

Microsoft® Research

Faculty Summit

10
YEAR ANNIVERSARY

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

***2009 Microsoft Faculty Summit
Redmond, USA
July 13th-15th, 2009***

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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”

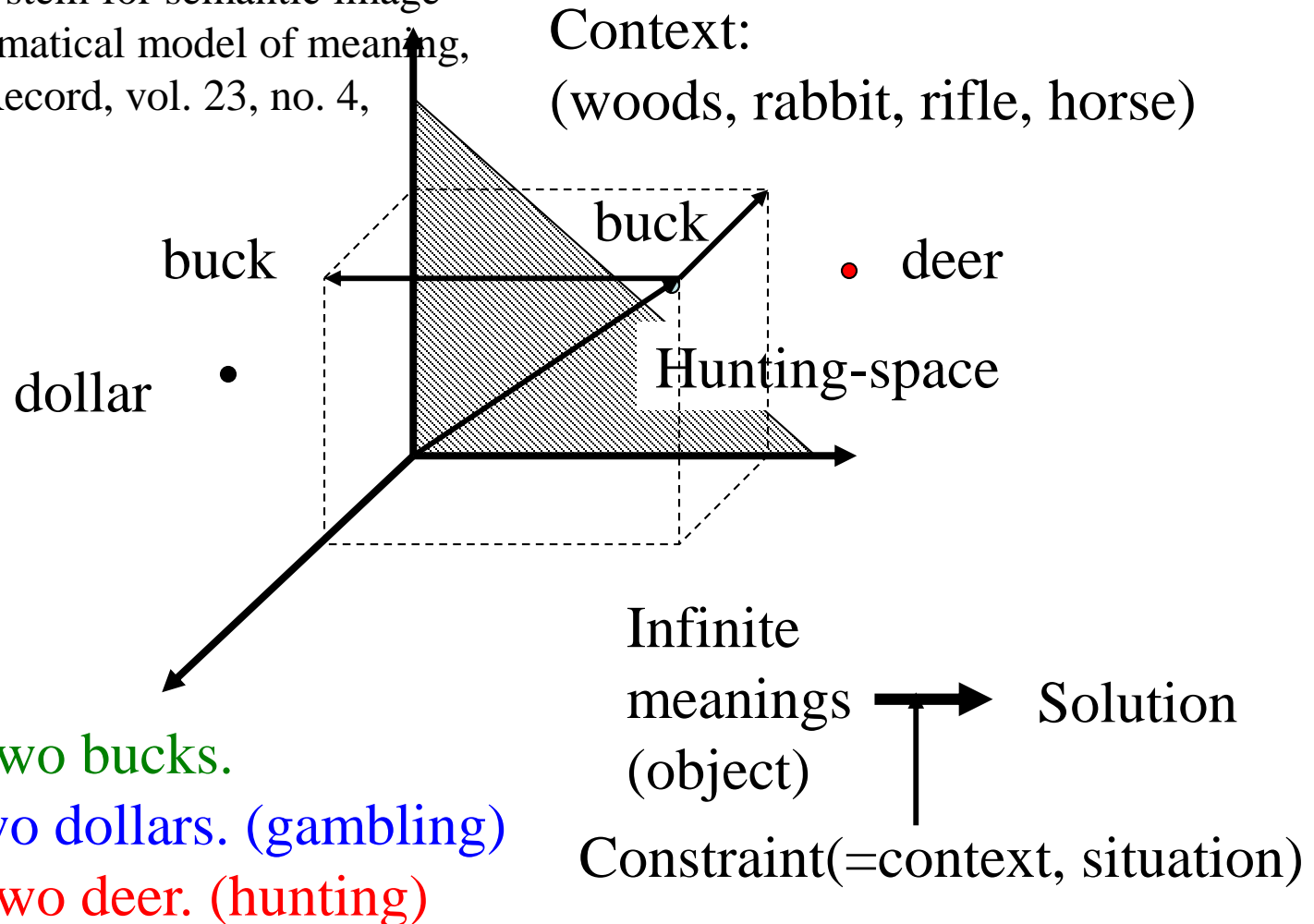
(5) “sensitivity”

(6) “psychological reaction”

(7) “physiological reaction”

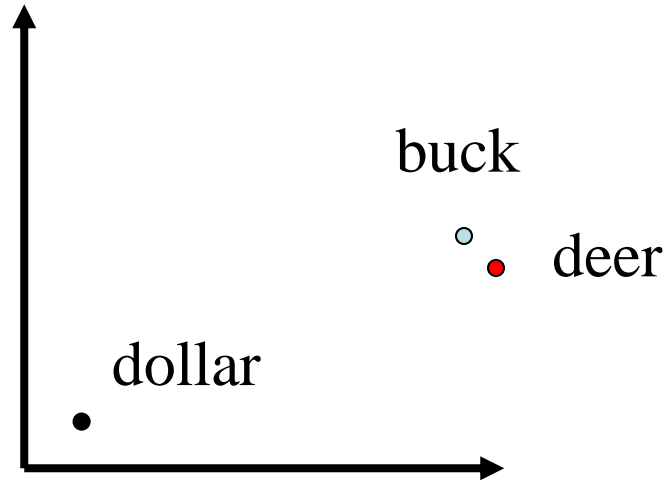
Basic Idea of the Mathematical Model of Meaning(MMM) (1993—) (2000, 710, 619, 425, 417 dimensions in our current implementation)

(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

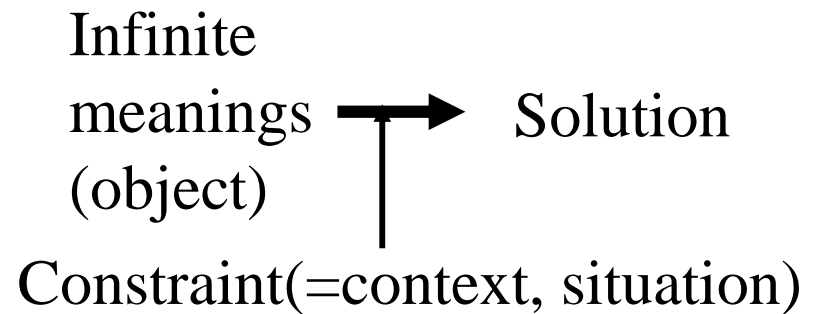
Context:
(woods, rabbit, rifle, horse)



He shot two bucks.

He bet two dollars. (gambling)

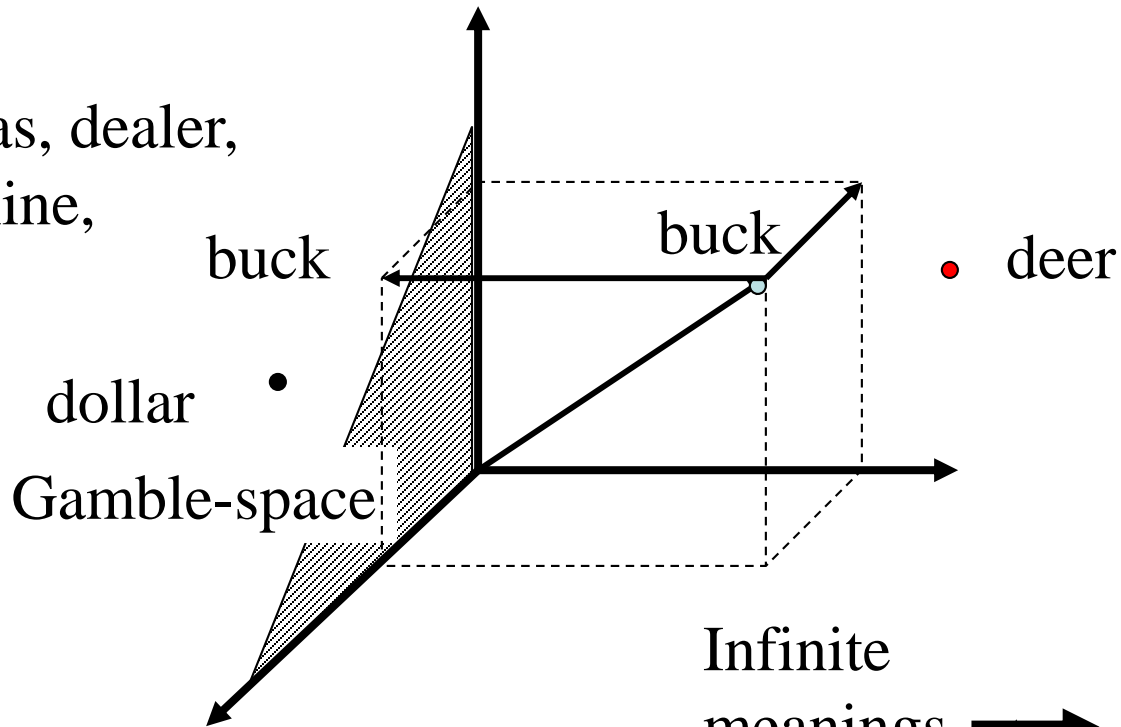
He shot two deer. (hunting)



Basic Idea

Context:

(Las Vegas, dealer,
slot machine,
chip)



He shot two bucks.

