
Microsoft® Research
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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"

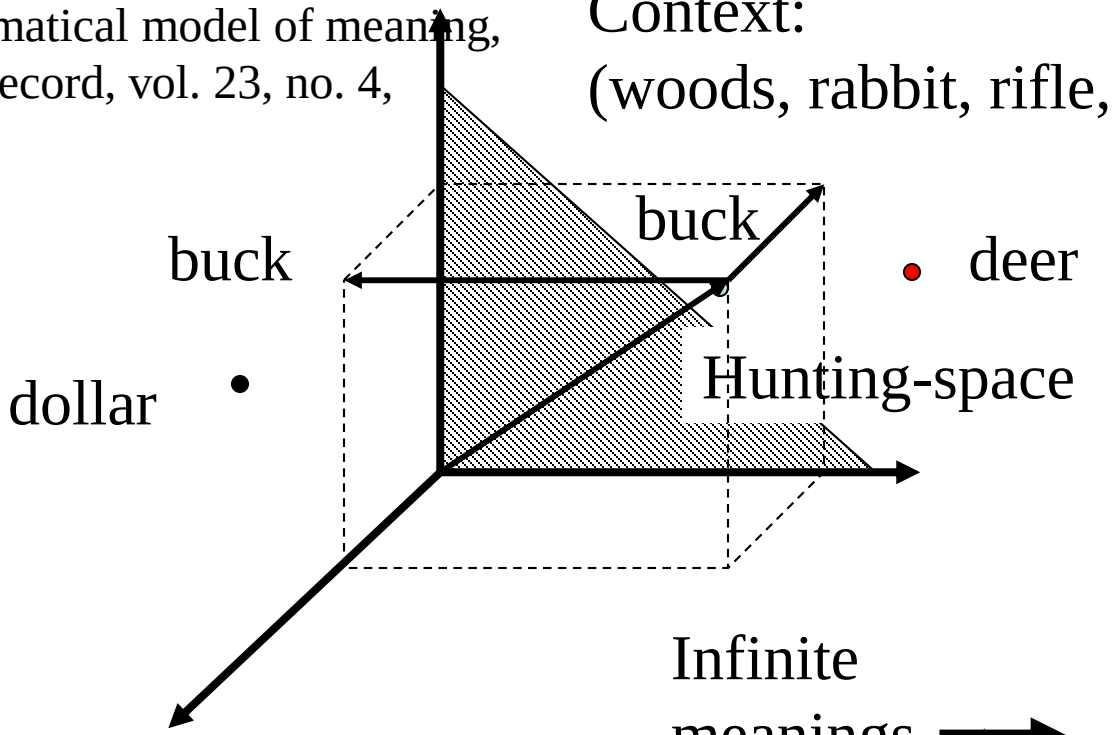
(5)"sensitivity"

(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.)



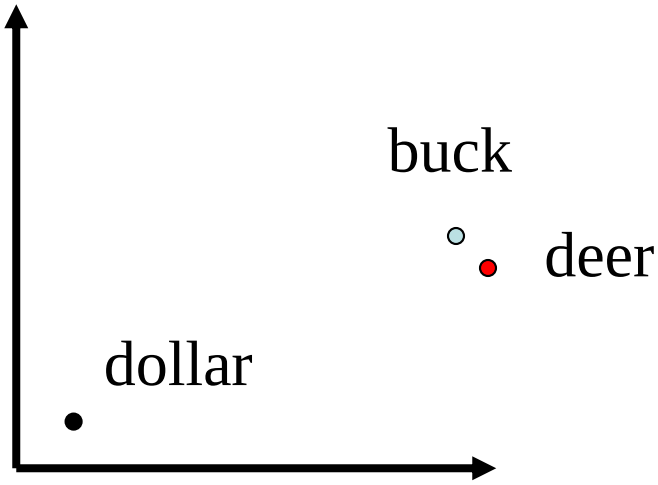
He shot two bucks.
He bet two dollars. (gambling)
He shot two deer. (hunting)

Infinite meanings (object) → Solution

Constraint(=context, situation)

Basic Idea

Context:
(woods, rabbit, rifle, horse)



