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Faculty Summit

10
YEAR ANNIVERSARY

***A Semantic and “Kansei”
Computing System
for Analyzing Global Environments***

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“Kansei (感性)” and Semantic Multimedia DB Systems

In the design of multimedia database systems, one of the most important issues is:

*How to deal with “semantics” and
“Kansei” of human beings.*

Multimedia DB system for *“Kansei”* information

The concept of “Kansei” includes several meanings on sensitive recognition, such as:

(1) “impression”

(2) “emotion”

(3) “human senses”

(4) “feelings”

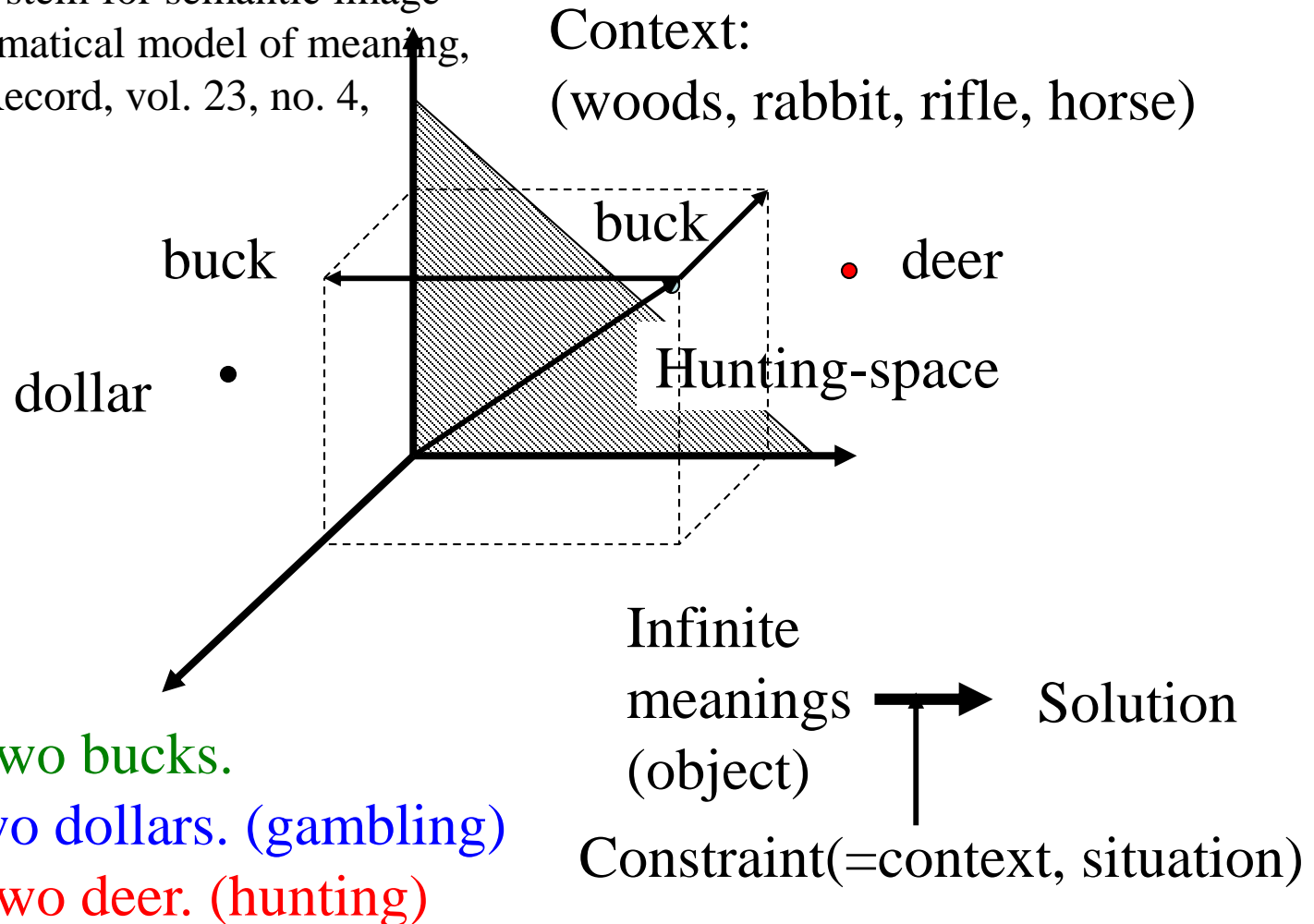
(5) “sensitivity”

(6) “psychological reaction”

(7) “physiological reaction”

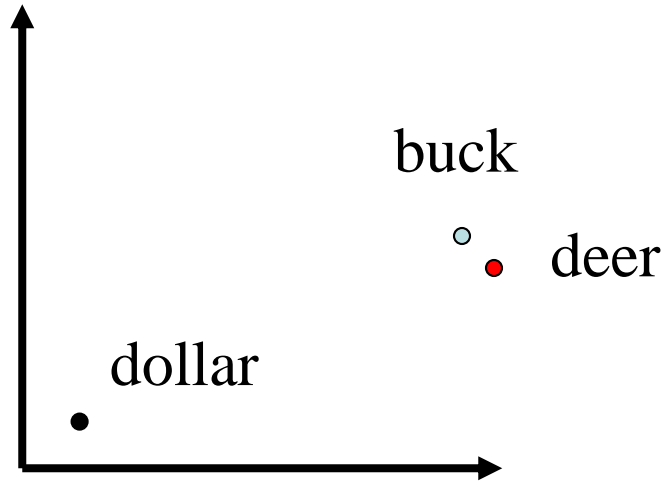
Basic Idea of the Mathematical Model of Meaning(MMM) (1993—) (2000, 710, 619, 425, 417 dimensions in our current implementation)

(Kiyoki, Y., Kitagawa, T. and Hayama, T.:
A metadatabase system for semantic image
search by a mathematical model of meaning,
ACM SIGMOD Record, vol. 23, no. 4,
pp. 34-41, 1994.)



Basic Idea

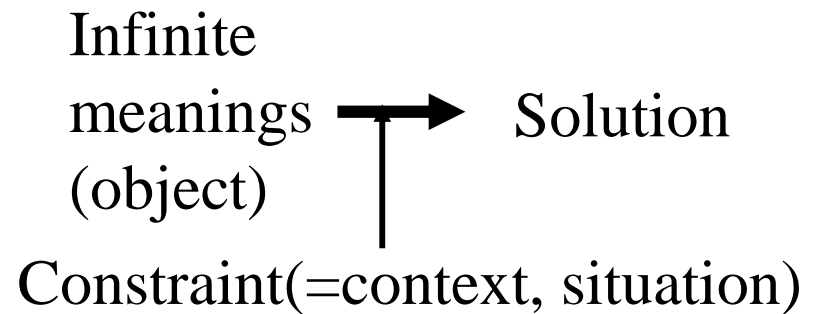
Context:
(woods, rabbit, rifle, horse)



He shot two bucks.

He bet two dollars. (gambling)

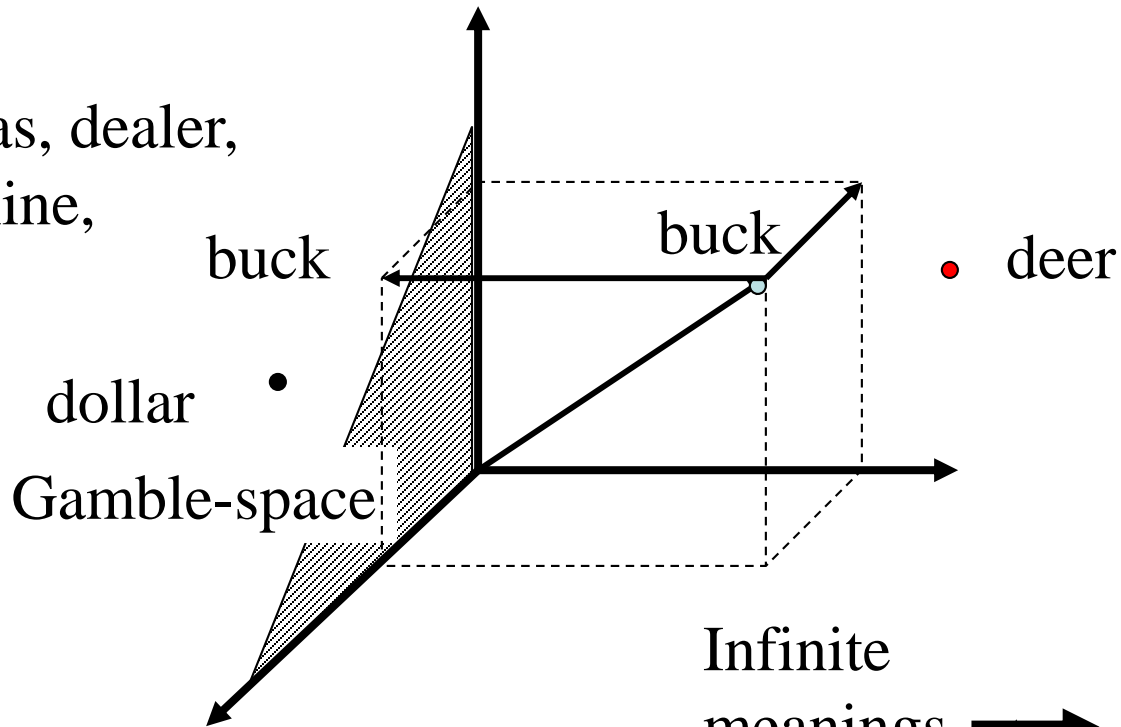
He shot two deer. (hunting)



Basic Idea

Context:

(Las Vegas, dealer,
slot machine,
chip)



He shot two bucks.

