

# SIMILARITY-BASED PARTIAL IMAGE RETRIEVAL GUARANTEERING SAME ACCURACY AS EXHAUSTIVE MATCHING

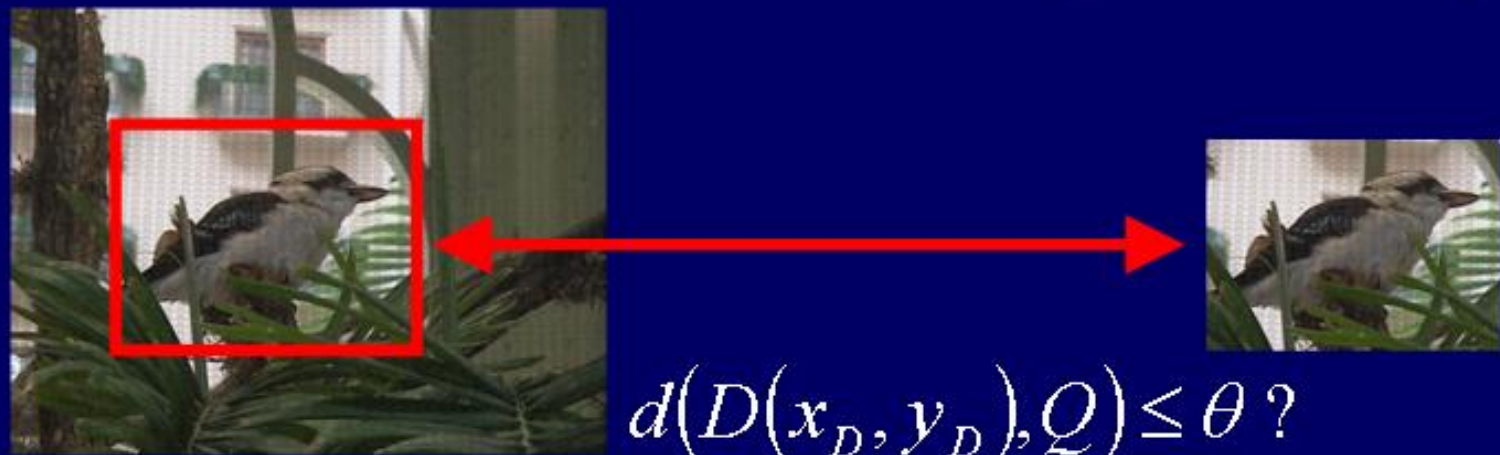
Akisato Kimura, Takahito Kawanishi, and Kunio Kashino

NTT Communication Science Laboratories, NTT Corporation

Contact Address: akisato@eye.brl.ntt.co.jp

## SUMMARY

To prevent an explosive growth of storage space for indexing in region-based CBIR, we propose a new framework for similarity-based partial image retrieval called **SPIRE**. (Sparse-index-based Partial Image REtrieval)



### Result summary

- Reduce index size to 1/250
- *Theoretically* guarantee same accuracy as exhaustive matching

## BACKGROUND

CBIR (Content-Based Image Retrieval)

Object-based : ex. QBIC, ExSight  
Trying to decompose an image into individual objects and give indexes