He shot two bucks.
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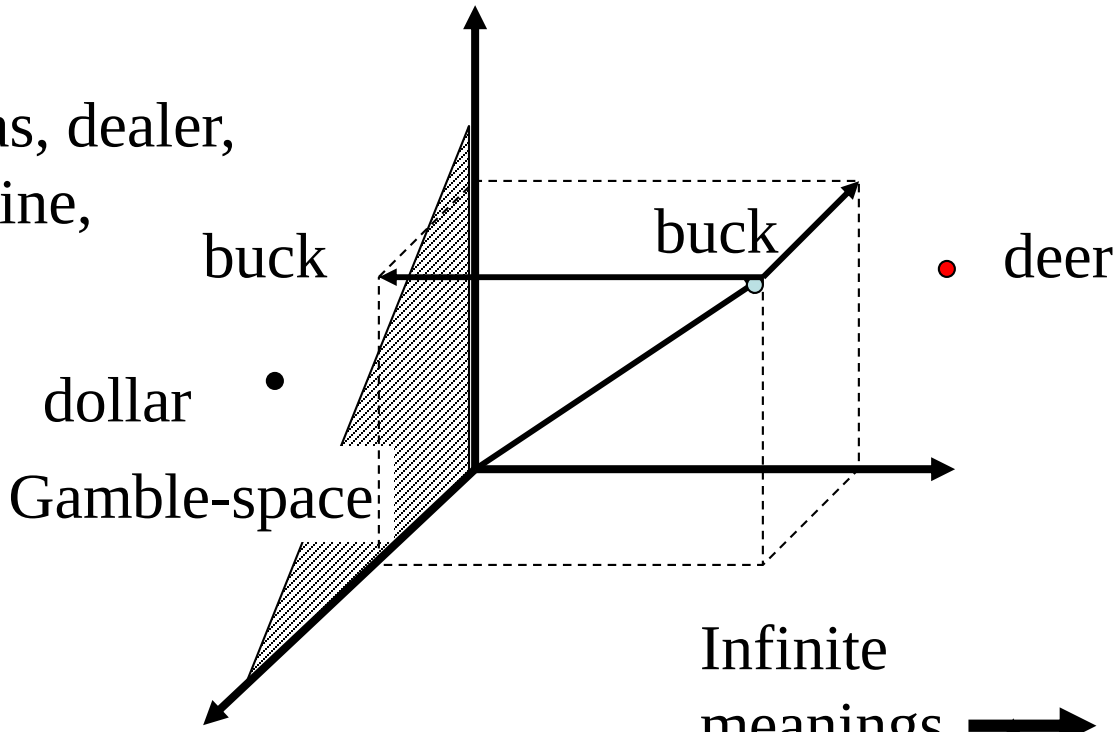
Infinite meanings (object) → Solution

Constraint(=context, situation)

Basic Idea

Context:
(Las Vegas, dealer, slot machine, chip)



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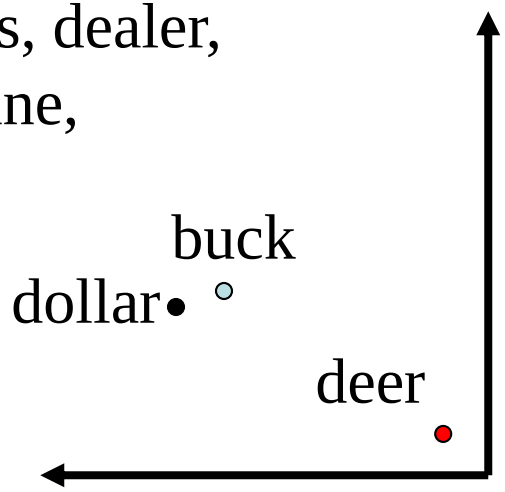