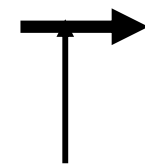
He bet two dollars. (gambling)

He shot two deer. (hunting)

Infinite

meanings
(object)

Constraint(=context, situation)

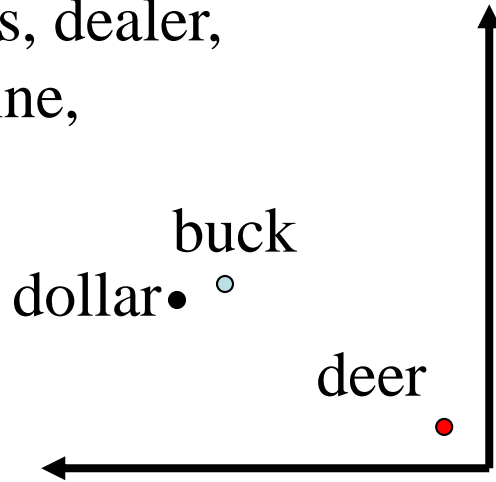


Solution

Basic Idea

Context:

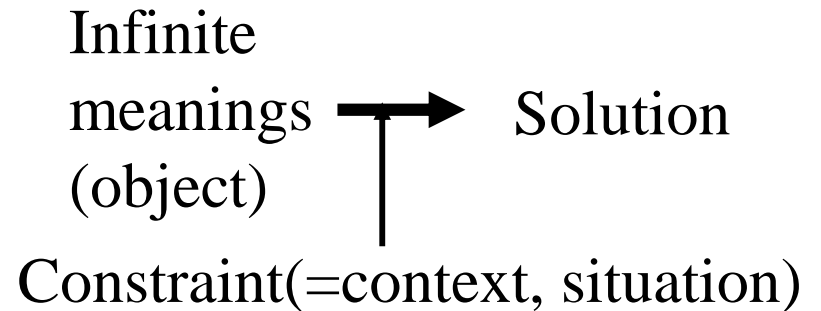
(Las Vegas, dealer,
slot machine,
chip)



He shot two bucks.

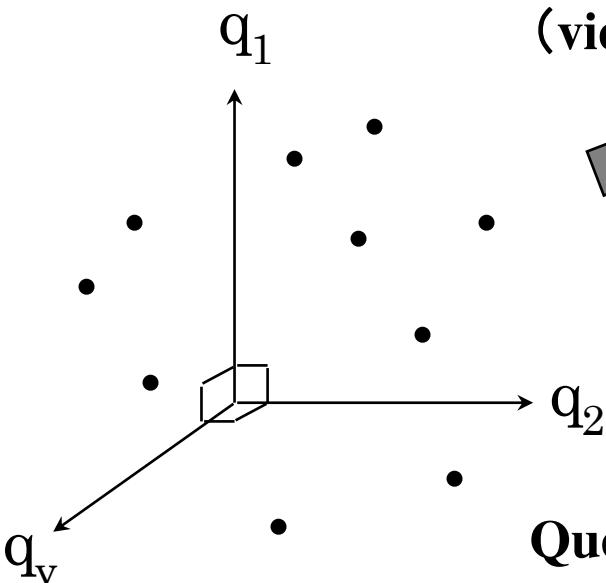
He bet two dollars. (gambling)

He shot two deer. (hunting)

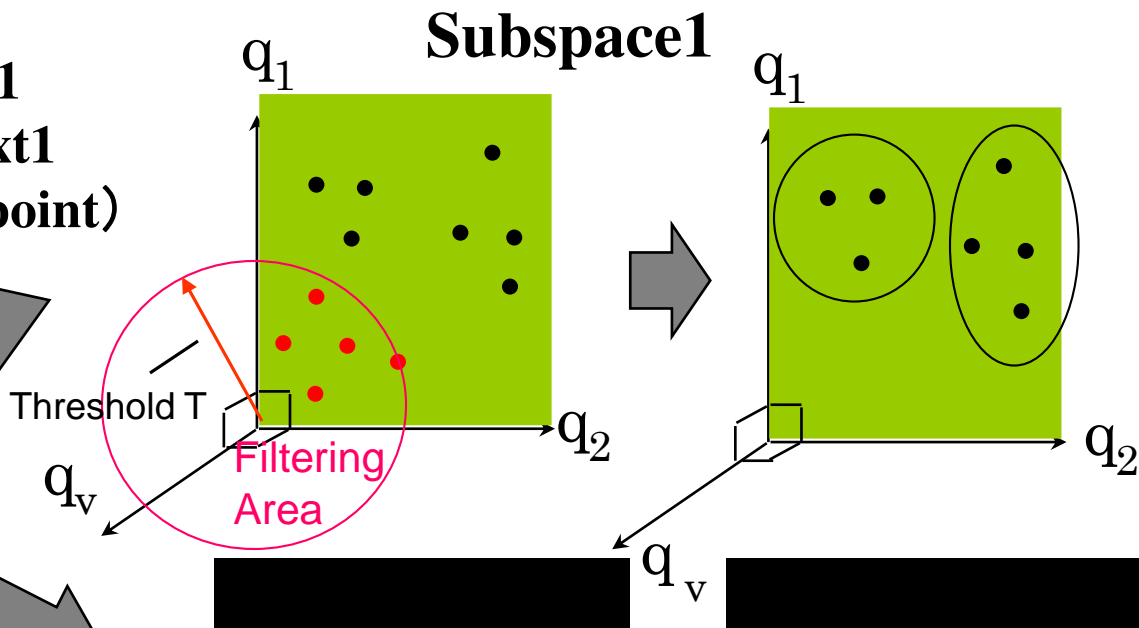
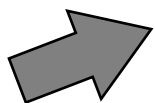


An Overview of The Mathematical Model of Meaning (MMM)

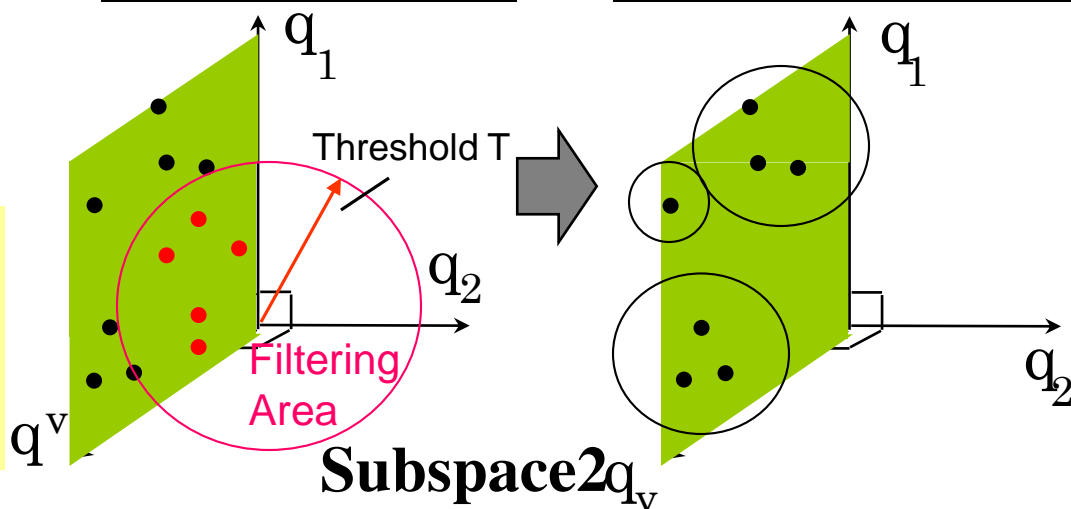
Semantic Space



**Query1
Context1
(viewpoint)**



**Query2
Context2**



Applying proposing method to Semantic Associative Search Method based on mathematical model of meaning

Kiyoki, Y., Kitagawa, T. and Hayama, T.:A metadatabase system for semantic image search by a mathematical model of meaning, ACM SIGMOD Record, vol. 23, no. 4, pp. 34-41, 1994.

Current Applications of Mathematical Model of Meaning (MMM)

- Image and Video Data Retrieval
- Data Retrieval from Scenario(movie, story)
- Music Data Retrieval
- Knowledge Grid Computing for Global Environment-Analysis
- Medical Document Data Clustering and Mining
- International Relations
- Environmental and Medical Space Integration
- Semantic Interoperability for Heterogeneous Databases
- Semantic Search Engine for WWW
- Multilanguage-based Multimedia Data Retrieval