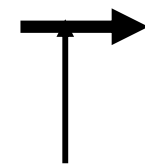
He bet two dollars. (gambling)

He shot two deer. (hunting)

Infinite

meanings
(object)

Constraint(=context, situation)

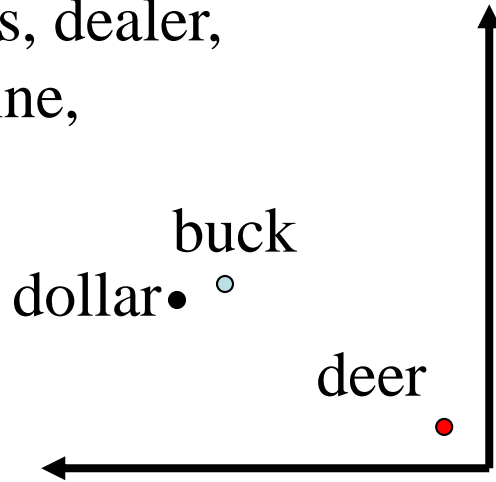


Solution

Basic Idea

Context:

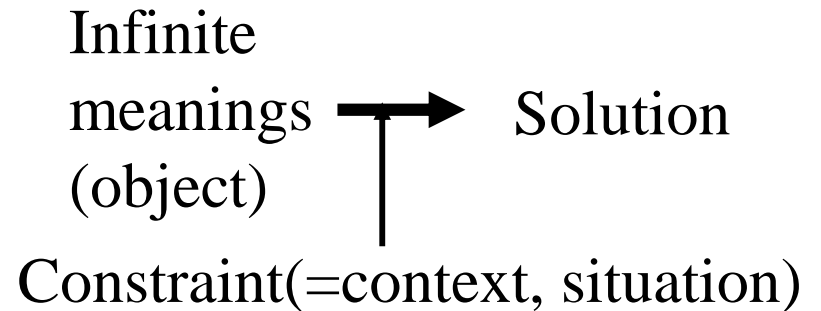
(Las Vegas, dealer,
slot machine,
chip)



He shot two bucks.

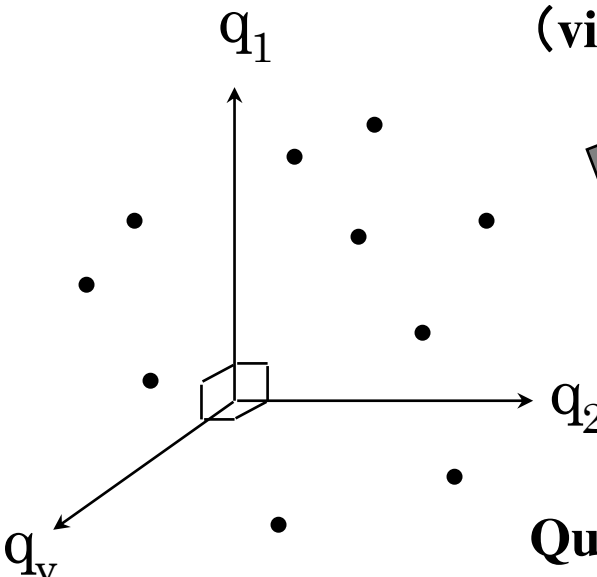
He bet two dollars. (gambling)

He shot two deer. (hunting)

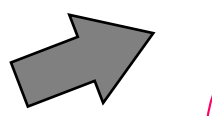


An Overview of The Mathematical Model of Meaning (MMM)

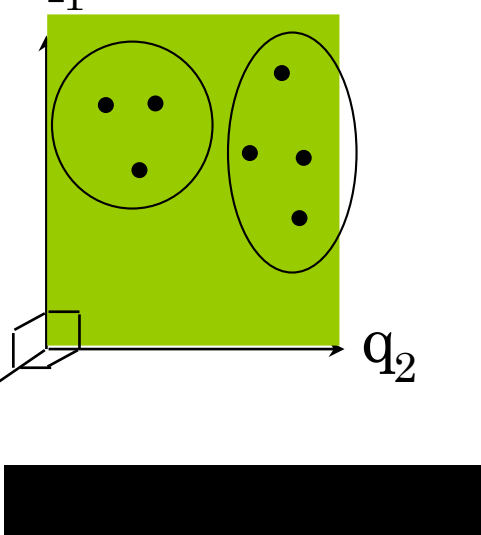
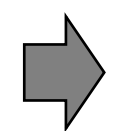
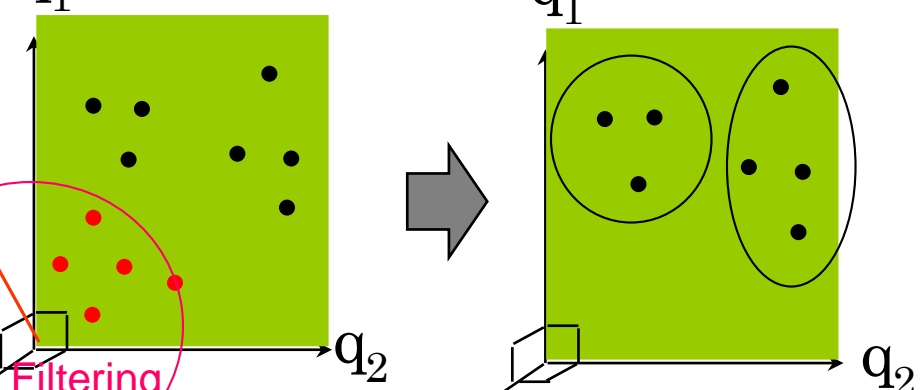
Semantic Space



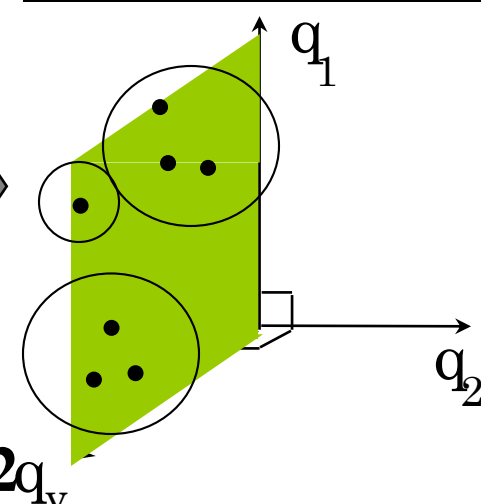
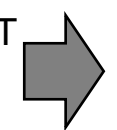
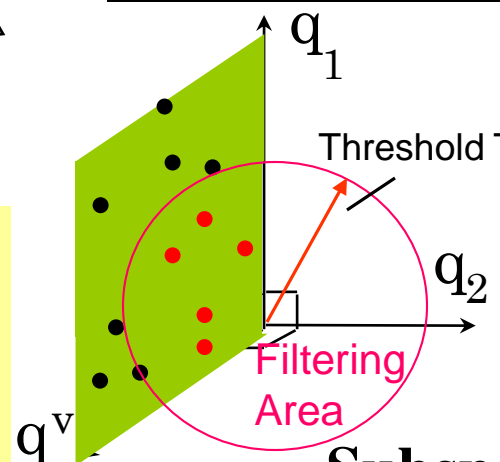
**Query1
Context1
(viewpoint)**