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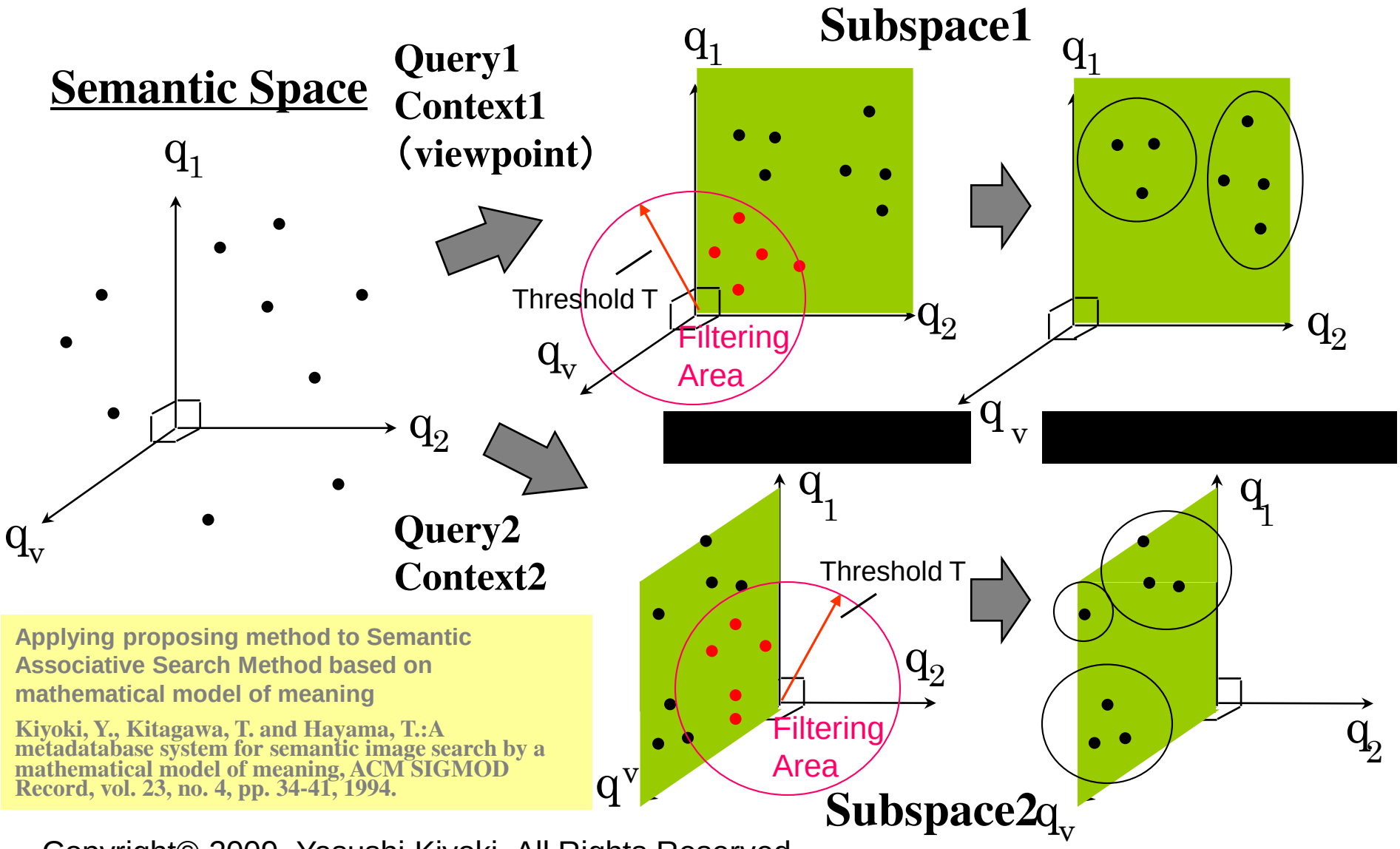
Infinite
meanings → Solution
(object)
↑
Constraint(=context, situation)

An Overview of The Mathematical Model of Meaning (MMM)