Global Environments:
“Mudflow Warning System”
Demonstration

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Mudflow in Indonesia

“Mudflow Warning System” Demonstration



Mudflow Semantic Elements



Mud



Steam gas



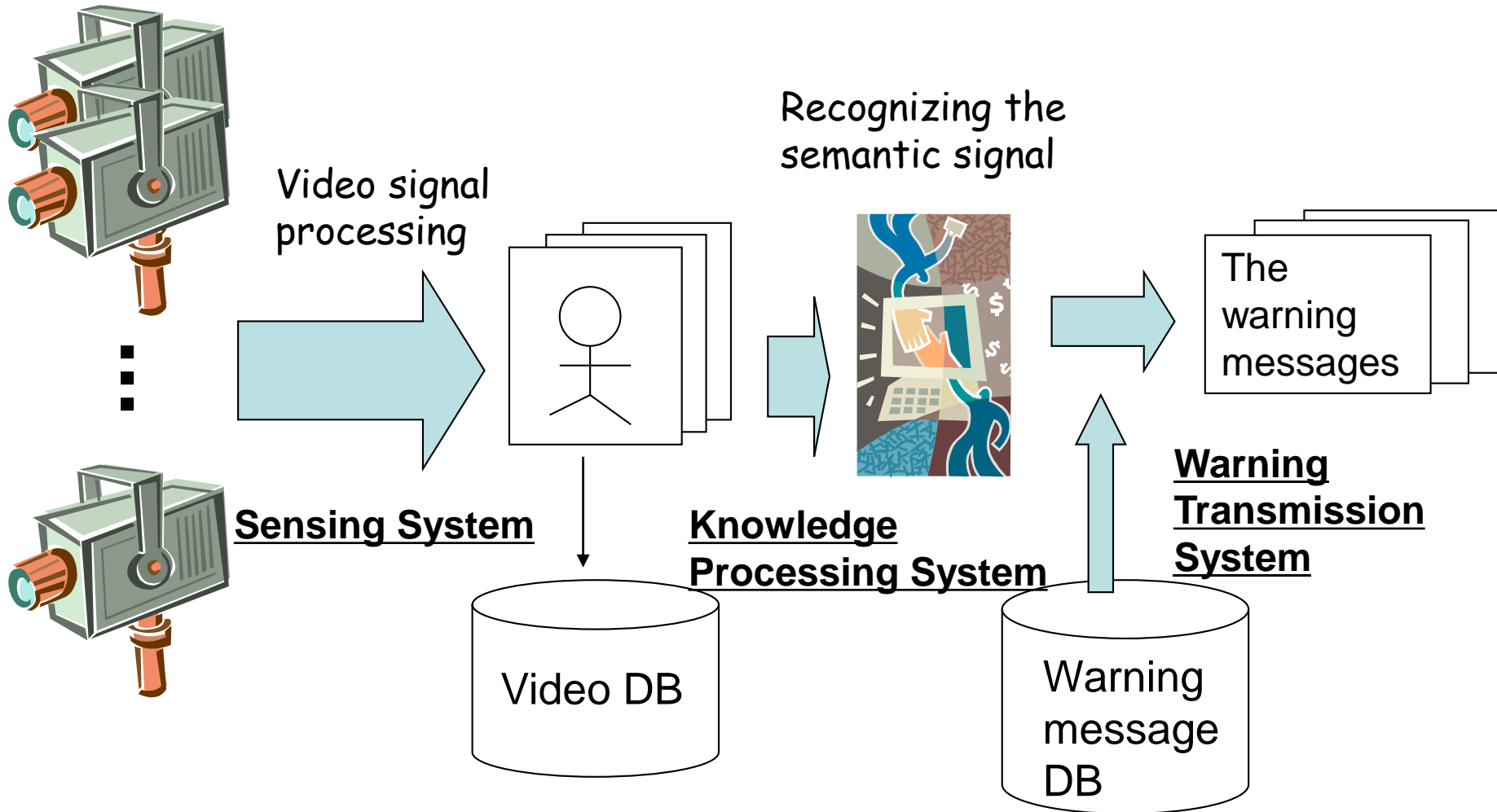
Disaster Monitor Cameras



The Mudflow Warning system

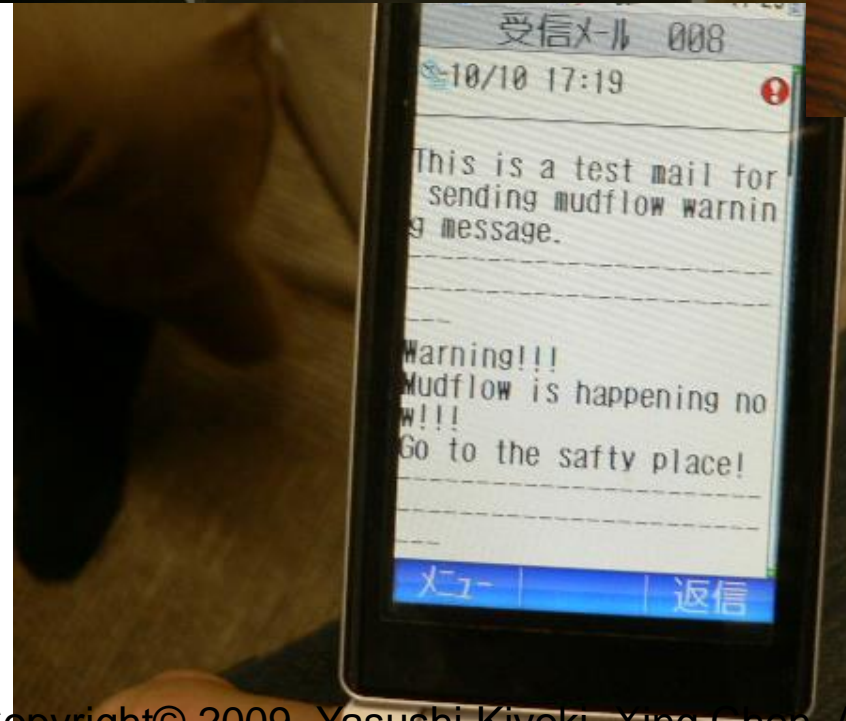
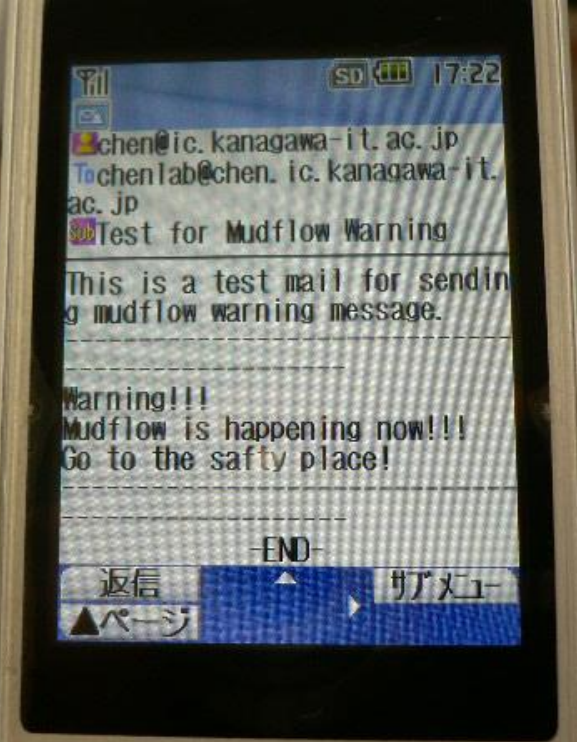
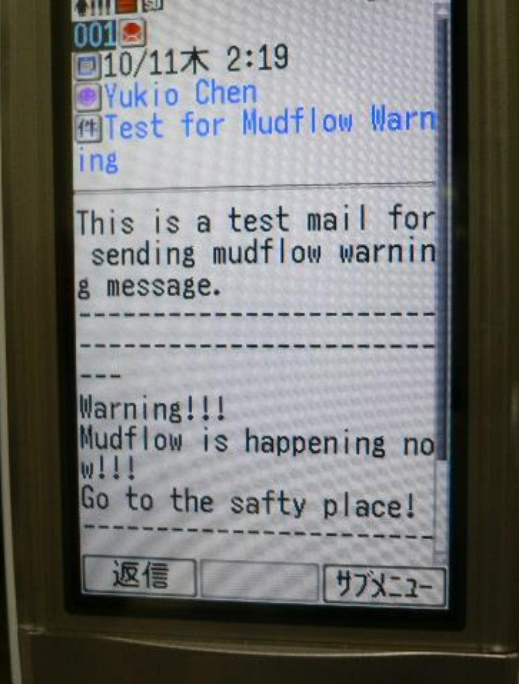
System construction

Monitoring cameras



The Scene of the warning system



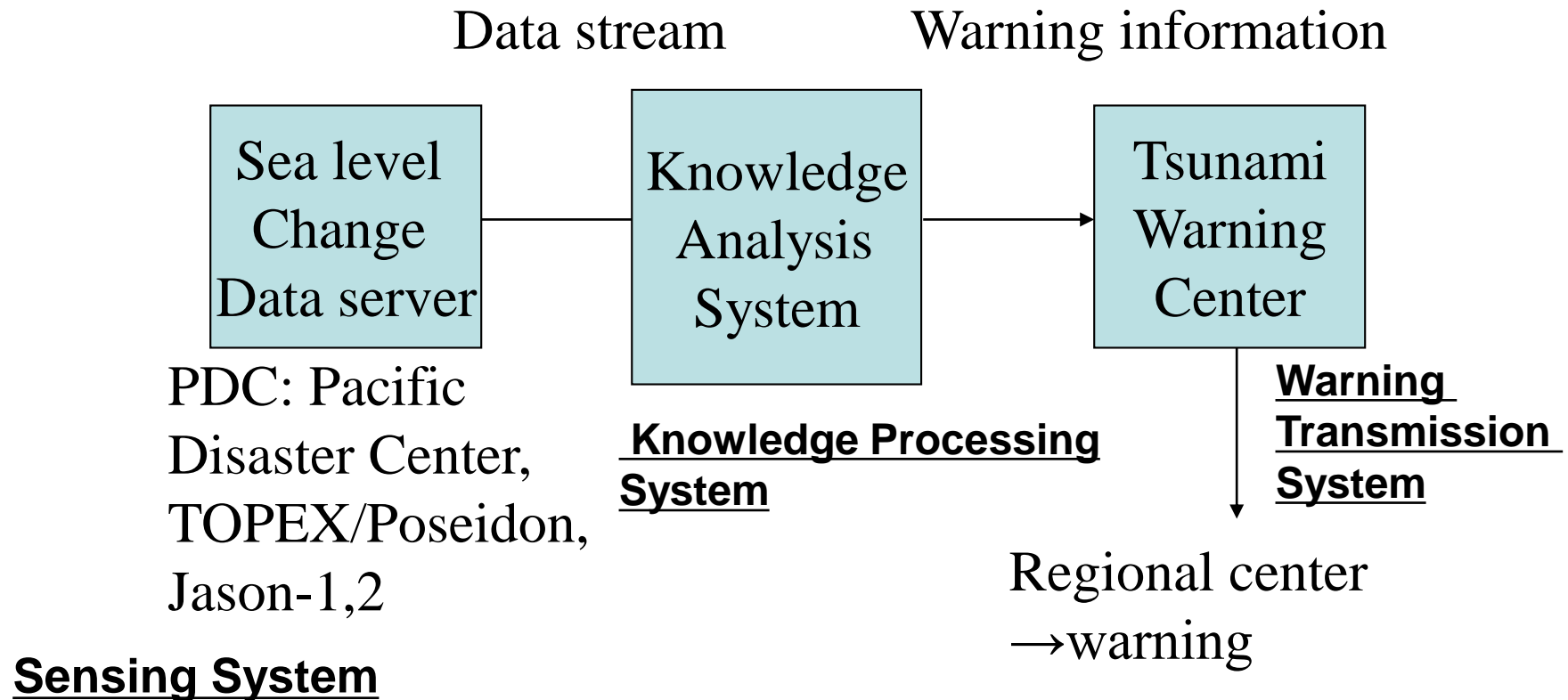


The warning message is received by three mobile-phones in real-time.