Subspace1



**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

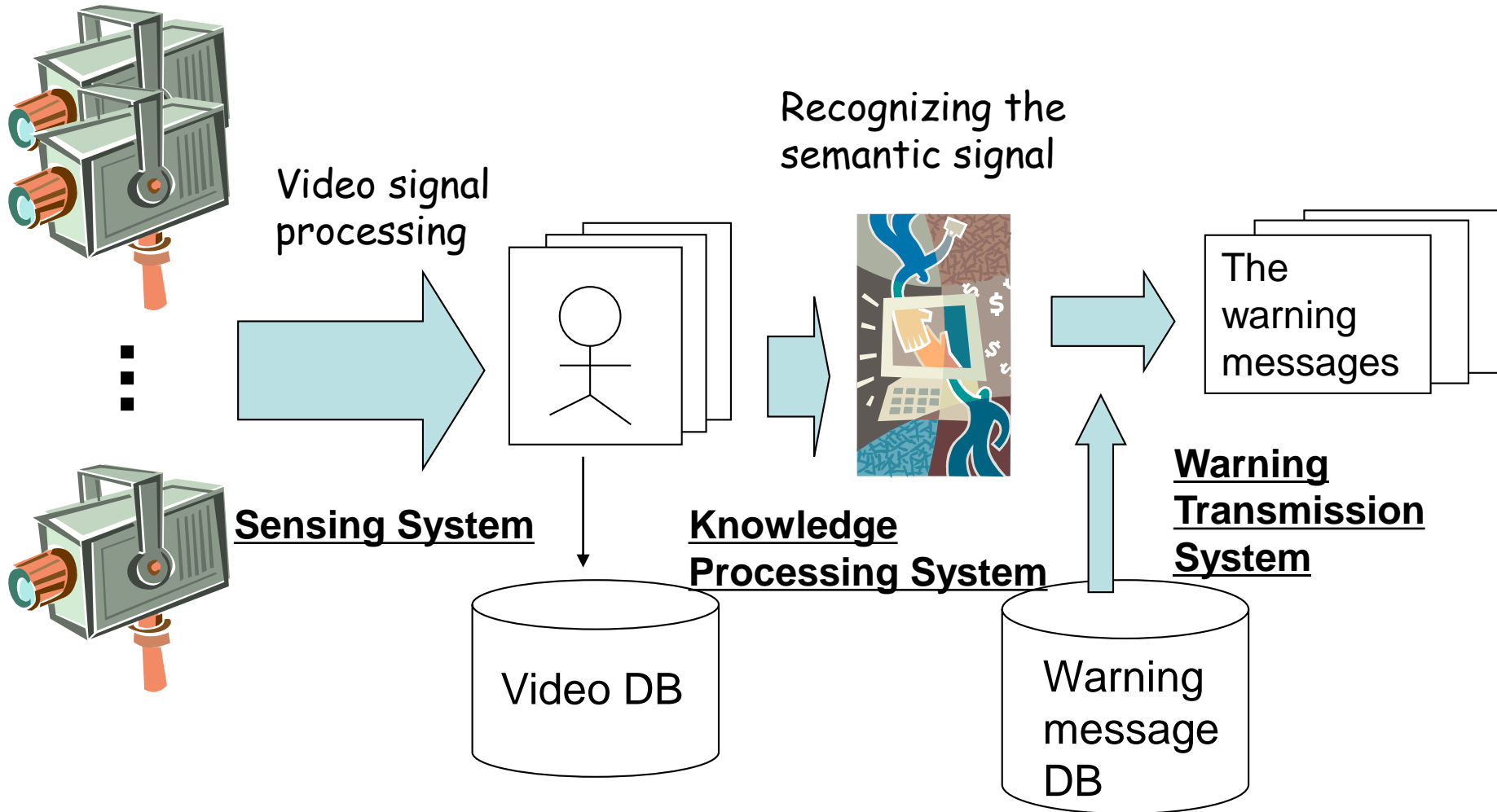
Disaster Monitor Cameras



The Mudflow Warning system

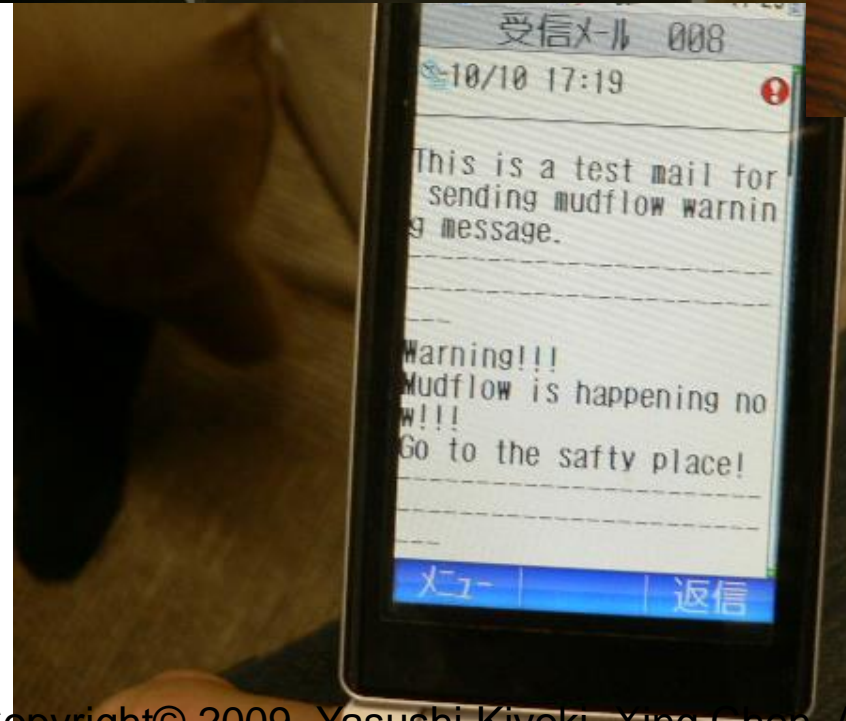
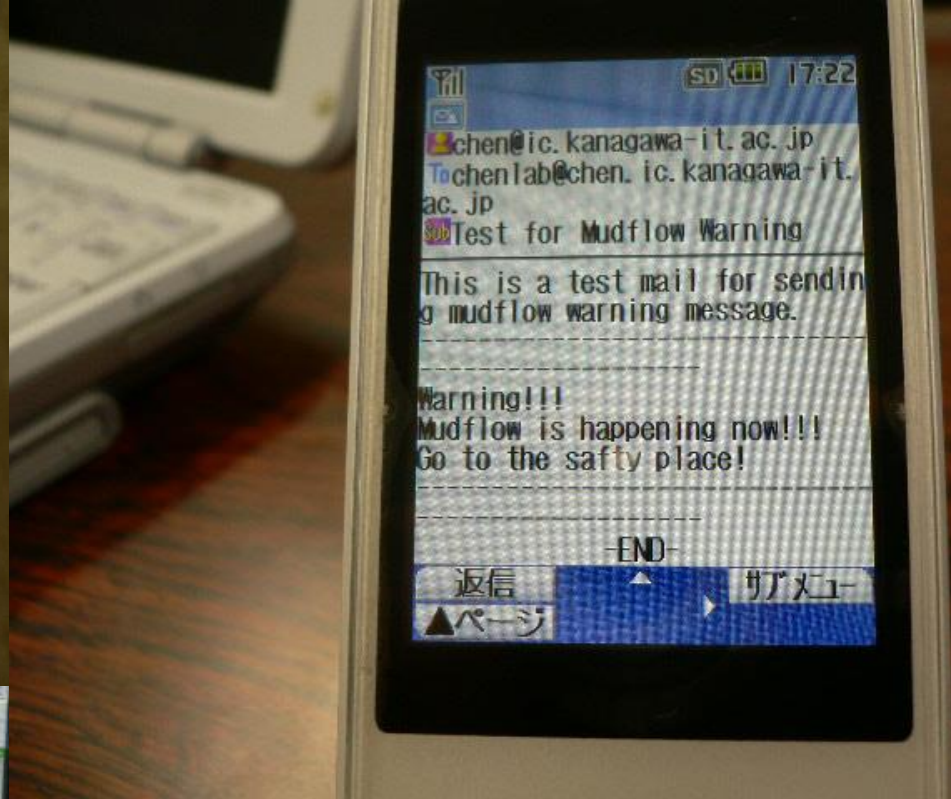
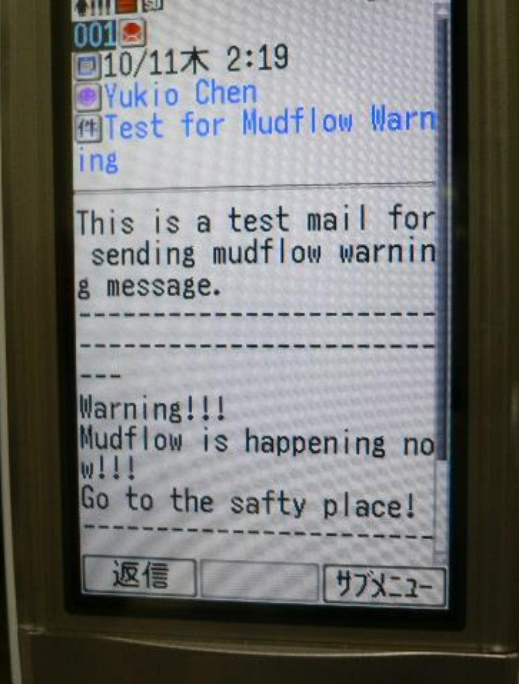
System construction