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

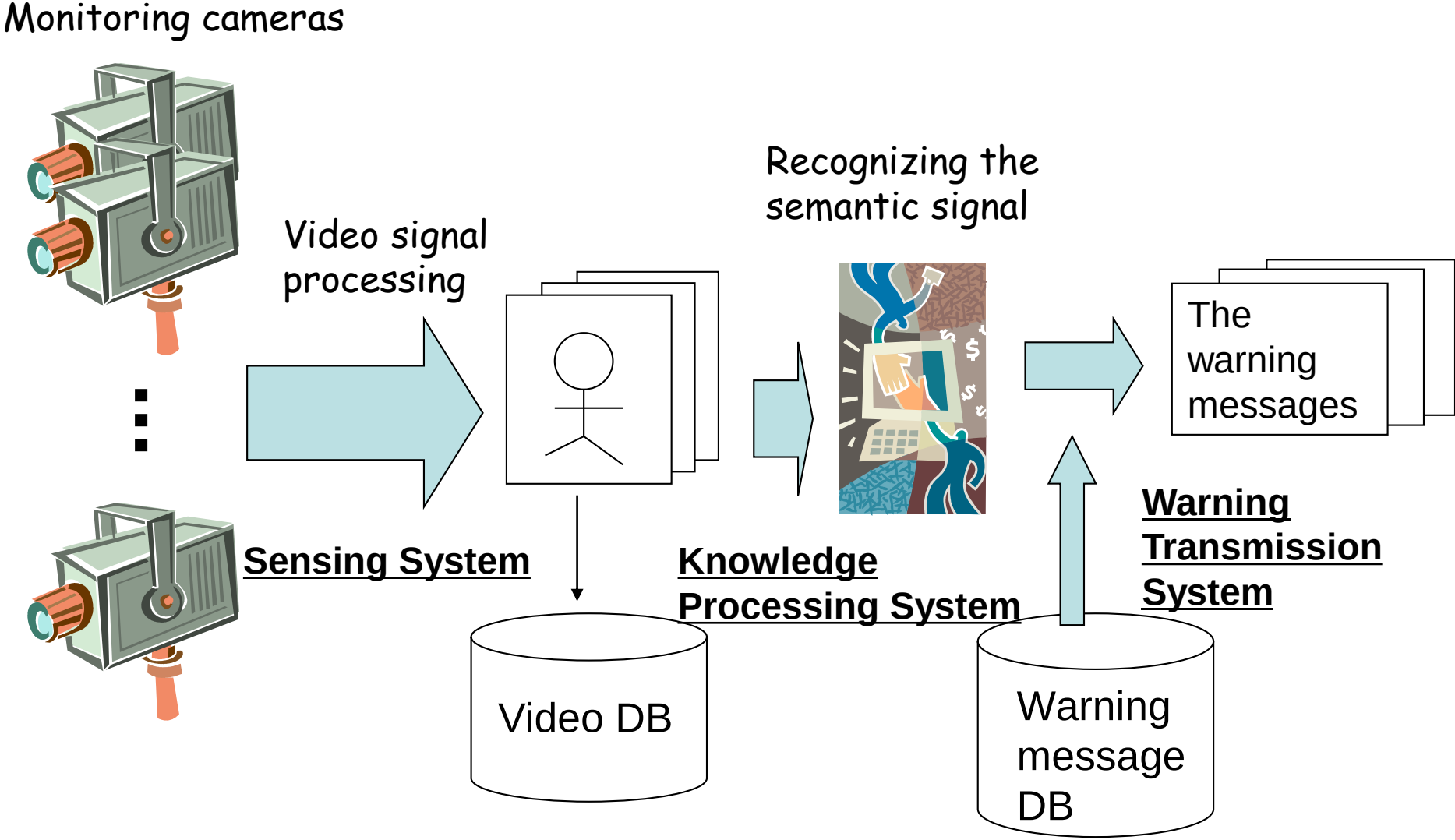
“Mudflow Warning System” Demonstration

Mudflow Semantic Elements

