?
  - Contrast, coarseness, fineness, direction, line-likeness, polarization, scale...
  - Regional property



- How can these visual characteristics be captured in a feature?

# Grey Level Co-occurrence Matrices

- Haralick 1979
- GLCM is a matrix of frequencies at which 2 pixels separated by a vector occur in the image
- Generate the GLCM and then extract features
  - Energy
  - Contrast
  - Entropy
  - Homogeneity

# Co-occurrence

Query



Horizontal  
vector



[1,0]

Vertical  
vector



[0,1]



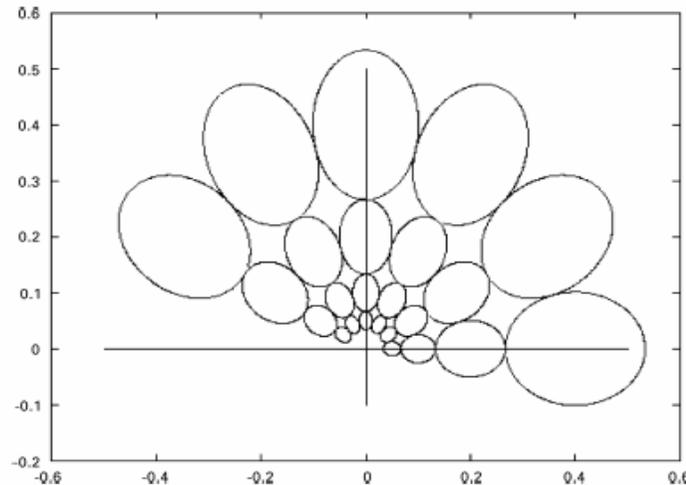
[2,0]



[0,2]

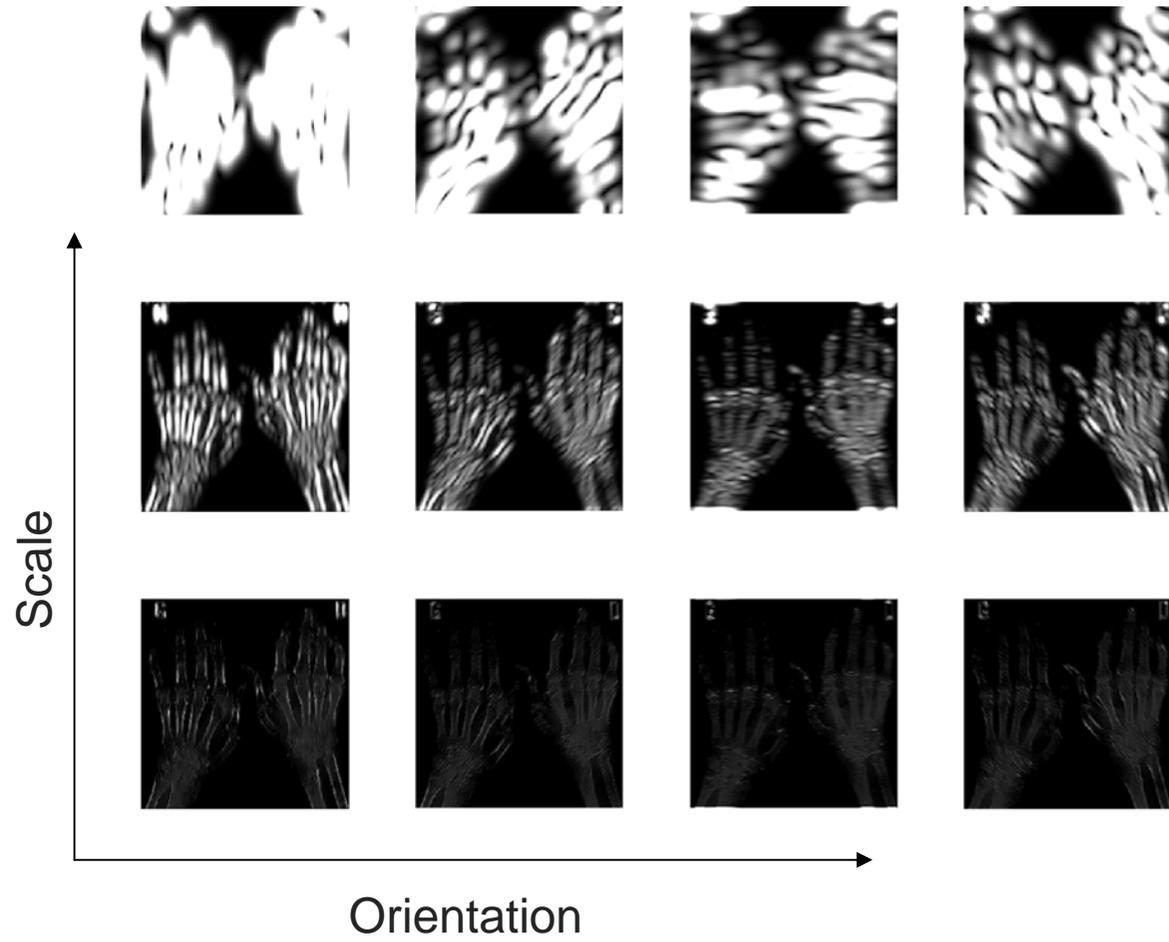
# Gabor Features

- Turner 1986, Manjunath 1996 2000
- Gabor filters are defined by harmonic functions modulated by a Gaussian distribution
- By varying the orientation and scale can detect edge and line features that characterize texture