Monitoring cameras



The Scene of the warning system



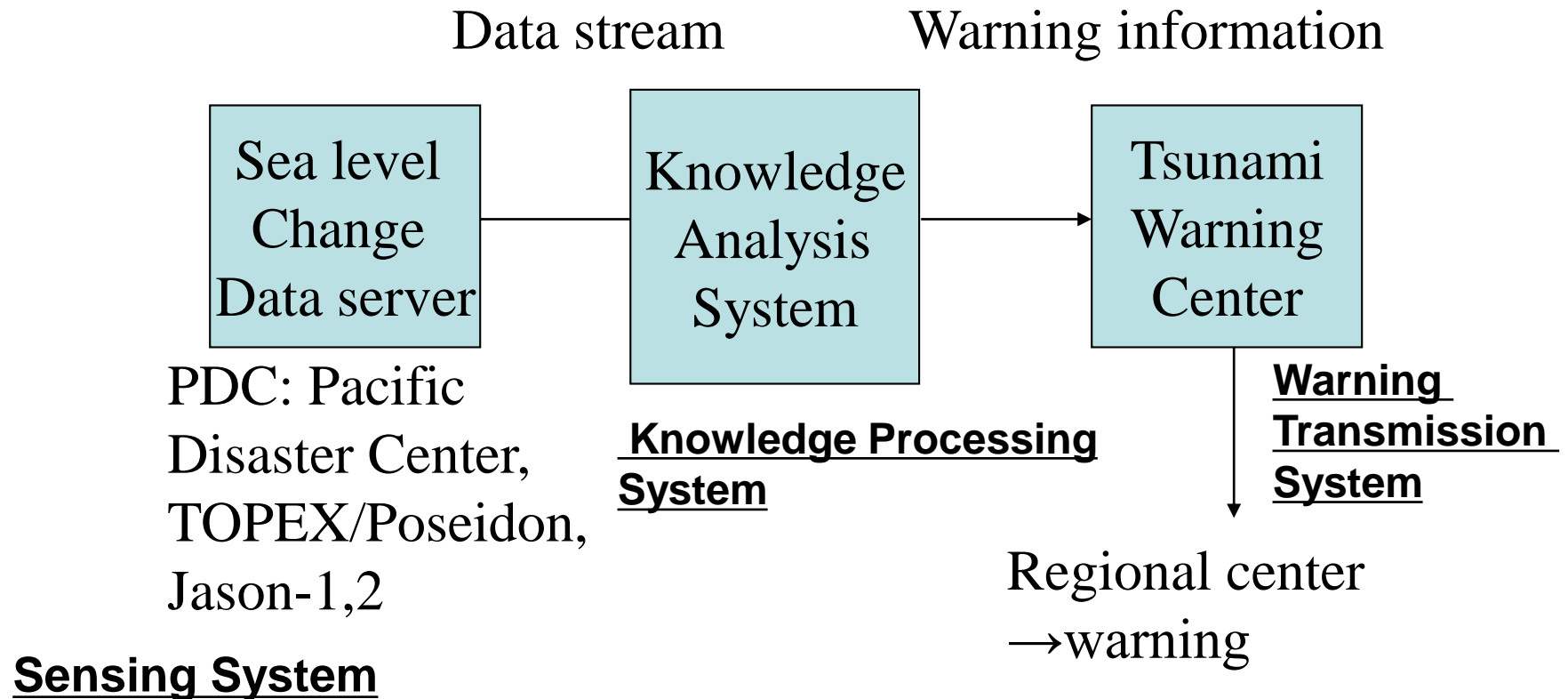


The warning message is received by three mobile-phones in real-time.

Global Environments:

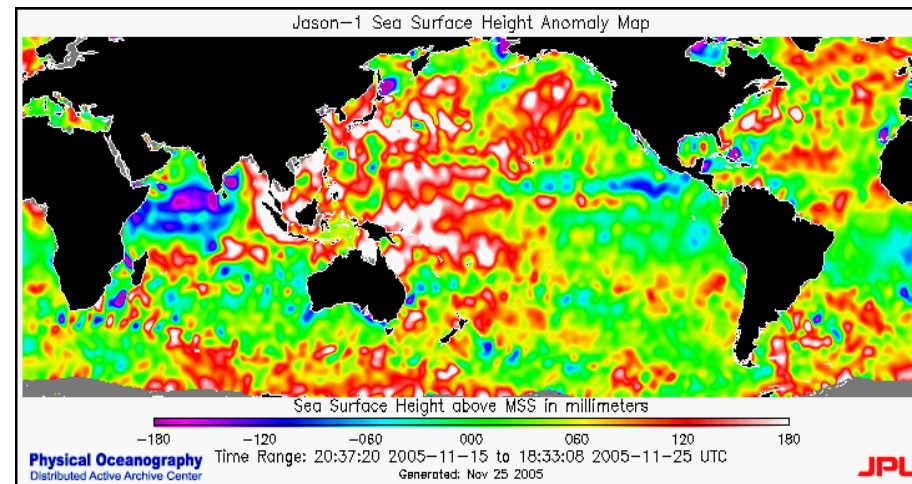
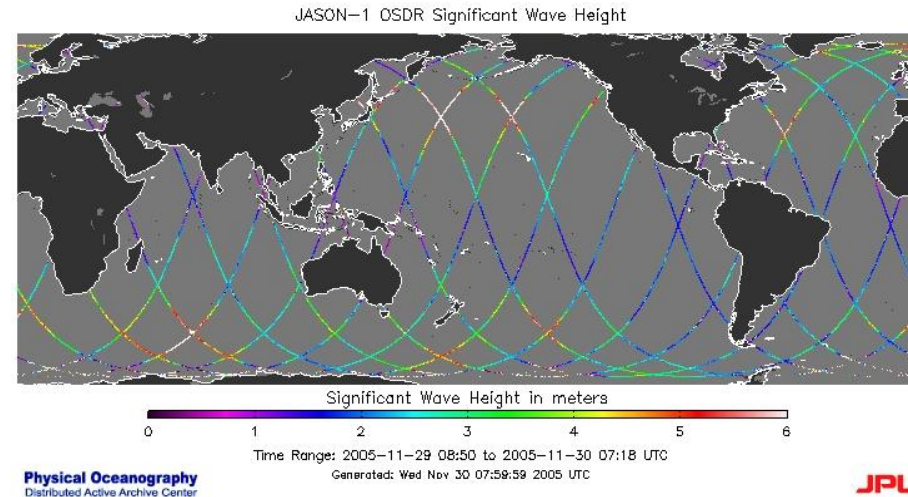
Global Risk Management

— 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 several red circular markers indicating search results. To the left of the map, there are search filters and a results table.