### Problems

Needs domain-specific constraints to improve accuracy

Region-based

Determine similarities of whole images based on partial similarities of images

### Problems

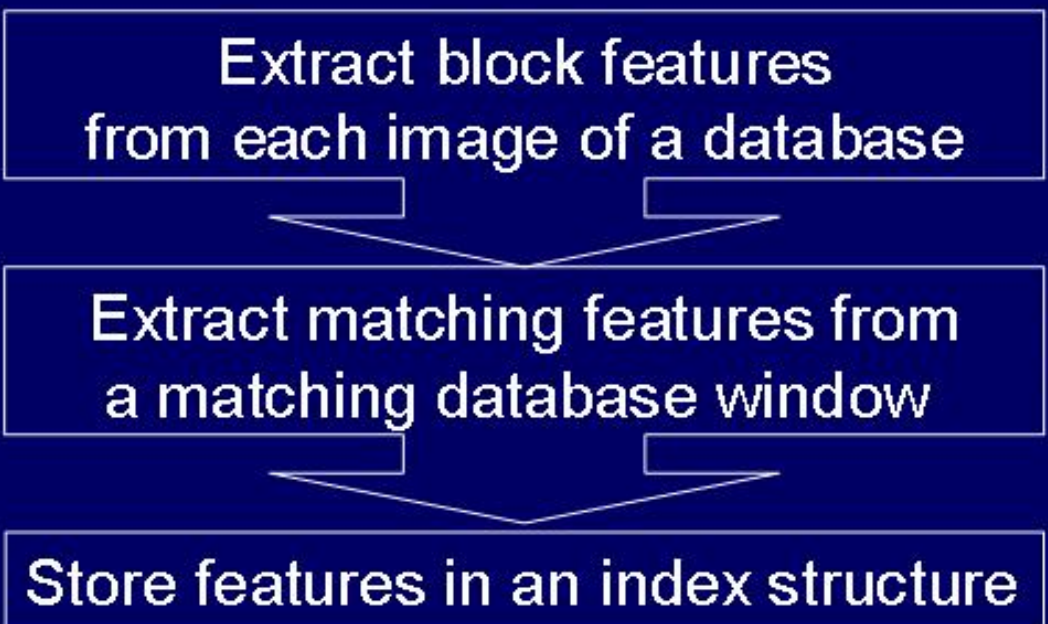
Requires a huge amount of calculation and storage space for index structures to maintain accuracy

## WHAT IS SPIRE ?

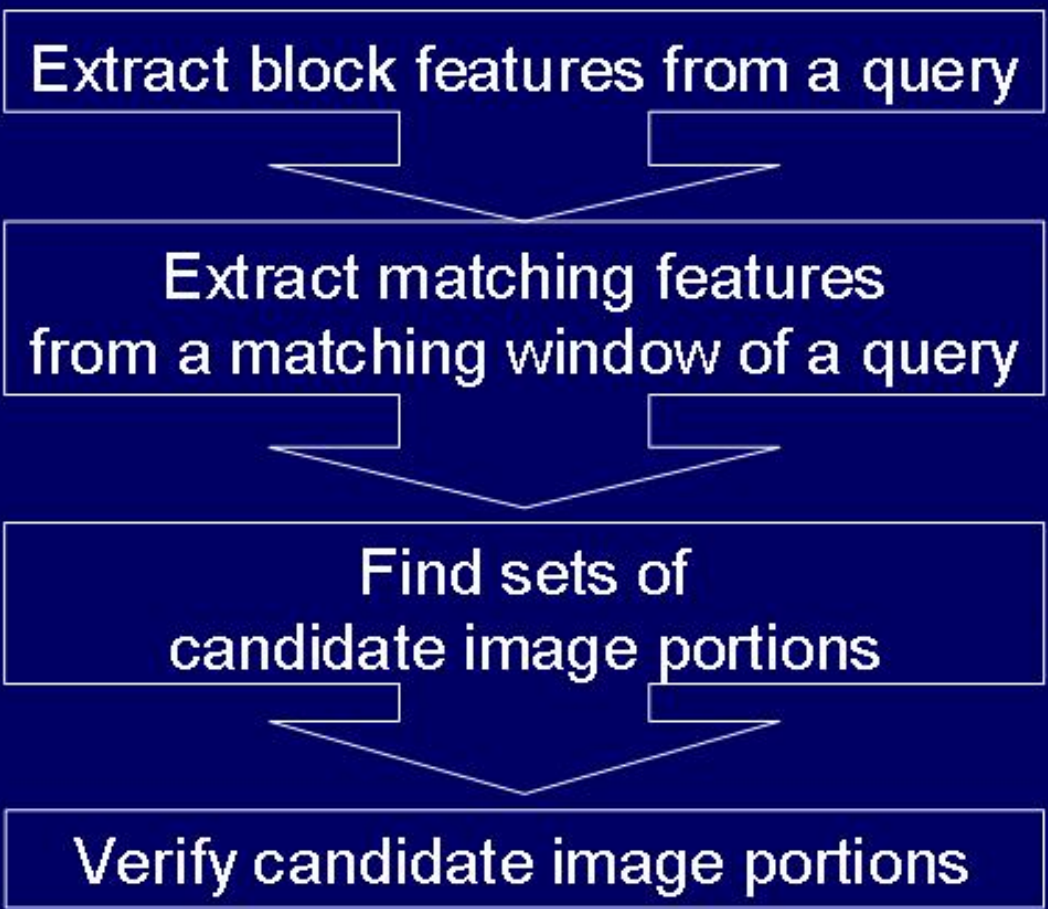
SPIRE extends the indexing algorithm of the fast matching methods [1] [2] for time-series signals and applies it to partial image retrieval