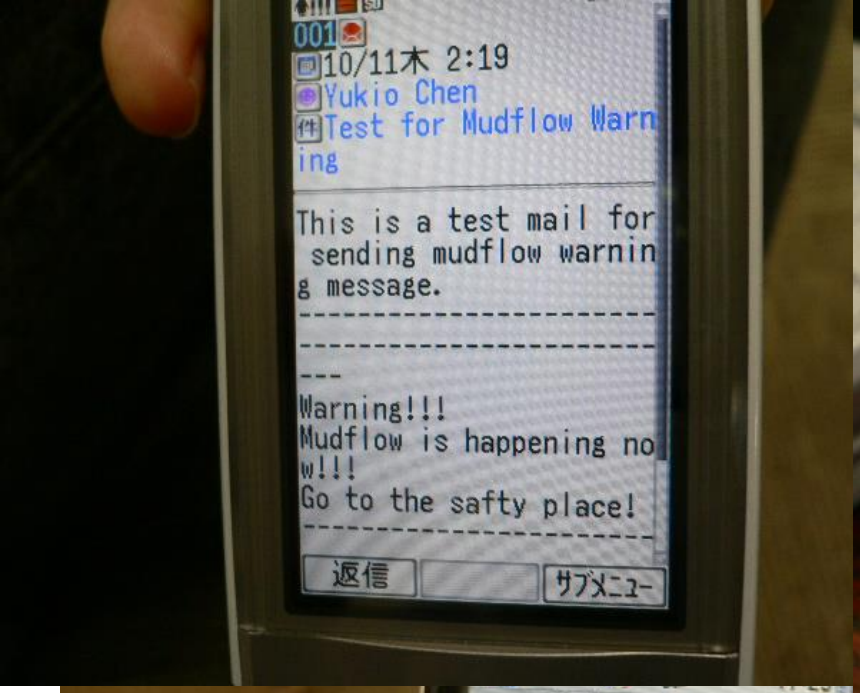
Disaster Monitor Cameras

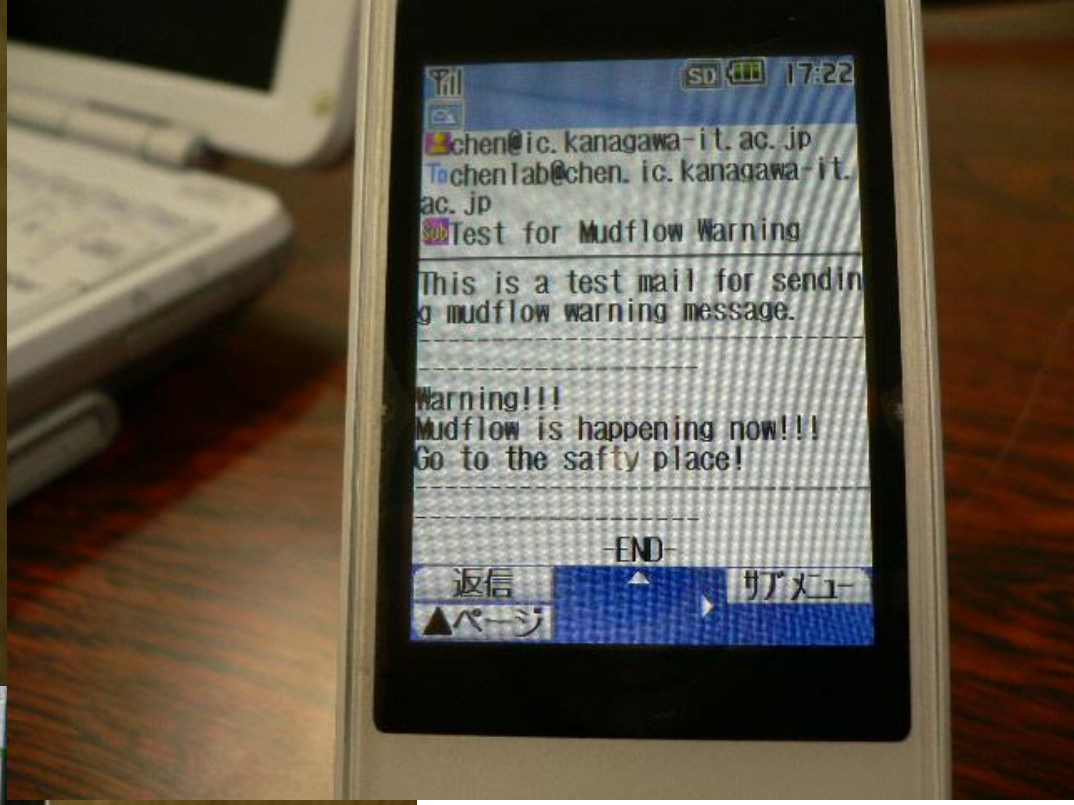
The Mudflow Warning system

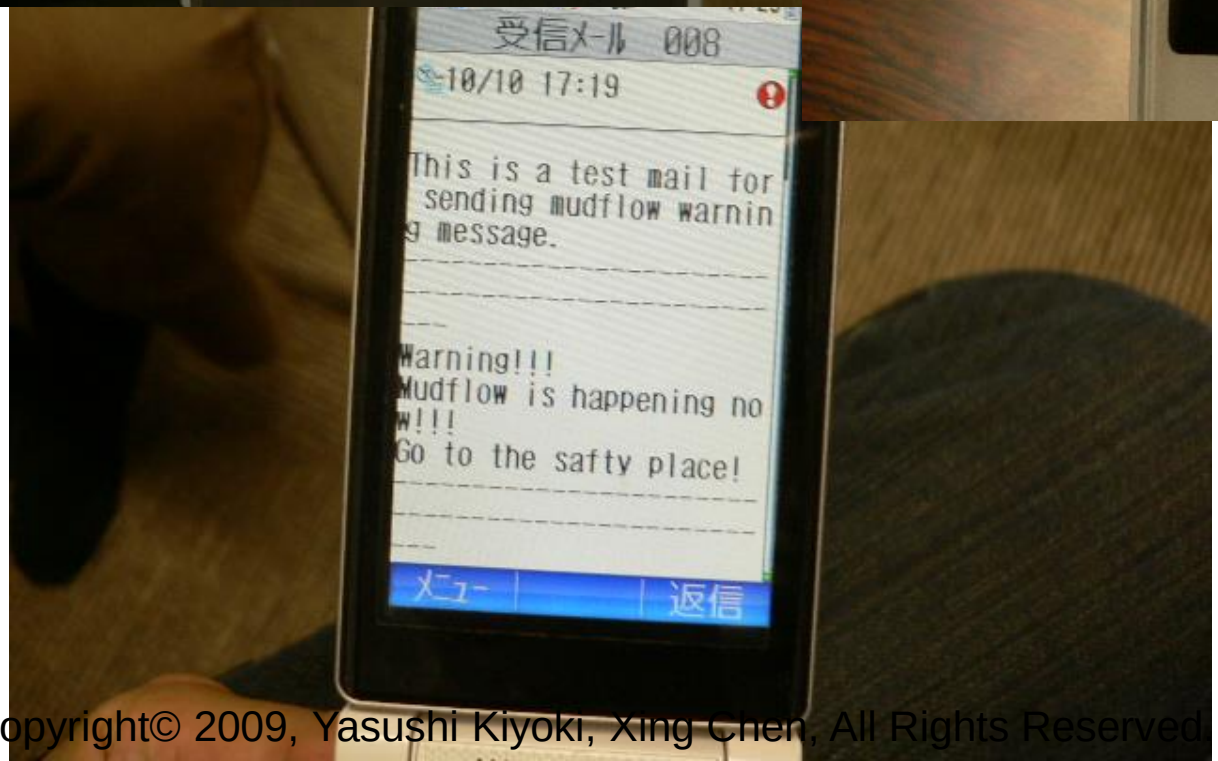