Global Environments:

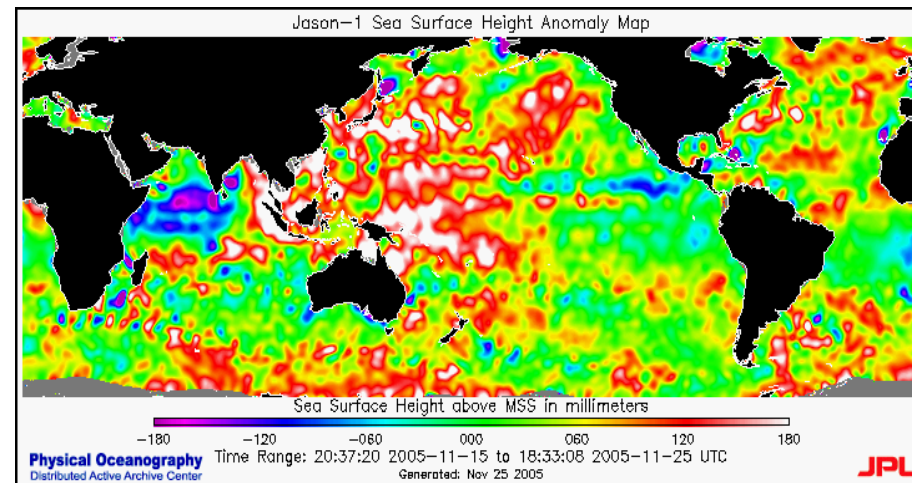
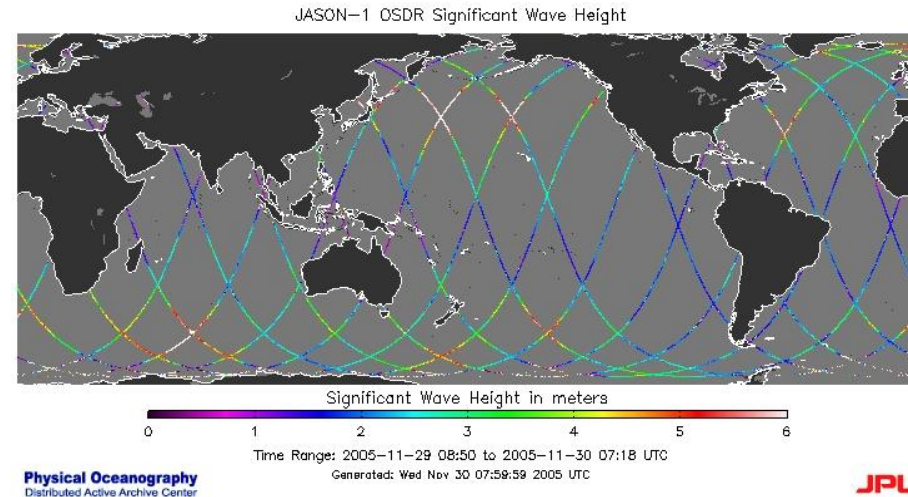
Global Risk Management

— Disaster warning system—
(Ex. Tsunami warning system)



Example of the data from Topex / Poseidon and Jason satellites

- Topex/Poseidon&Jason-1
 - Launched on Aug. 10 1992 and in Dec.2001
 - Joint mission between U.S.A. and France
- Specific features
 - Microwave altimeter
 - Non sun-synchronous
 - Inclination: 66°
 - Global coverage within 10 days



Example of the retrieval results related to “Tsunami”

The screenshot shows a web browser window titled "TOPEX/Poseidon - PostGIS - Microsoft Internet Explorer". The address bar displays "http://localhost/test/". The main content area features a map of Japan with a grid overlay. Three red circles on the map indicate search results, located in the Kanto region. To the left of the map are search filters:

適地検索条件

日付: 19980101 ~ 19981231
波高: 0 m 以上
ジオ高: -3.157 m 以上
風速: 0 m/s 以上

Buttons: 検索, reset

各値の範囲

日付: 19980101 ~ 19981231
波高: 0.0 ~ 655.35
ジオ高: -3.157 ~ 49.813
風速: 0.6 ~ 25.5

To the right of the map are navigation controls:

ナビゲーション

移動
拡大
縮小
拡大/縮小率 2
デフォルト

At the bottom of the browser window, a status bar shows "ページが表示されました" and "イントラネット".

Global Environments:
Knowledge Cluster System Project
in NICT

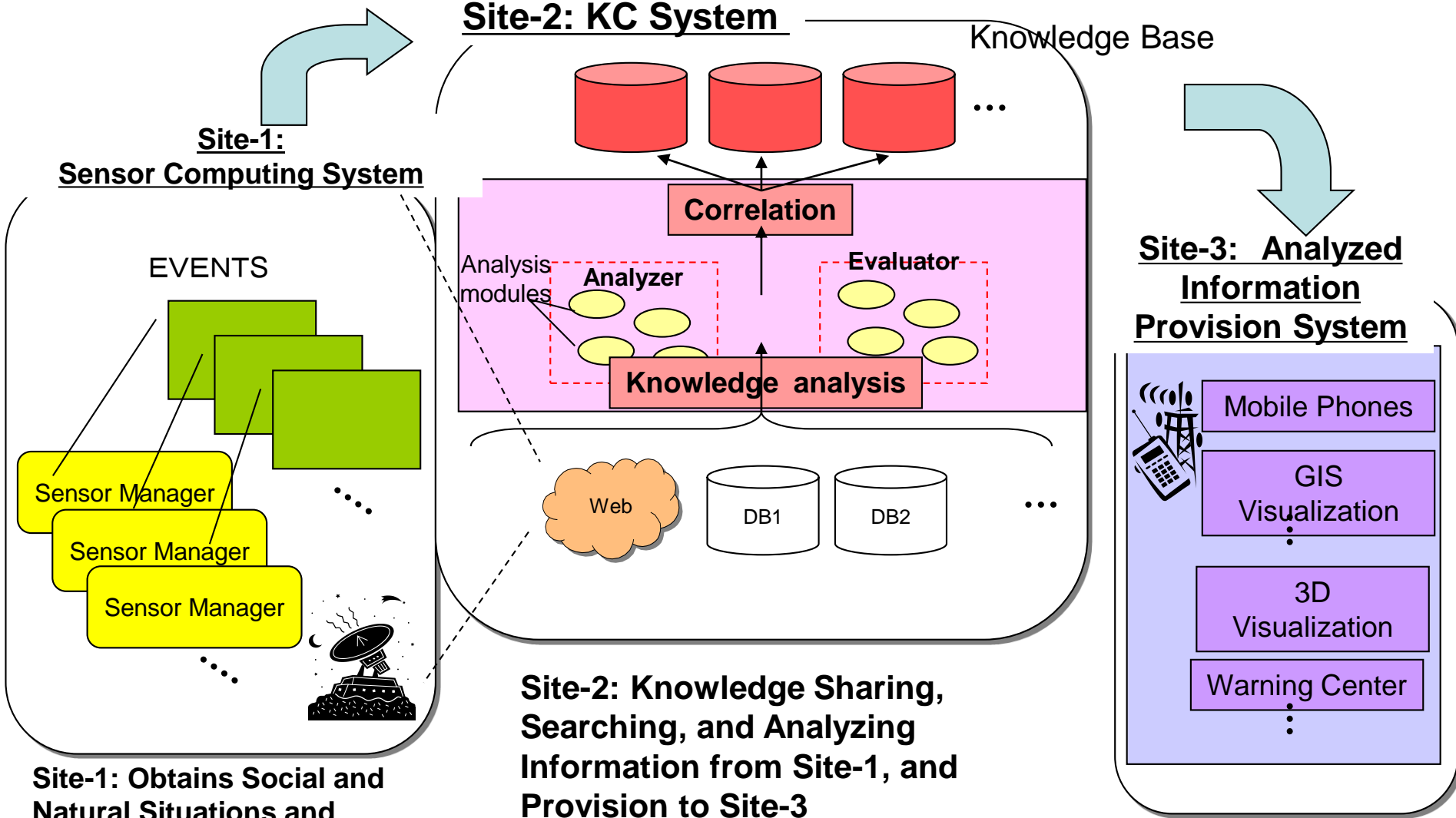
(National Institute of Information and Communication
Technology)

Yasushi Kiyoki, Yutaka Kidawara, Koji Zetteu,
Takafumi Nakanishi, Kim Kyoung-Sook, Rong Zhang,
Hidenori Honma, Syuko Kato

NICT KEIHANNA RESEARCH CENTER

Knowledge Grid System

3-Sites Long-Distance Knowledge Sharing and Delivery System



Site-1: Obtains Social and Natural Situations and Environments by a computing system for Sensing

Site-2: Knowledge Sharing, Searching, and Analyzing Information from Site-1, and Provision to Site-3

Site-3: Providing Analyzed Information to Local Residents or Clients with Real time or Visualization Mechanisms

Knowledge Grid System

*Environmental Assessment Hot Mud Flow
East Java, Indonesia Final Technical Report:
UNITED NATIONS

Mudflow* Eruption Starts!