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
[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

ナビゲーション

移動
拡大
縮小
拡大/縮小率 2
デフォルト [Go]

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

Global Environments:
Knowledge Cluster System Project
in NICT

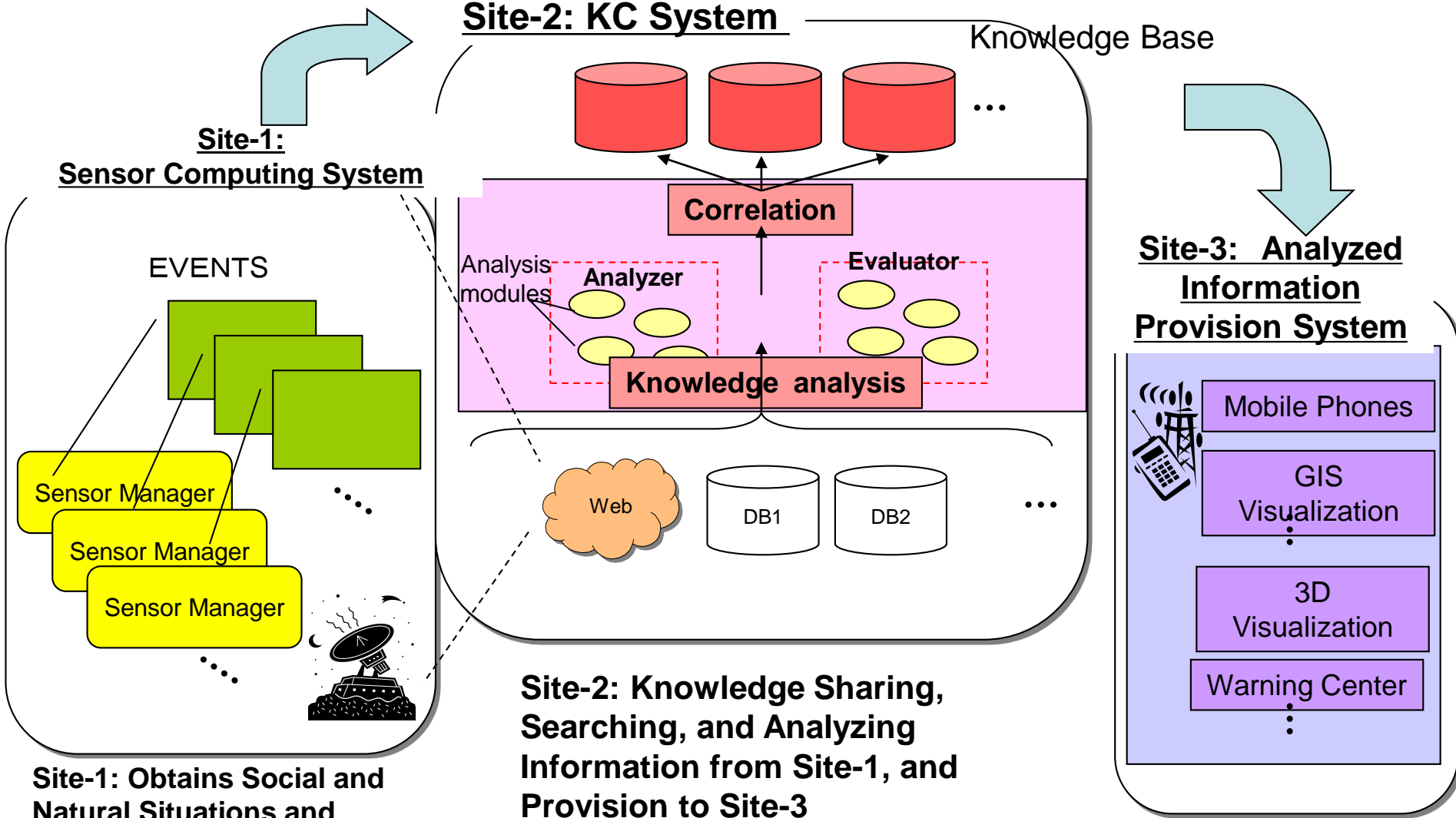
(National Institute of Information and Communication
Technology)

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



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

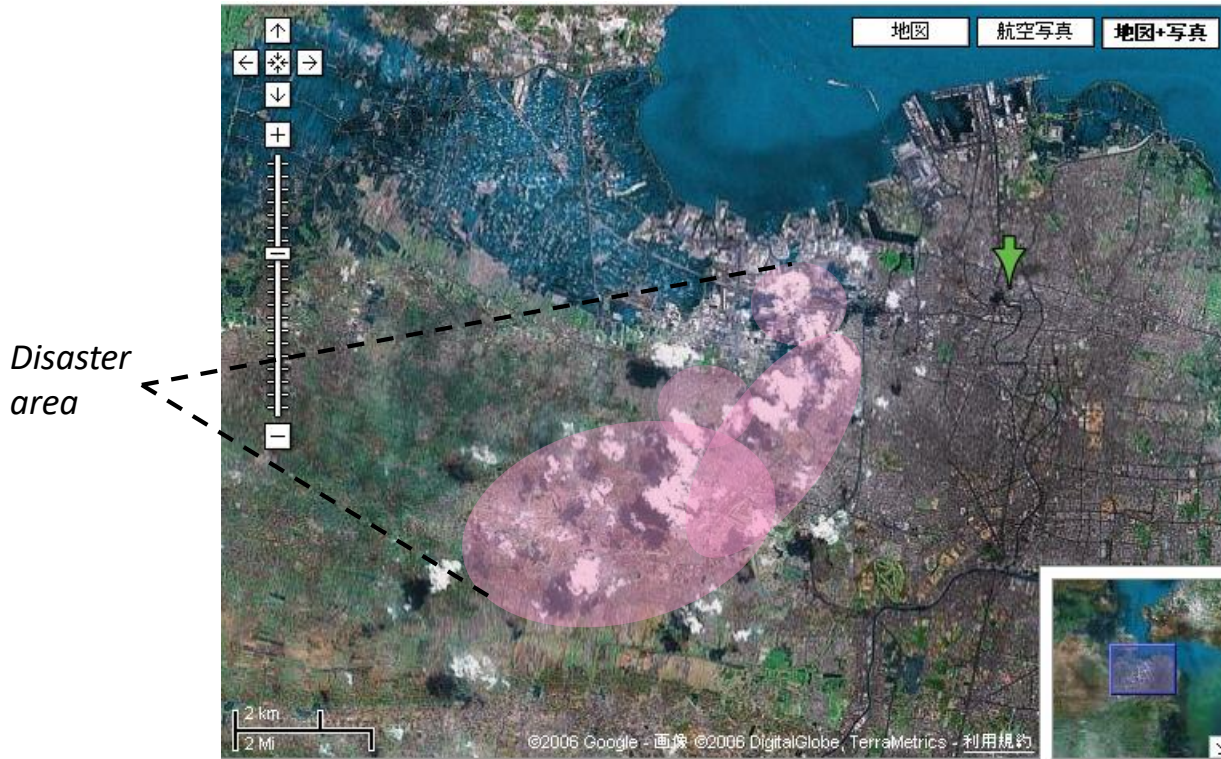
Possibility of secondary disaster and
influence on environmental fields, on
economy, and infectious disease .etc