System construction



The Scene of the warning system

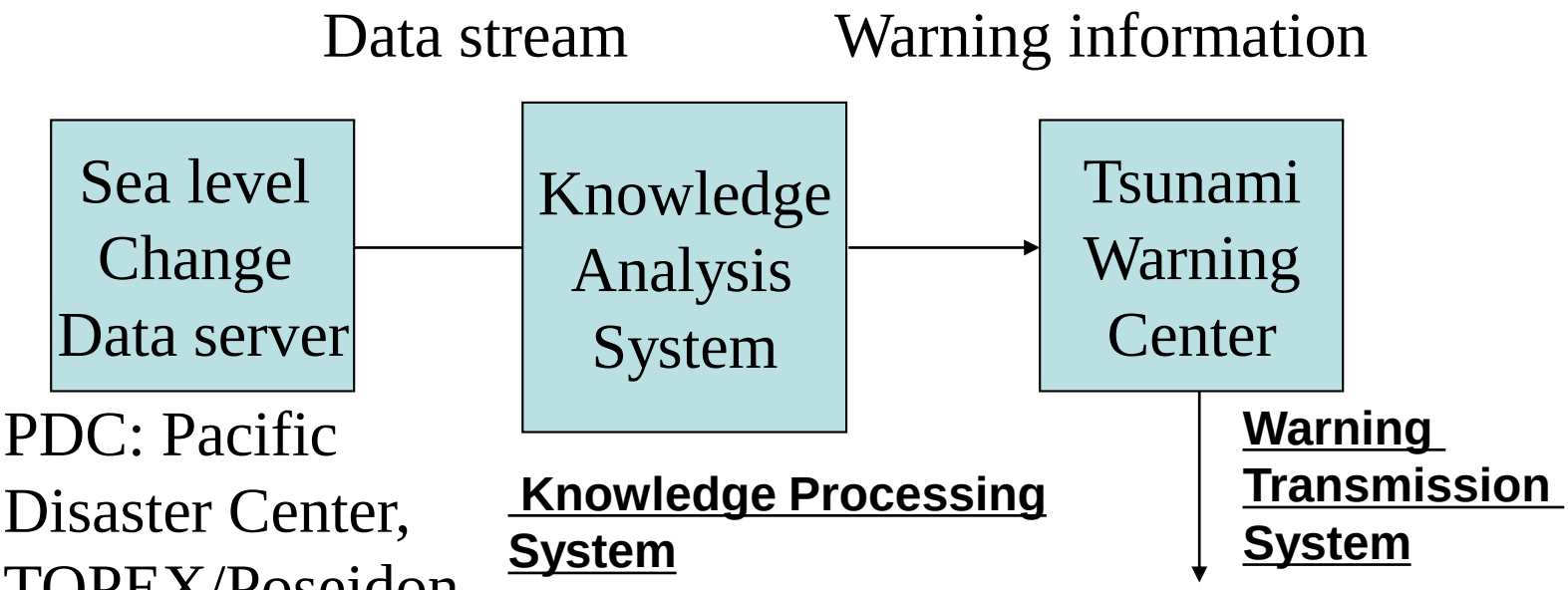






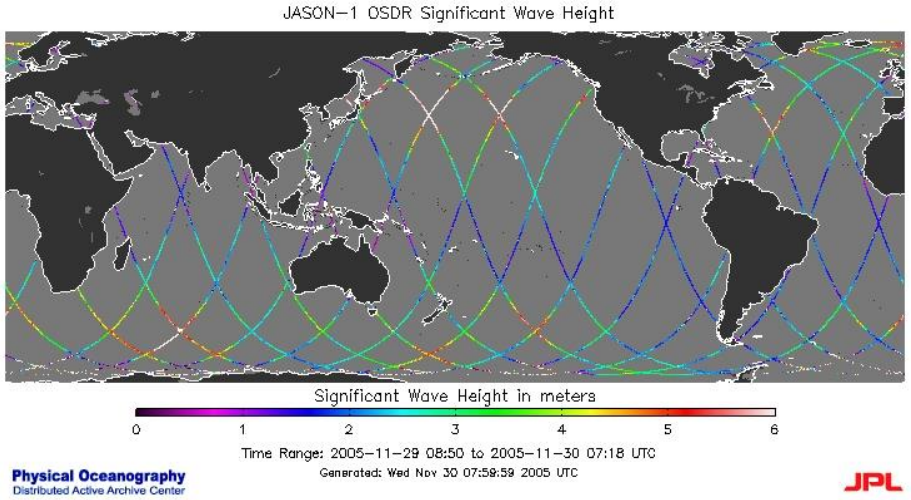
The warning message is received by three