- Index image portions *sparse* for a database
- Extract image portions from a query by using a *sliding* window

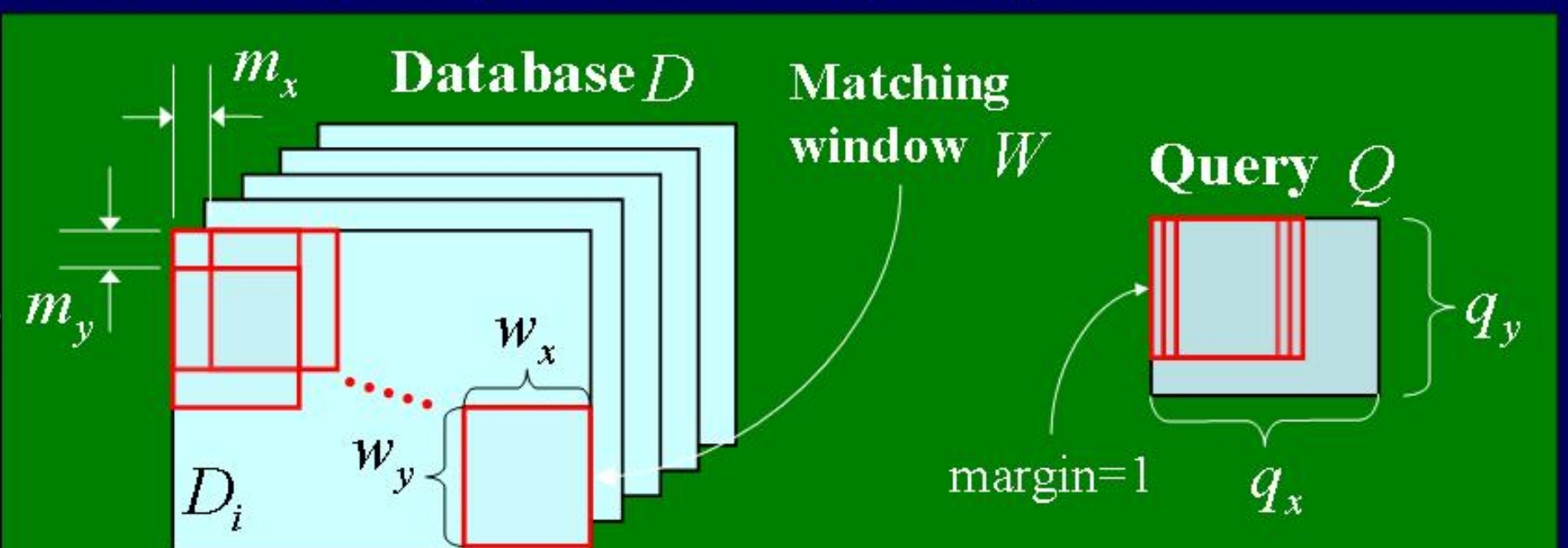
### Preprocessing



### Retrieving



### Determining margin (window spacing)



To avoid false dismissals, the margin, the size of a matching window and the size of a query image must satisfy

$$q_x \geq w_x + m_x, \quad q_y \geq w_y + m_y$$

$m_x, m_y$  : larger  $\rightarrow$   $w_x, w_y$  : small  $\rightarrow$  false alarm : increasing  
 $w_x, w_y$  : larger  $\rightarrow$   $m_x, m_y$  : small  $\rightarrow$  index size : increasing