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



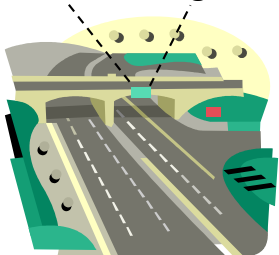
Deep analysis of risk information



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

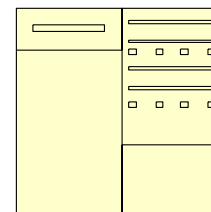


Mobile phones



First-aid actions to local people

Risk Management Server

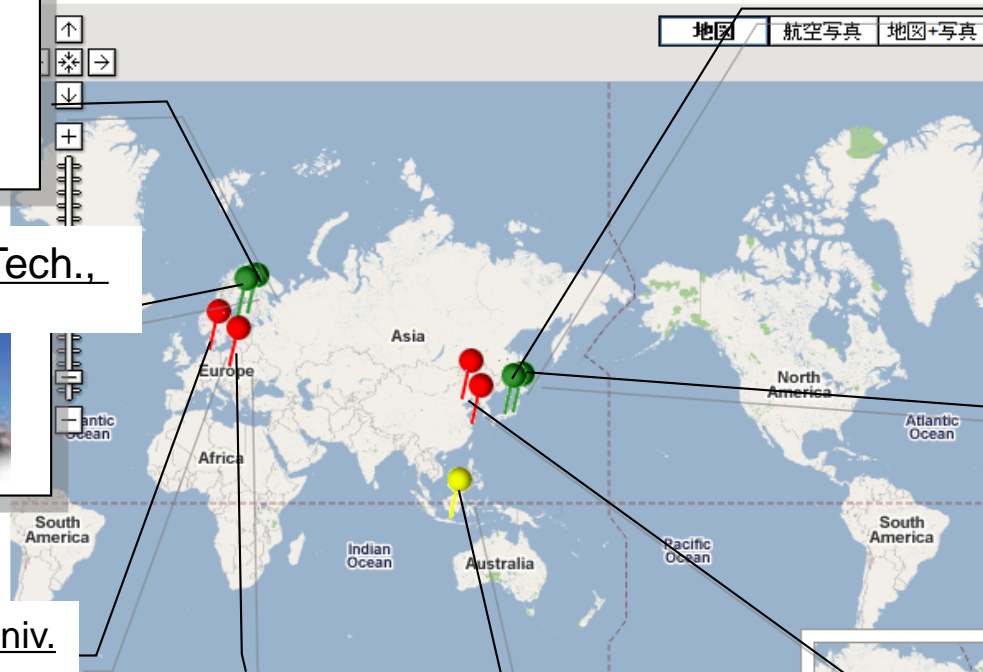


International Research Collaboration for Knowledge Grid System Development

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)