mobile-phones in real-time.

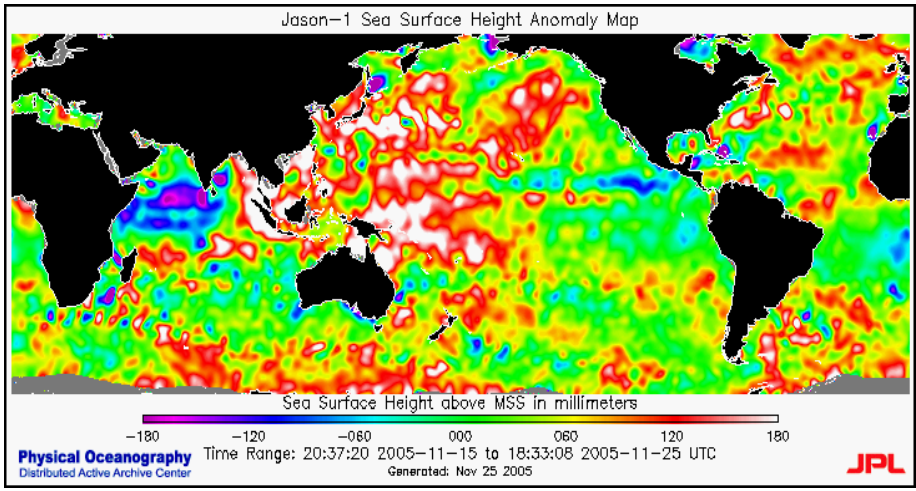
Global Environments:
Global Risk Management
― Disaster warning system―
(Ex. Tsunami warning system)