International Economy
Knowledge Base

roads damaged by mud
(damage to transportation)

Sidoarjo mud flow
Knowledge Base

Connecting
each expert
knowledge
existing
independently



Environment
Knowledge Base

water pollution,
heavy metal pollution,
and ground pollution, etc



Healthcare
Knowledge Base

Damage of
sulfur compound gas

delivering disaster
information quickly
to people

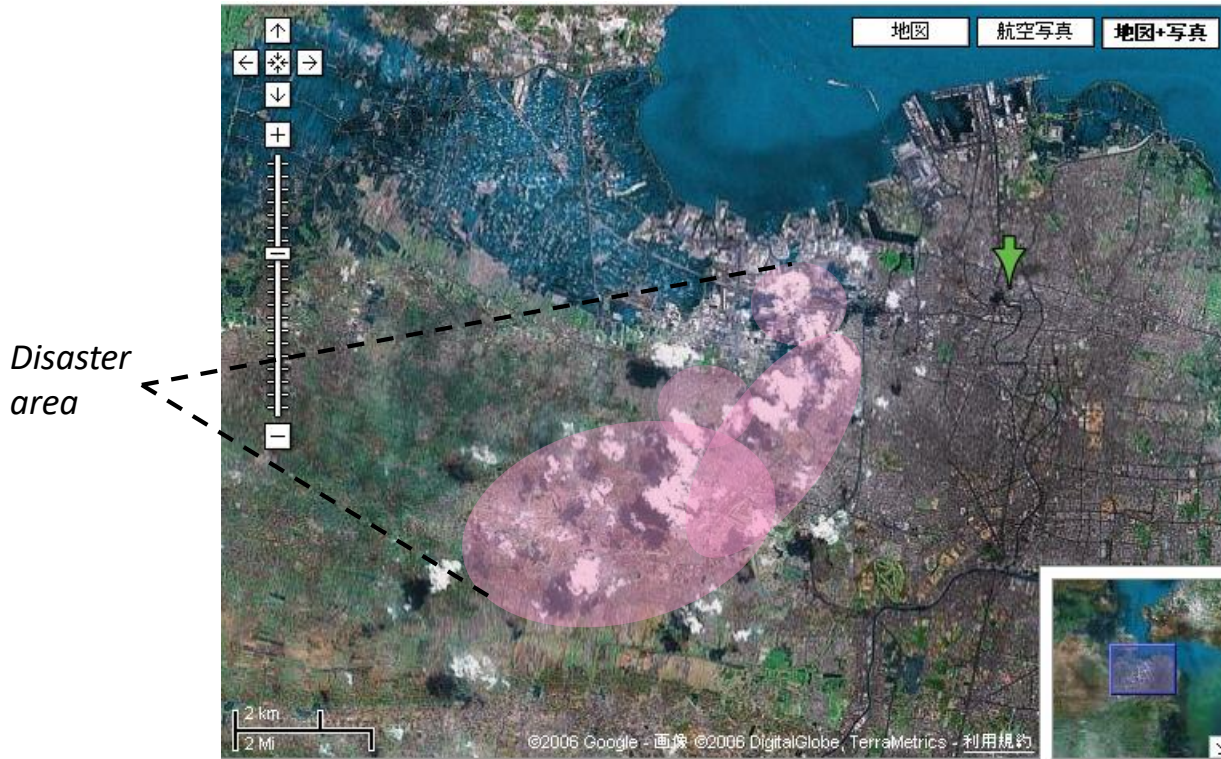
Possibility of secondary disaster and
influence on environmental fields, on
economy, and infectious disease .etc

Knowledge Communications for Estimating “Secondary” Impacts

- Some Events (especially second impacts, second disaster) affect to other fields.
- Connecting expert knowledge existing independently.
- Discovering the influences and the risks, spread from the event



Knowledge Grid System for Managing Risks on Natural Disasters– Indonesian Case –



Policy decision makers



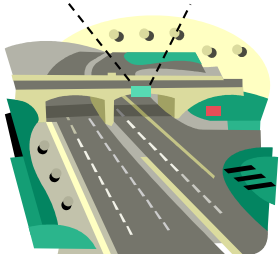
Deep analysis of risk information



Collection and analysis of disaster information

- Evaluations of local/global risks include those affecting:
 - Transportation risk
 - Healthcare risk
 - Economical risk
 - etc.
- Provision of risk information

Digital road sign of traffic damage

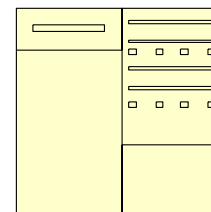


Mobile phones



First-aid actions to local people

Risk Management Server

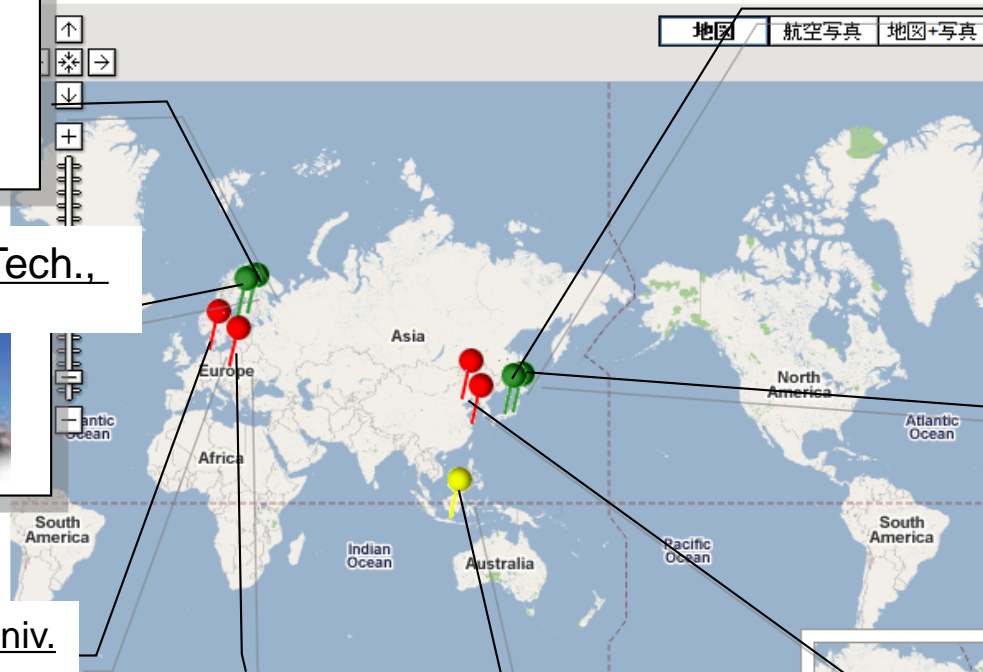


International Research Collaboration for Knowledge Grid System Development

Univ. of Jyväskylä (Finland)



Global Knowledge Grid Node Map



NICT



Tampere Univ. of Tech., (Finland)



Keio Univ. SFC



Christian Albrechts Univ. at Kiel (Germany)



VSB-Technical Univ. of Ostrava (Czech Rep.)



EEPIS-ITS (Indonesia)