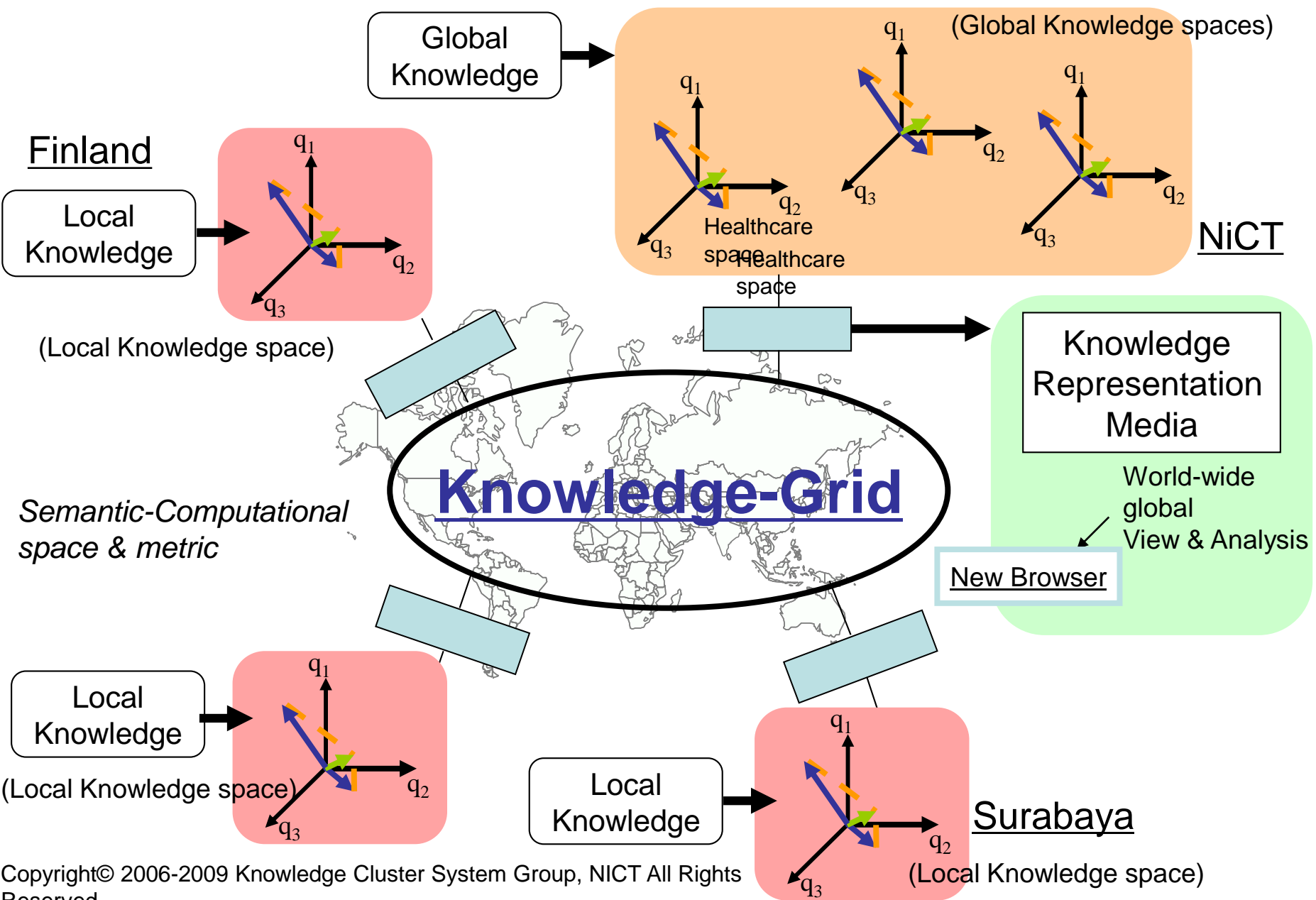


Geomaint MDS Dy

(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

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

Knowledge Grid

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

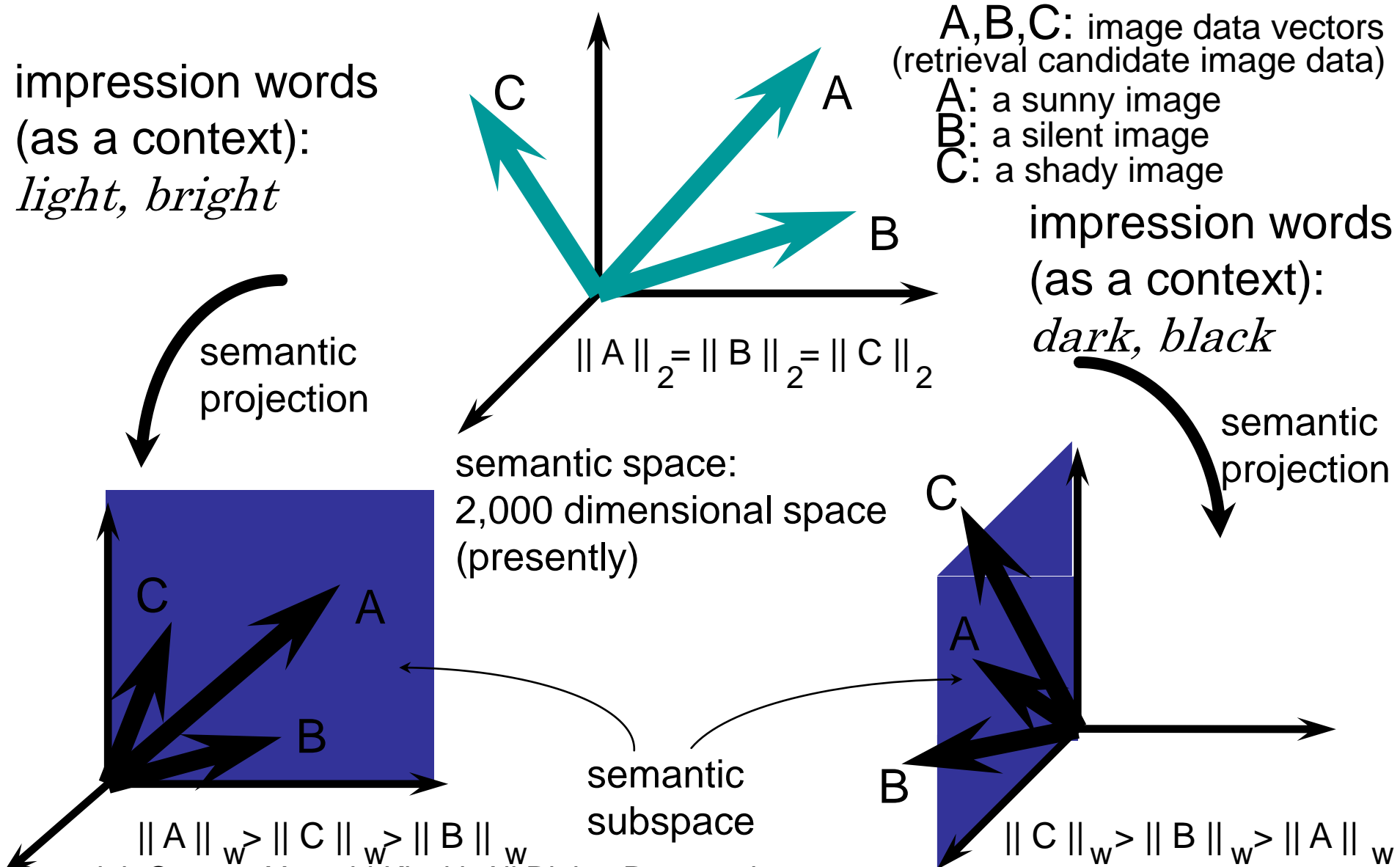
CONTEXT :

“Semantic Space Creation”

and

“Metric Setting”