# Gabor

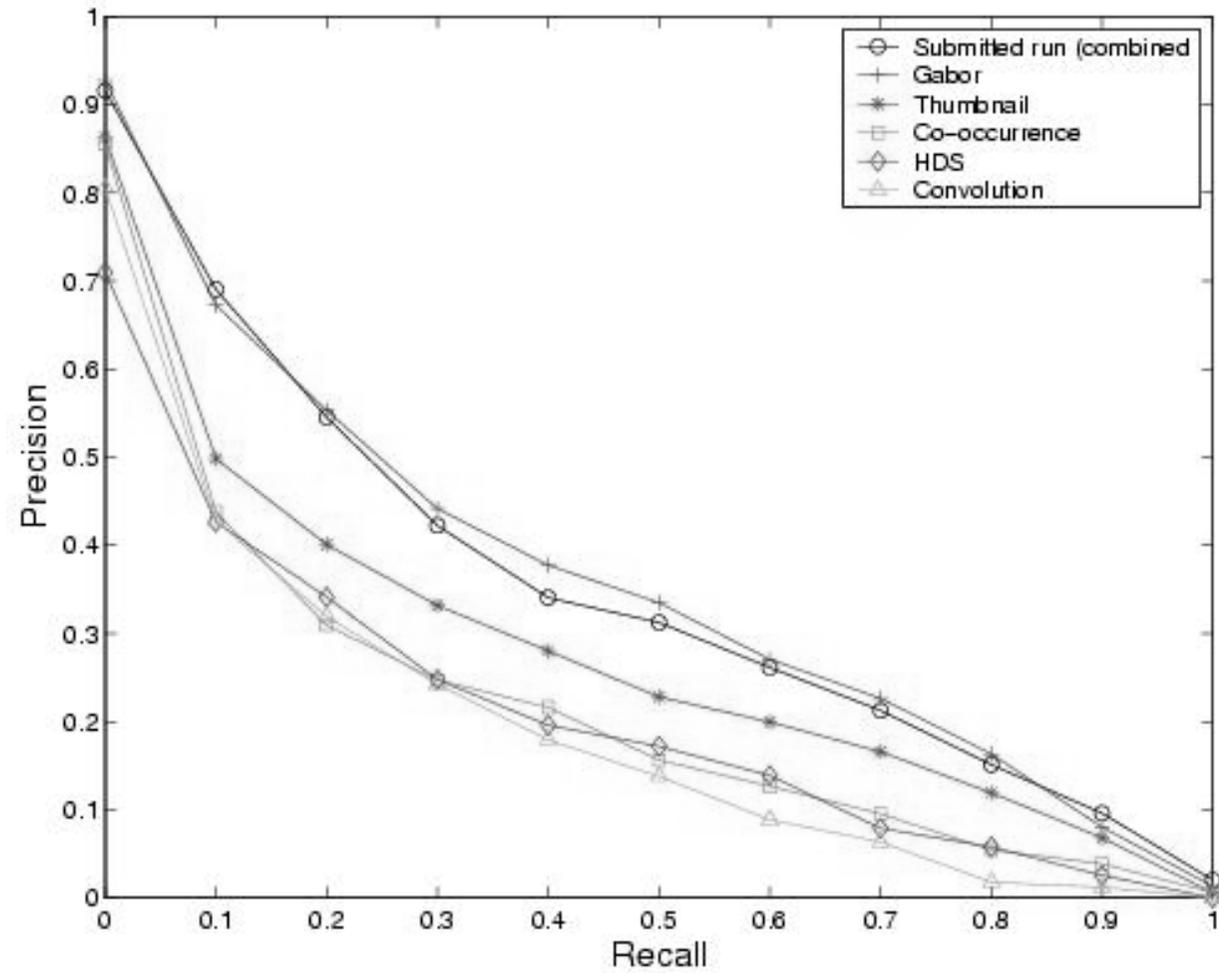
Query



# Results

M.A.P.

34.5%



## Fusing features

$$D^W(Q, i) = \sum_f w_f \times d_f(Q, i)$$

- Convex combination
- $W$  is the plasticity of the retrieval system

# Approaches to feature weighting

- Relevance feedback
- SVM metaclassifier
  - Find optimum weights for retrieving an image class
  - [Yavlinsky et al ICASSP 04]
- $NN^k$ 
  - Find the nearest neighbour for for a given weight set
  - [Heesch et al ECIR 04]

# NN<sup>k</sup> Browsing



# Conclusions

- Gabor wavelet feature gave best retrieval performance for this test collection
- Browsing approach is useful for image search
- Next year...
  - Training data?

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