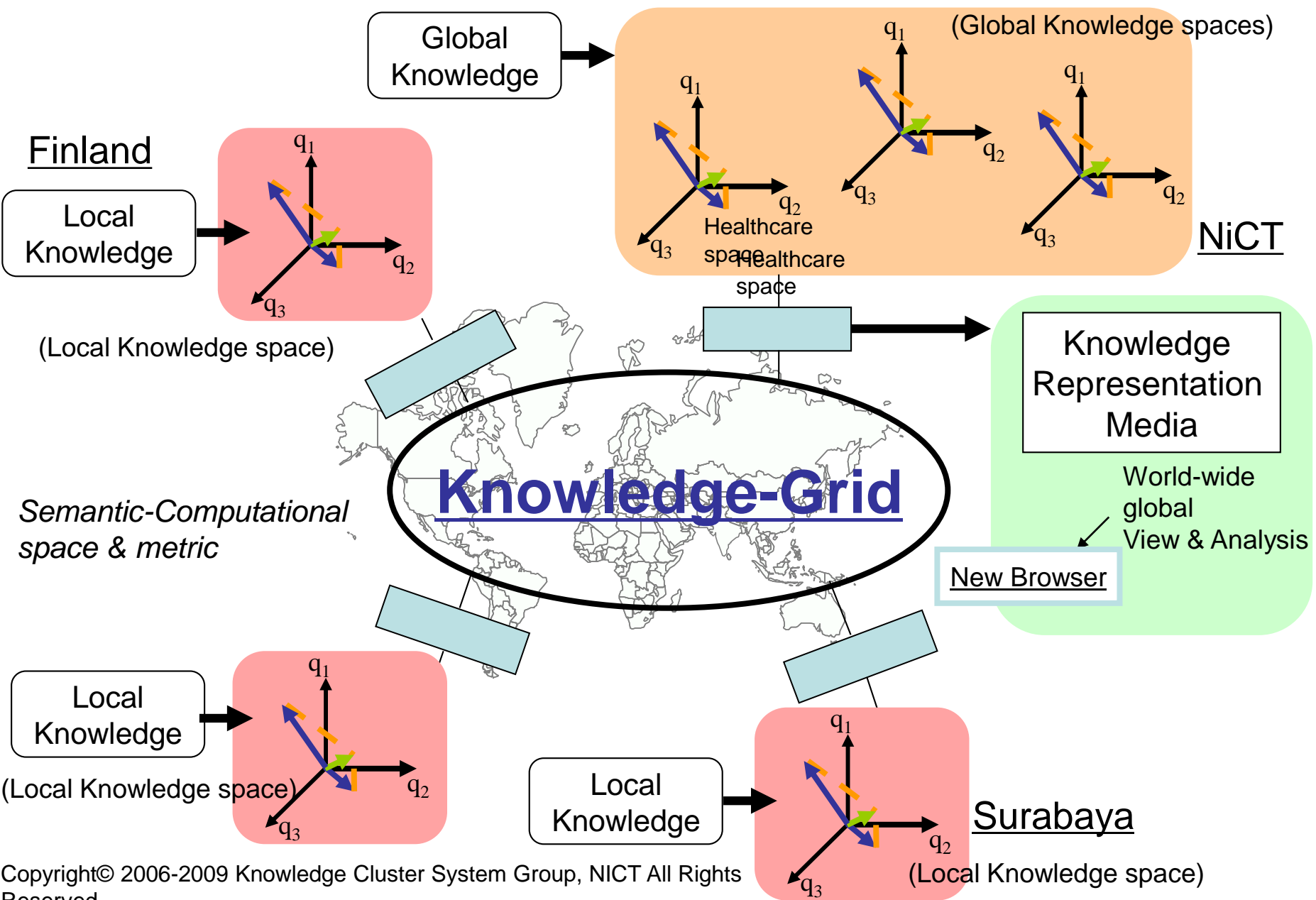


Geomaint MDS Dy

(Planned)

- Fudan Univ. (China)
- CAS (China)
- Pusan Univ. (Korea)

A Framework of our Knowledge Grid System



The **Sidoarjo mud flow** or **Lusi** (from **Lumpu** term of mud), is an ongoing

1. Select interested content

2. Search associative concepts over heterogeneous domains for a given subject (e.g., global warming)

Site 3
3. Generate links to related contents

Link-free Web browsing
Subject-oriented Web restructuring, instead of embedded hyperlinks

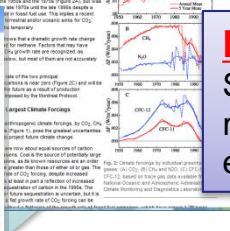
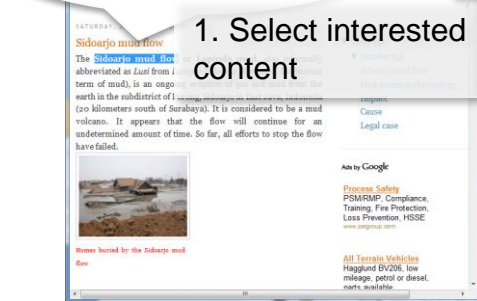
Proactive navigation
Travelling with story-lines

Appl. 1: Dynamic link generation for navigating cross-domain associative Web contents (subject: global warming)

Appl. 2: Associative navigation for Kyoto sightseeing

Appl. 3: Industrial cluster (= company network) construction support

Knowledge Grid



Communication channel establishment
Discover latent correlations among people, products and organizations

Operational Status of Global Knowledge Grid

Legend
● Running
● Maintenance
● Down
● Under construction

Global Knowledge Grid Node Map



Node	Location
● gig001	NICT Keihanna (Kyoto, Japan)
● gig002	NICT Koganei (Tokyo, Japan)
● gig003	NICT Keihanna (Kyoto, Japan)
● gig102	Univ. of Jyväskylä (Jyväskylä, Finland)
● gig103	Keio Univ. SFC (Kanagawa, Japan)
● gig104	Tampere Univ. of Tech. (Pori, Finland)
● gig105	Christian Albrechts Univ. at Kiel (Kiel, Germany)
● gig106	East China Normal Univ. (Shanghai, China)
● gig107	Korea Aerospace Univ. (Seoul, Korea)
● (T.B.A)	EEPIS-ITS (Surabaya, Indonesia)
● (T.B.A)	VSB-Technical Univ. of Ostrava (Czech Rep.)
● (T.B.A)	Chinese Academy of Science (Beijing, China) (as of June 6, 2009)

Our Vision & Mission in World-Wide Scopes

- **Knowledge Communication Infrastructure & Knowledge Base Development** in order to provide **adequate and comprehensible knowledge to world-wide areas**
 - *Building Knowledge Communication Infrastructure for Sharing and Integrating Multimedia Knowledge Resources*

Summary

- The semantic associative search system and the Mathematical Model of Meaning for multimedia databases dealing with Semantic and “*Kansei*” information
- 2000, 710, 619, 425, 417 Dimensional Semantic Spaces in our current implementation

Important Issue

- *Context Computing* for Semantics and “*Kansei (感性)*”

How to compute CONTEXTS?

Essential Combination for Computing

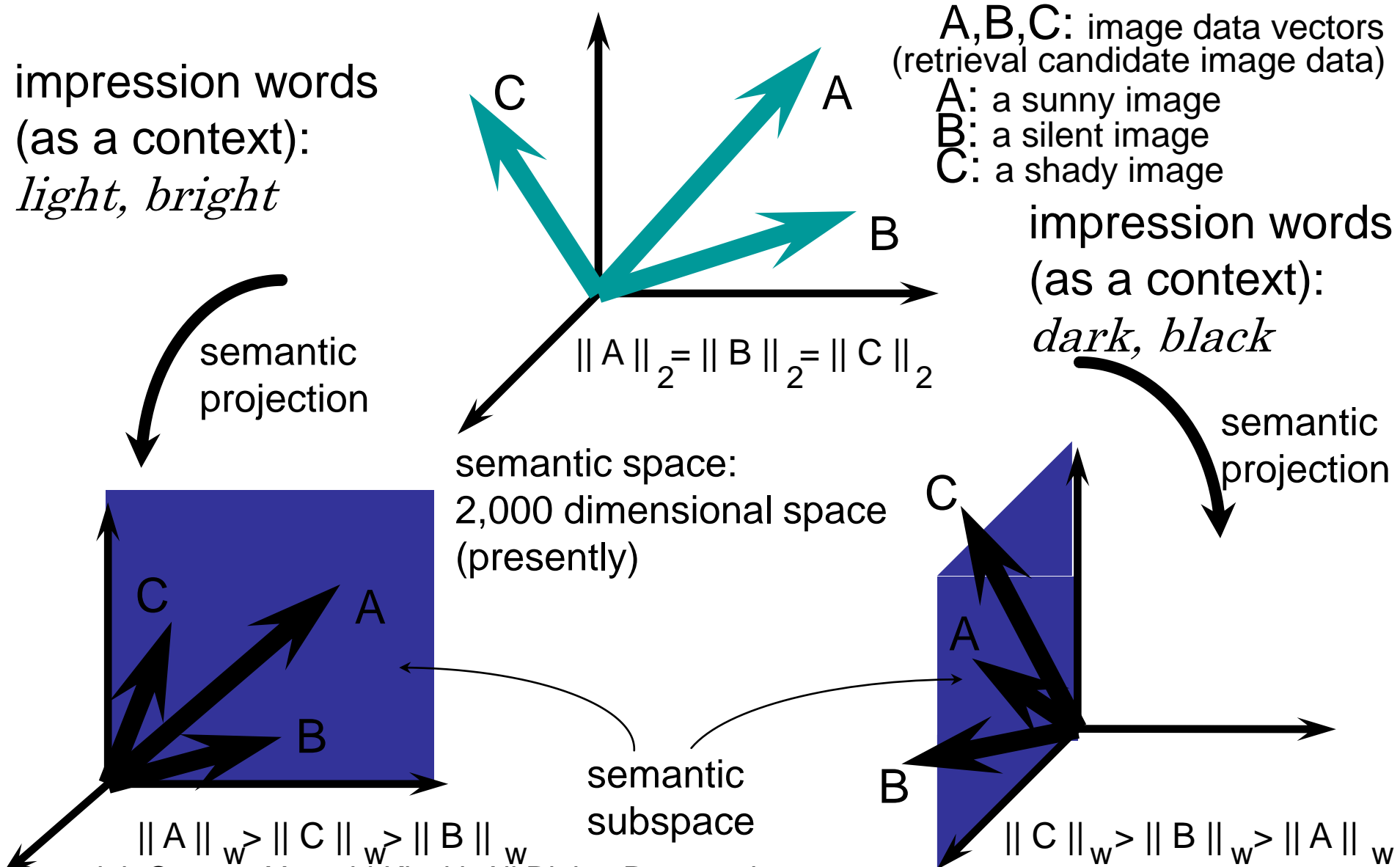
CONTEXT :

“Semantic Space Creation”

and

“Metric Setting”

The Semantic Associative Search Method (MMM: The Mathematical Model of Meaning)

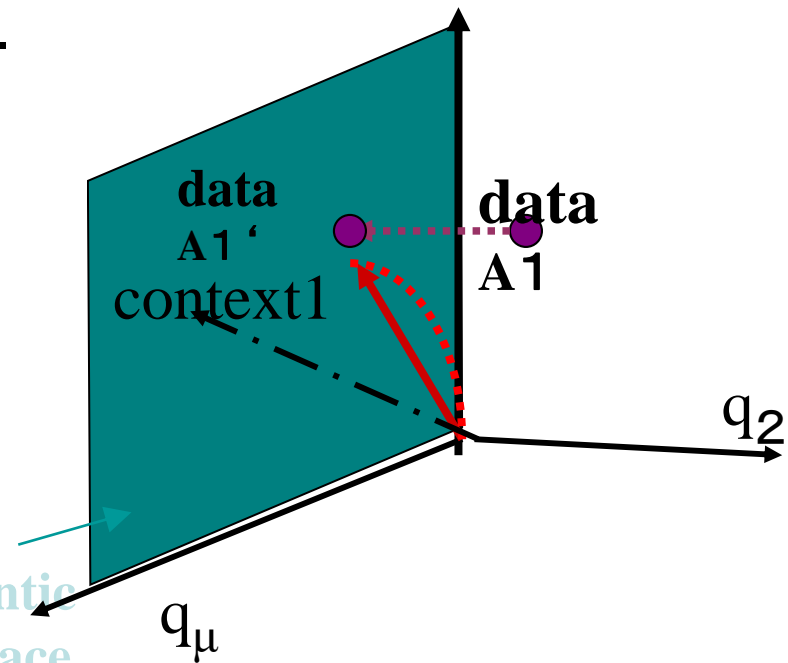


Context Recognition Mechanism in MMM

(1) The context represented as a set of impression words is given by a user.