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

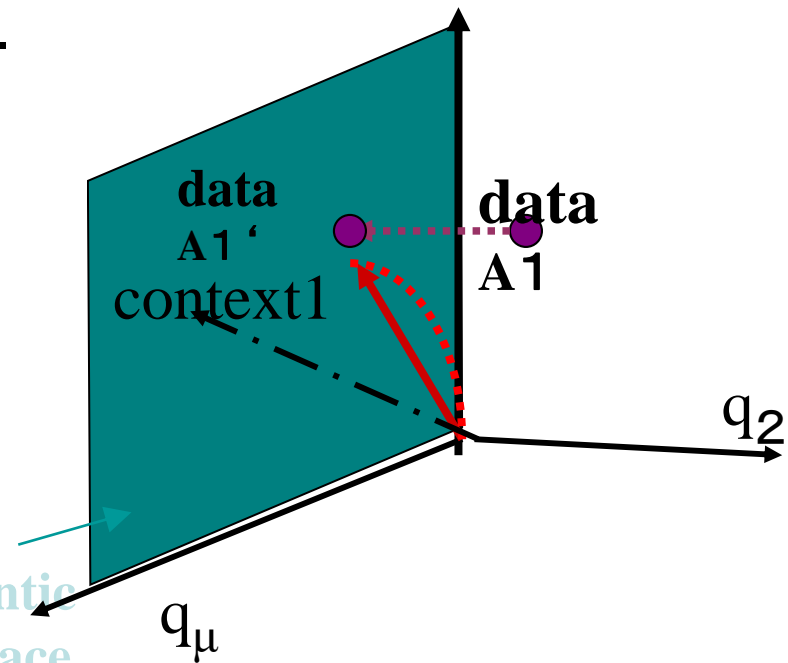


Context Recognition Mechanism in MMM

(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

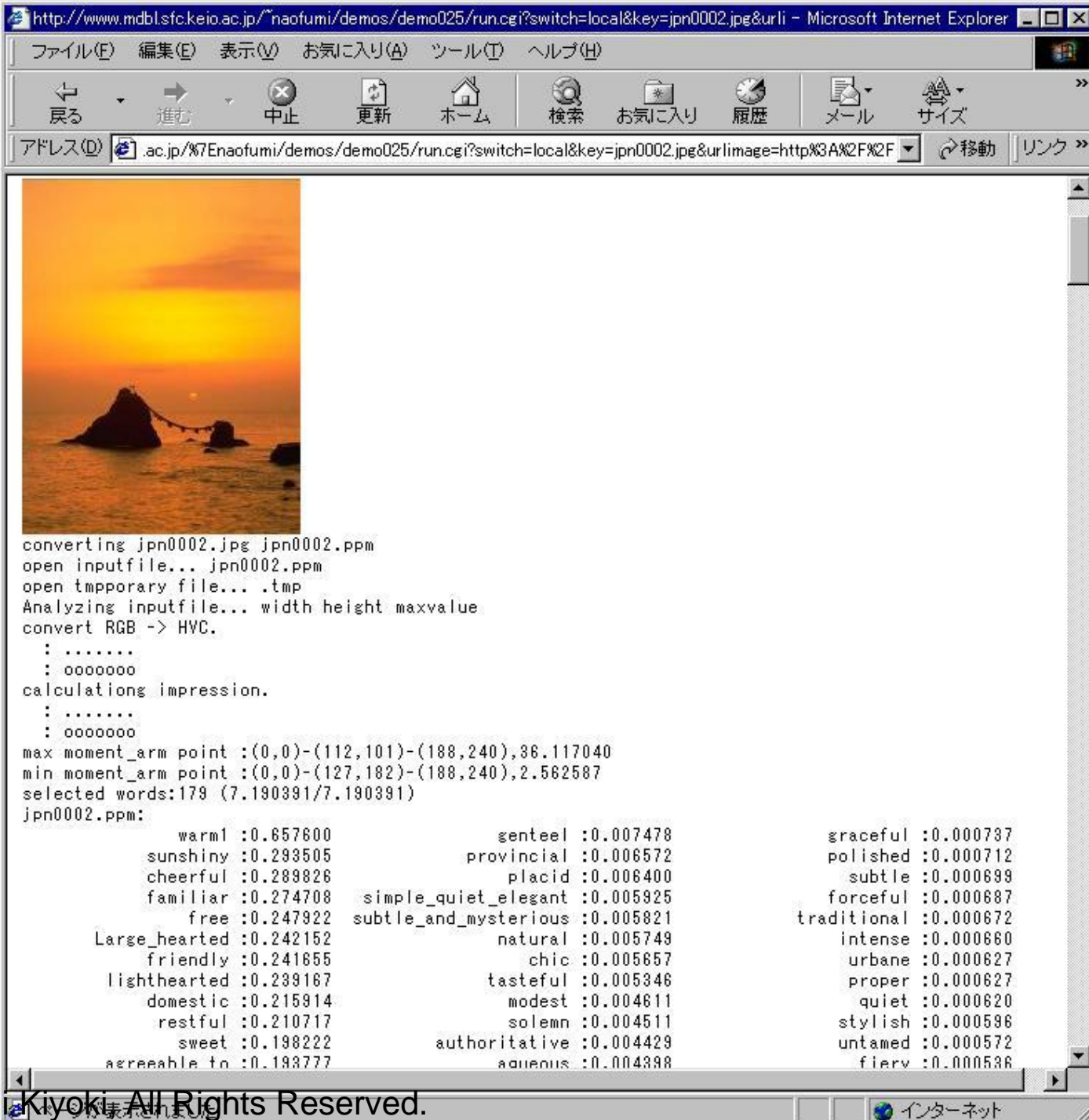
select key image:
 local file
 URL

[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

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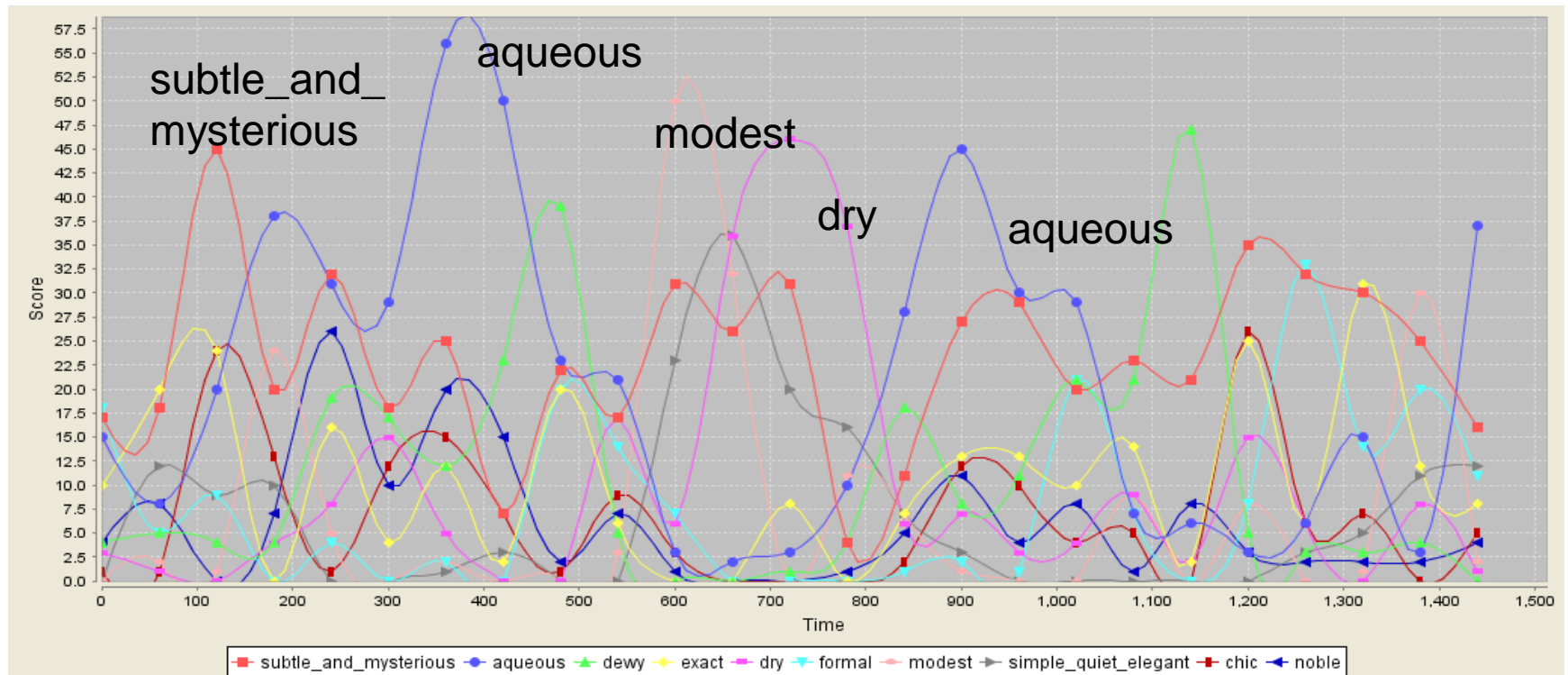
Automatic Metadata Extraction [2/2]



The screenshot shows a Microsoft Internet Explorer browser window. The address bar contains the URL: `http://www.mdbl.stc.keio.ac.jp/~naofumi/demos/demo025/run.cgi?switch=local&key=jpn0002.jpg&urlimage=http%3A%2F%2F`. The main content area displays a photograph of a sunset over the ocean with a large rock in the foreground. Below the image is a terminal window with the following text:

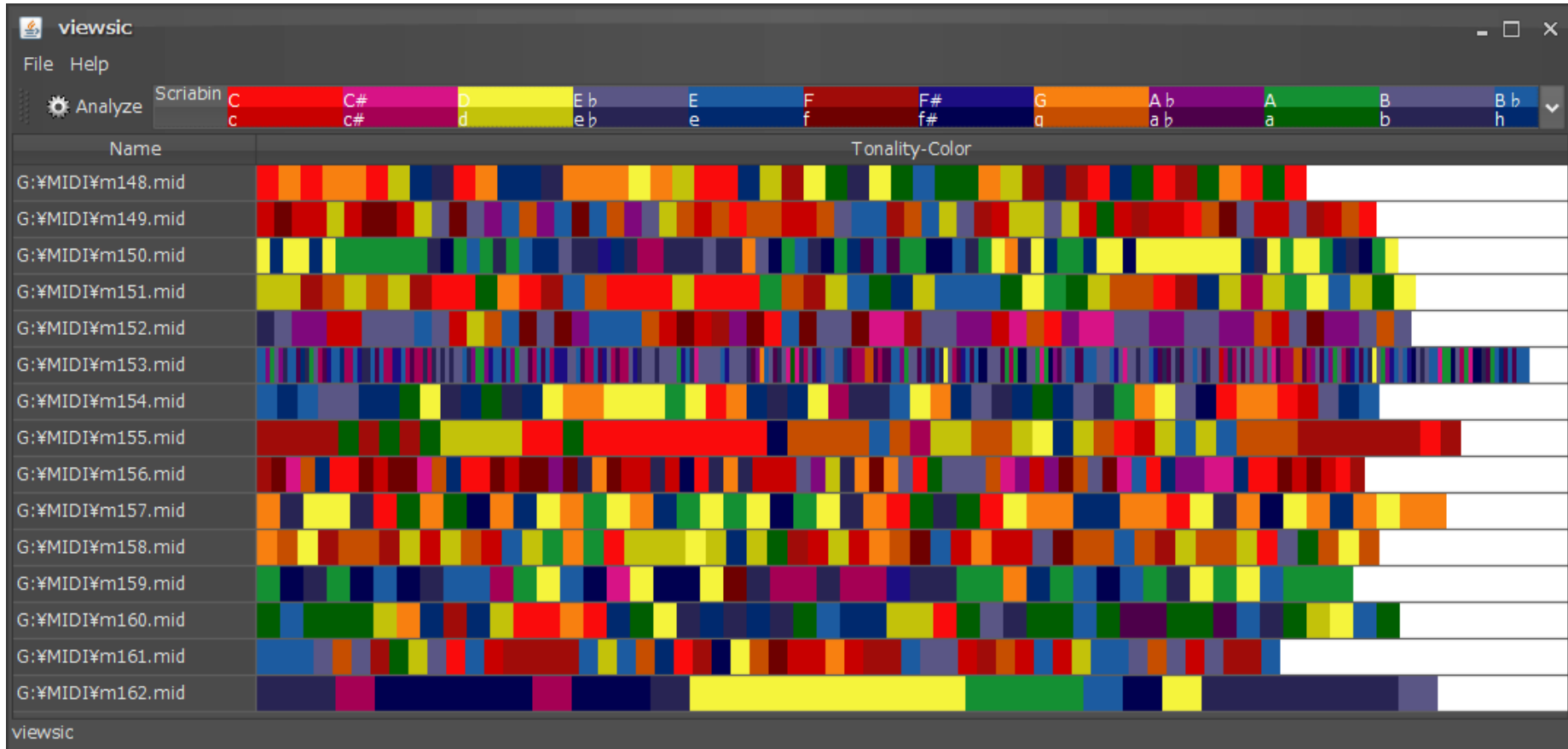
```
converting jpn0002.jpg jpn0002.ppm
open inputfile... jpn0002.ppm
open tmpporary file... .tmp
Analyzing inputfile... width height maxvalue
convert RGB -> HVC.
: .....
: 0000000
calculations impression.
: .....
: 0000000
max moment_arm point :(0,0)-(112,101)-(188,240),36.117040
min moment_arm point :(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).