### Determining pruning threshold

We select relevant features satisfying

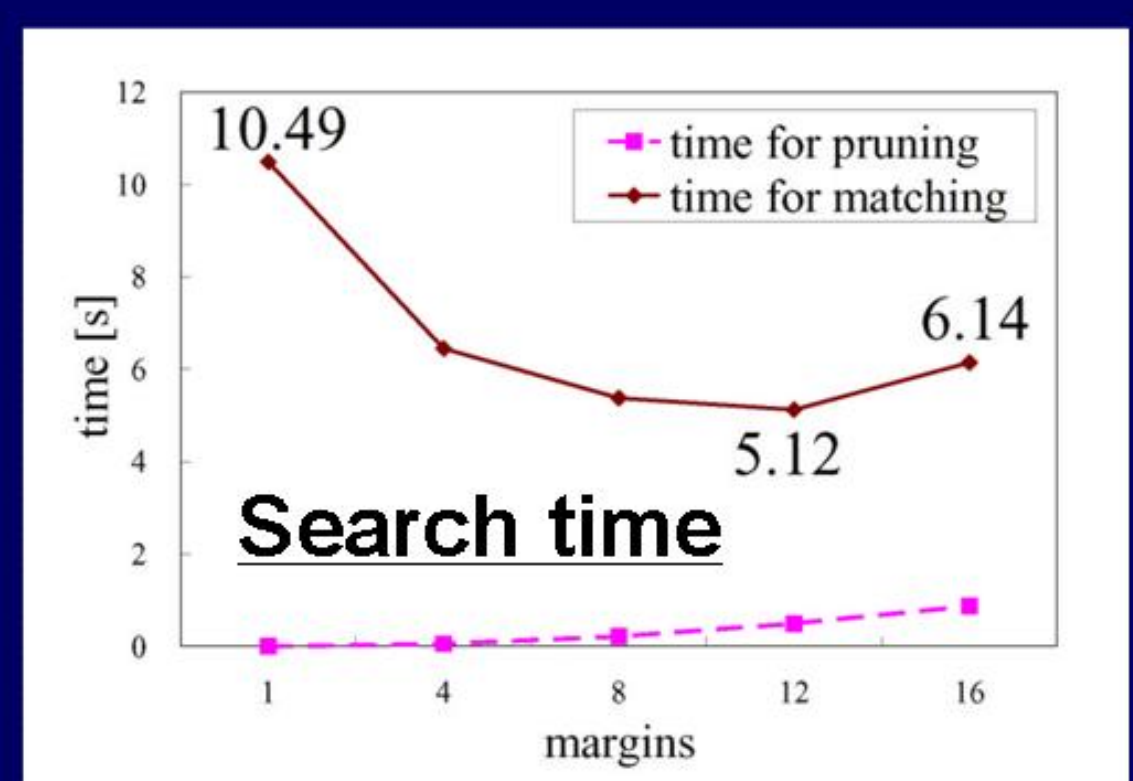
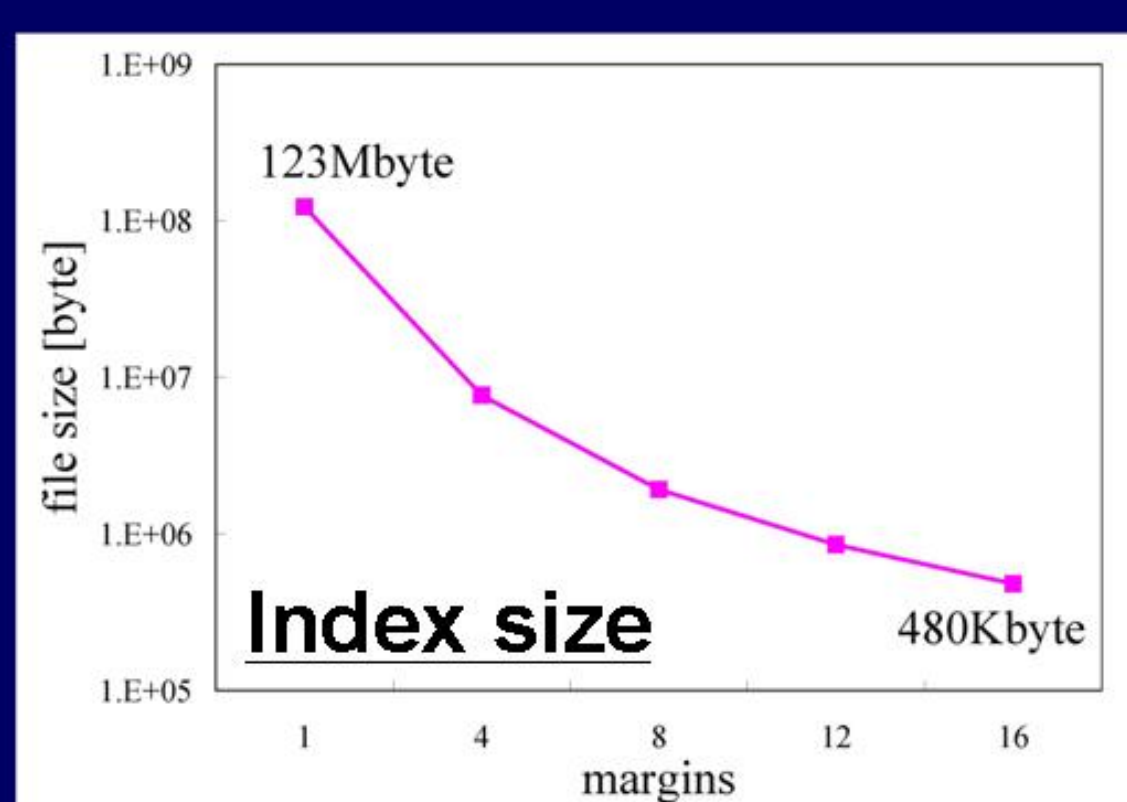
$$d(f_D^{(W)}(x_D, y_D), f_Q^{(W)}(x_Q, y_Q)) \leq \hat{\theta}$$

To avoid false dismissals, the pruning threshold must satisfy  $\hat{\theta} \geq \theta \cdot N^{-1}$  where

$$N = N_x \cdot N_y$$

$$N_i = \max(1, \lfloor (q_i + 1) / \min(w_i, m_i) - 1 \rfloor) \quad (i = x, y)$$

## EXPERIMENTS



cf. Exhaustive matching = 117.54sec

References:

- [1] Y.Moon et al. "Duality-based subsequence matching in time-series signals", Proc. of ICDE, 2001
- [2] Y.Moon et al. "GeneralMatch: A subsequence matching method in time-series signals based on generalized windows", Proc. of ACM SIGMOD, 2002
- [3] A.Kimura et al. "A quick search method for multimedia signals using global pruning", Systems and Computers in Japan, Vol.34, No.13, 2003.

---Conditions---

- PC: CPU = Intel Pentium4 2.8GHz, RAM = 1.0Gbyte
- Database: real-life image data set (1000 images, 384x256 pixels)
- Queries: extracted from database (10 images, 80x80 pixels)
- Size of matching windows: 64x64 pixels
- Features: average RGB values of blocks
- Index structure: global pruning method [3] (VQ-based index & pruning)