(2) A subspace is selected according to the given context.
(Context Recognition)

(3) Media data are mapped onto the subspace, and the norm of the vector(A1') is calculated as the correlation value between media data and the context.



**the correlation of
data A1 for
given context1=(sad,silent)**

Automatic Metadata Extraction [1/2]

naofumi: Automatic Metadata Extraction for image data - Microsoft Internet Explorer

ファイル(E) 編集(E) 表示(V) お気に入り(A) ツール(T) ヘルプ(H)

戻る 進む 中止 更新 ホーム 検索 お気に入り 履歴 メール サイズ

アドレス(D) <http://www.mdbl.sfc.keio.ac.jp/%7Enaofumi/demos/demo025/> 移動 リンク

Automatic Metadata Extraction for image data

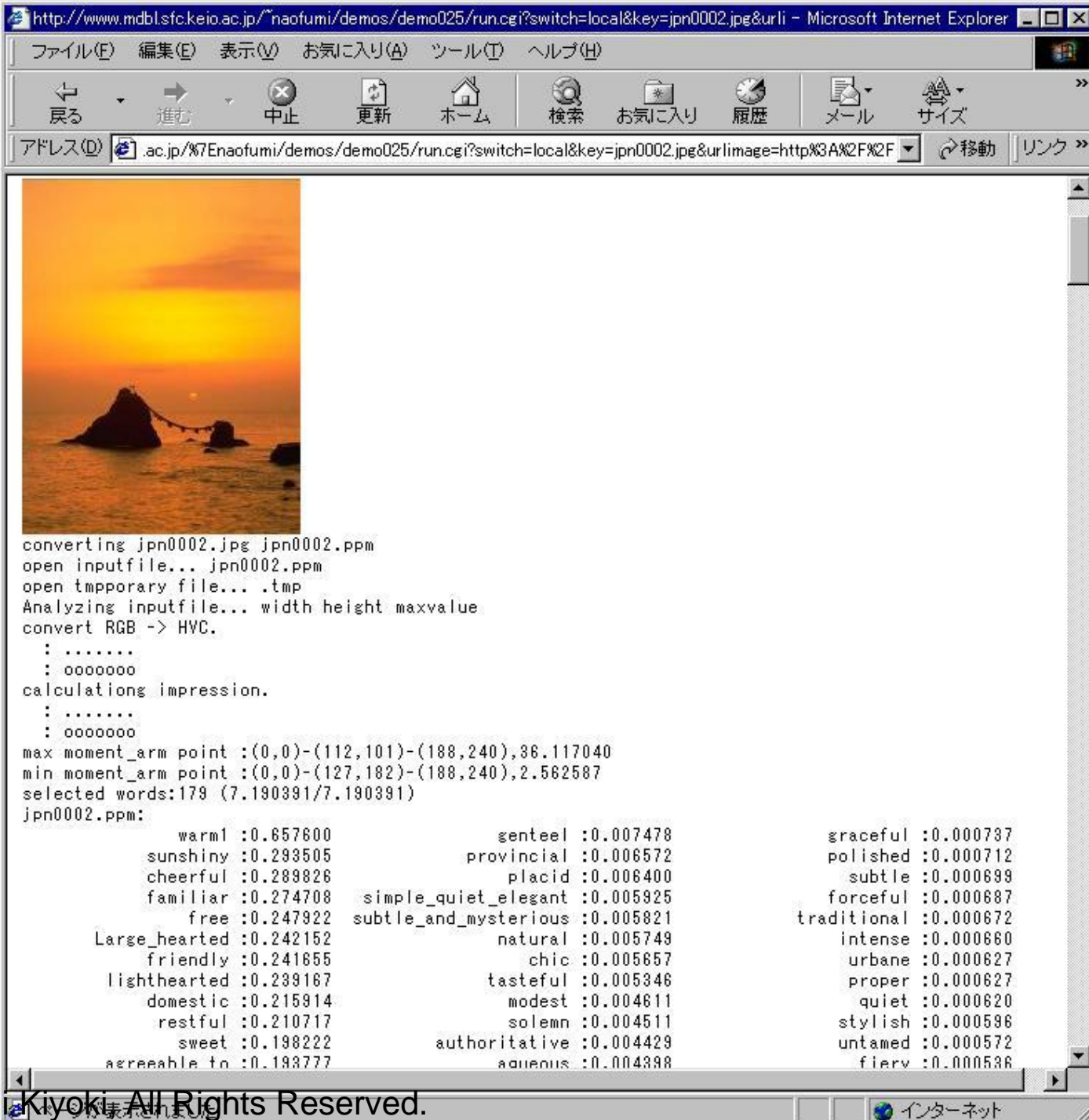
select key image:
 local file
 URL

[Louvre Museum](#)

jpn0002.jpg	jpn0004.jpg	jpn0006.jpg	jpn0009.jpg	jpn0011.jpg	
jpn0015.jpg	jpn0018.jpg	jpn0029.jpg	jpn0030.jpg	jpn0031.jpg	jpn0037.jpg
jpn0038.jpg	jpn0043.jpg	jpn0045.jpg	jpn0047.jpg	jpn0048.jpg	jpn0052.jpg
jpn0053.jpg	jpn0056.jpg	jpn0057.jpg	jpn0059.jpg	jpn0062.jpg	jpn0066.jpg
jpn0068.jpg	jpn0071.jpg	jpn0074.jpg	jpn0077.jpg	jpn0080.jpg	jpn0083.jpg

Copyright© 2009, Yasushi Kiyoki. All Rights Reserved. インターネット

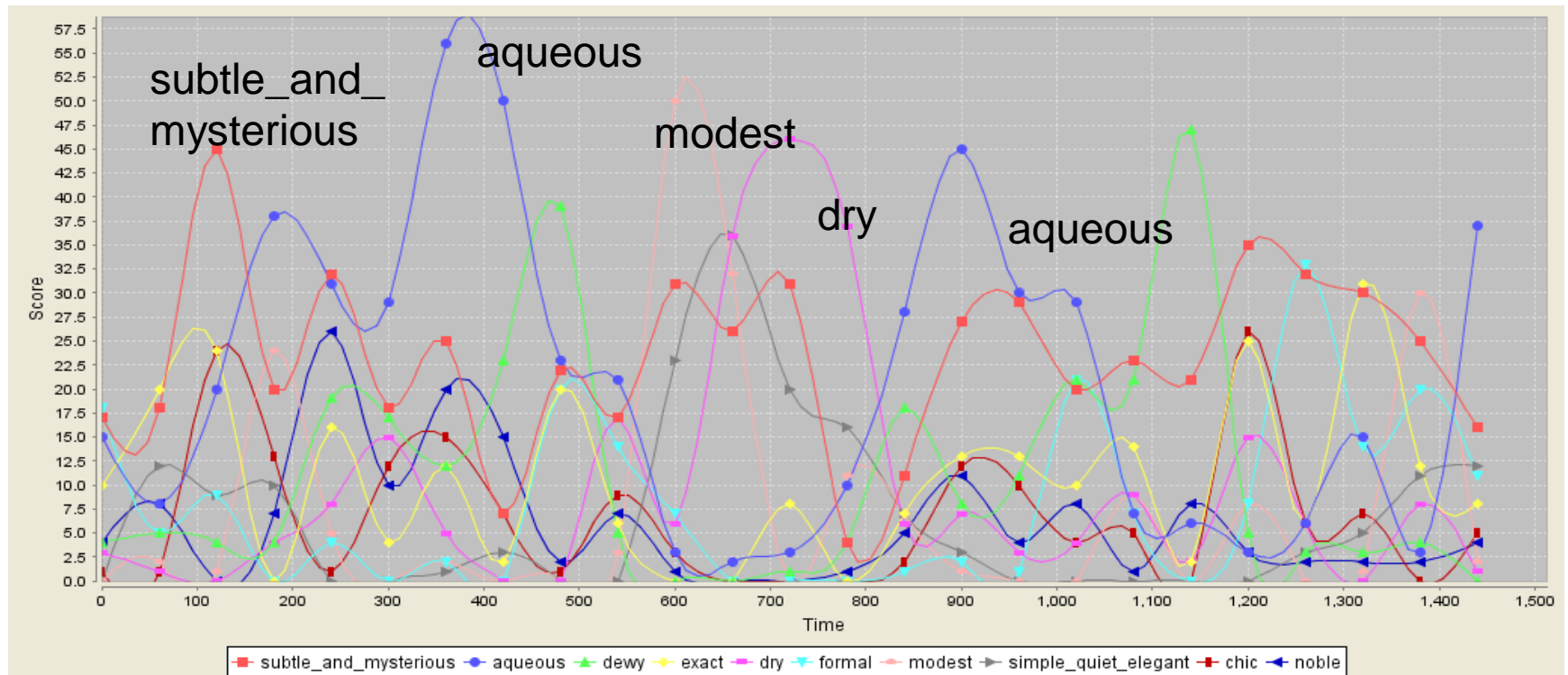
Automatic Metadata Extraction [2/2]



The screenshot shows a Microsoft Internet Explorer window displaying a sunset image. Below the image, a text area contains the output of a metadata extraction process, including file conversion steps and a list of descriptive words with their associated scores.

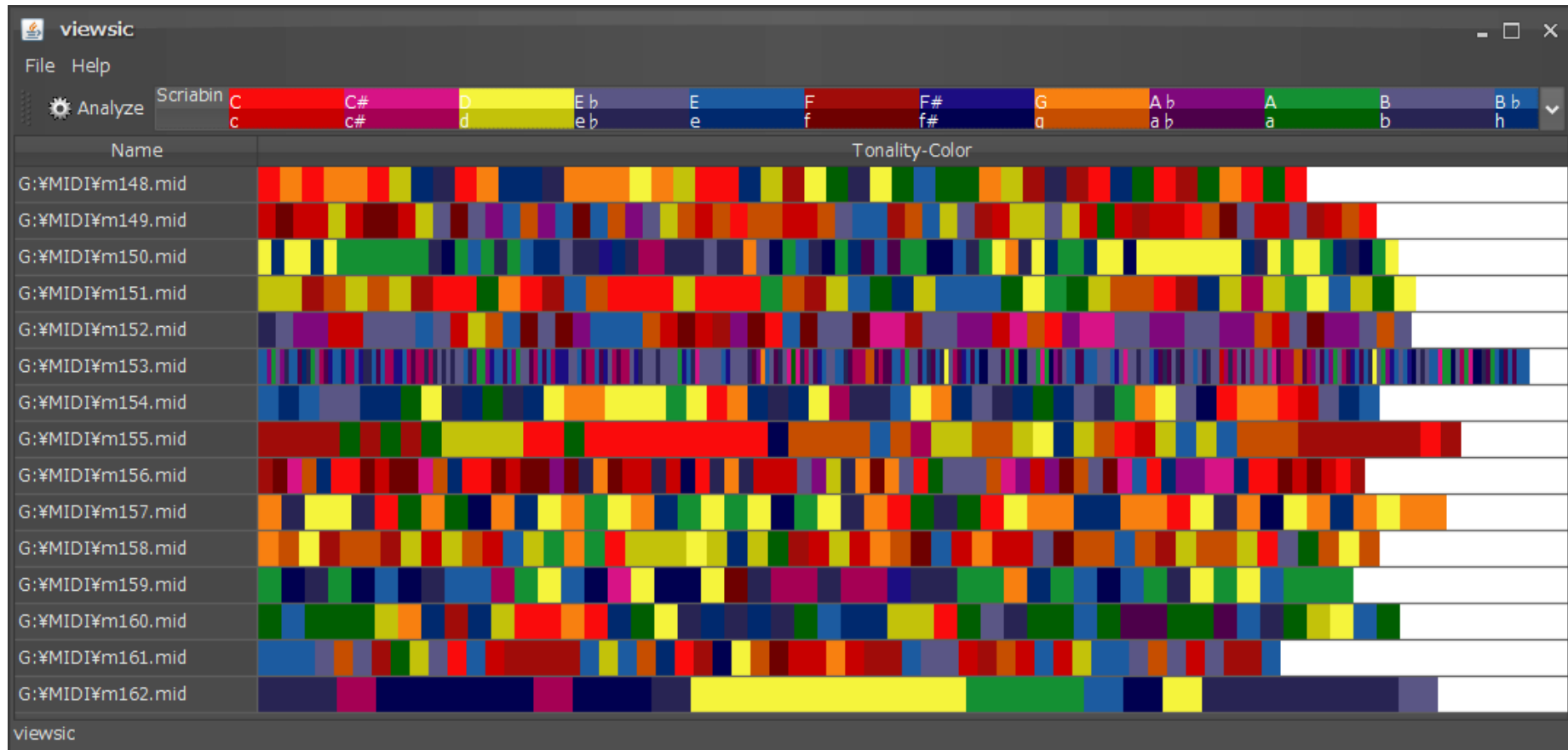
```
http://www.mdbl.stc.keio.ac.jp/~naofumi/demos/demo025/run.cgi?switch=local&key=jpn0002.jpg&urlimage=http%3A%2F%2F
ファイル(E) 編集(E) 表示(V) お気に入り(A) ツール(T) ヘルプ(H)
戻る 進む 中止 更新 ホーム 検索 お気に入り 履歴 メール サイズ
アドレス(D) http://www.mdbl.stc.keio.ac.jp/~naofumi/demos/demo025/run.cgi?switch=local&key=jpn0002.jpg&urlimage=http%3A%2F%2F
moving picture
converting jpn0002.jpg jpn0002.ppm
open inputfile... jpn0002.ppm
open tmpporary file... .tmp
Analyzing inputfile... width height maxvalue
convert RGB -> HVC.
: .....
: 0000000
calculations impression.
: .....
: 0000000
max moment_arm point :(0,0)-(112,101)-(188,240),36.117040
min moment_arm point :(0,0)-(127,182)-(188,240),2.562587
selected words:179 (7.190391/7.190391)
jpn0002.ppm:
warm1 :0.657600      genteel :0.007478      graceful :0.000737
sunshiny :0.293505   provincial :0.006572   polished :0.000712
cheerful :0.289826   placid :0.006400     subtle :0.000699
familiar :0.274708   simple_quiet_elegant :0.005925   forceful :0.000687
free :0.247922      subtle_and_mysterious :0.005821   traditional :0.000672
Large_hearted :0.242152   natural :0.005749    intense :0.000660
friendly :0.241655    chic :0.005657       urbane :0.000627
lighthearted :0.239167   tasteful :0.005346   proper :0.000627
domestic :0.215914     modest :0.004611    quiet :0.000620
restful :0.210717     solemn :0.004511     stylish :0.000596
sweet :0.198222       authoritative :0.004429   untamed :0.000572
agreeable to :0.193777    aqueous :0.004398     fierv :0.000536
```


Visualization of Video in Impression-transition



Timeline

Music-media decoration for J.S.Bach's Invention No.1—No.15 with tonality-transition in colors along the timeline



The Mathematical Model of Meaning

Published Papers (Main):

- Y. Kiyoki, T. Kitagawa and T. Hayama, "A metadatabase system for semantic image search by a mathematical model of meaning," ACM SIGMOD Record (refereed as the invited paper for special issue on metadata for digital media), Vol.23, No. 4, pp.34-41, 1994.
- Y. Kiyoki, T. Kitagawa and T. Hayama, "A metadatabase system for semantic image search by a mathematical model of meaning," *Multimedia Data Management -- using metadata to integrate and apply digital media* -- (McGraw Hill(book) , A. Sheth and W. Klas (editors)), Chapter 7, pp.191-222, 1998.
- Y. Kiyoki, T. Kitagawa and Y. Hitomi, "A fundamental framework for realizing semantic interoperability in a multidatabase environment," Journal of Integrated Computer-Aided Engineering, Vol.2, No.1(Special Issue on Multidatabase and Interoperable Systems), pp.3-20, John Wiley & Sons, Jan. 1995.
- Y. Kiyoki, T. Kitagawa and T. Miyahara, "A fast algorithm of semantic associative search for databases and knowledge bases," Information Modelling and Knowledge Bases (IOS Press), Vol. VII, pp. 44-58, 1996.
- Y. Kiyoki, T. Kitagawa and K. Kurata, "An adaptive learning mechanism for semantic associative search in databases and knowledge bases," Information Modelling and Knowledge Bases (IOS Press), Vol. VIII, May, 1996.
- Y. Kiyoki, A. Miyagawa and T. Kitagawa, "A multiple view mechanism with semantic learning for multidatabase environments," Information Modelling and Knowledge Bases (IOS Press), Vol. IX, May, 1997.
- Y. Kiyoki and T. Kitagawa, "Application of a Semantic Associative Search Method to Multidatabases for Environmental Information," Information Modelling and Knowledge Bases (IOS Press), Vol. XI, May, 1999.
- Y. Kiyoki, "A Semantic Associative Search Method for WWW Information Resources," Proceedings of 1ST International Conference on Web Information Systems Engineering(WISE200), (invited paper), 2000.
- Y. Kiyoki and X. Chen, "A Semantic Associative Computation Method for Automatic Decorative-Multimedia Creation with "Kansei" Information" (Invited Paper), The Sixth Asia-Pacific Conferences on Conceptual Modelling (APCCM 2009), 9 pages, January 20-23, 2009.

Integrated Database System and The Mathematical Model of Meaning

Patents:

- Y. Kiyoki and T. Kitagawa, “Integrated Database System,” US Patent Notice of Allowance March 7, 2001, (Application No. 08/940,274, July 31, 1997).
- Y. Kiyoki and T. Kitagawa, “Method and Apparatus for Retrieving Data,” Issued in US Patent 6,138,116, Oct. 24, 2000 (Application No. 08/904,149, July 31, 1997).
- Y. Kiyoki and T. Kitagawa, “Integrated Database System,” EU, EP19970305755, EP0822505, Feb. 2005, (Application, July 31, 1997).
- Y. Kiyoki and T. Kitagawa, T. Washizawa, “Data processing apparatus and method,” United States Patent 09/236221, United States Patent 6334129, Dec. 2001. (Application, Jan. 25, 1999).
- Y. Kiyoki and T. Kitagawa, T. Washizawa, “Method and apparatus for selecting and utilizing one of computers or databases, United States Patent 09/207022, United States Patent 6347315, Feb.2002. (Application, Dec. 8, 1998).