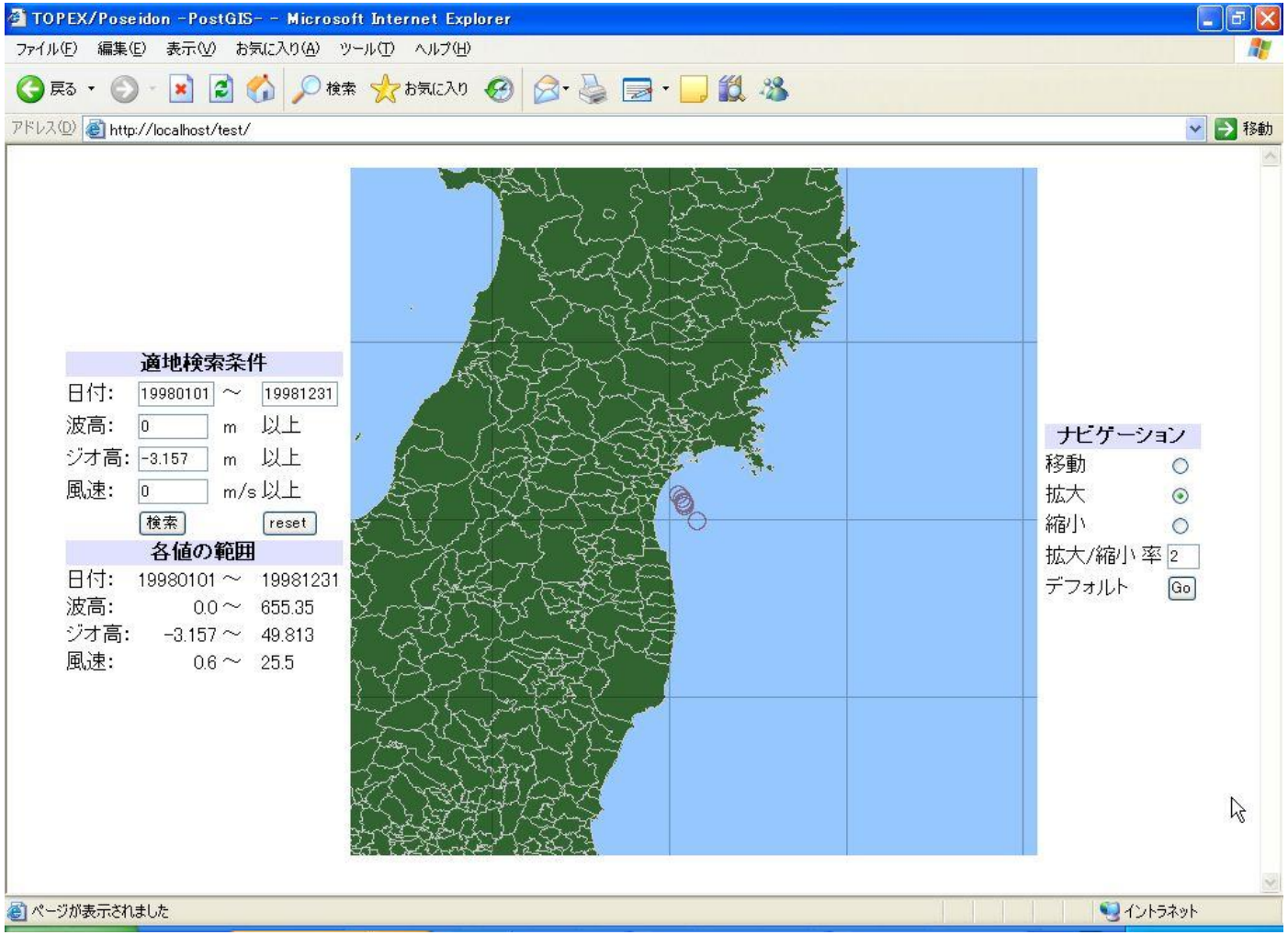
Example of the data from Topex / Poseidon and Jason satellites

- 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”



Global Environments:

Knowledge Cluster System Project

in NICT

(National Institute of Information and Communication Technology)

Yasushi Kiyoki, Yutaka Kidawara, Koji Zetteu,

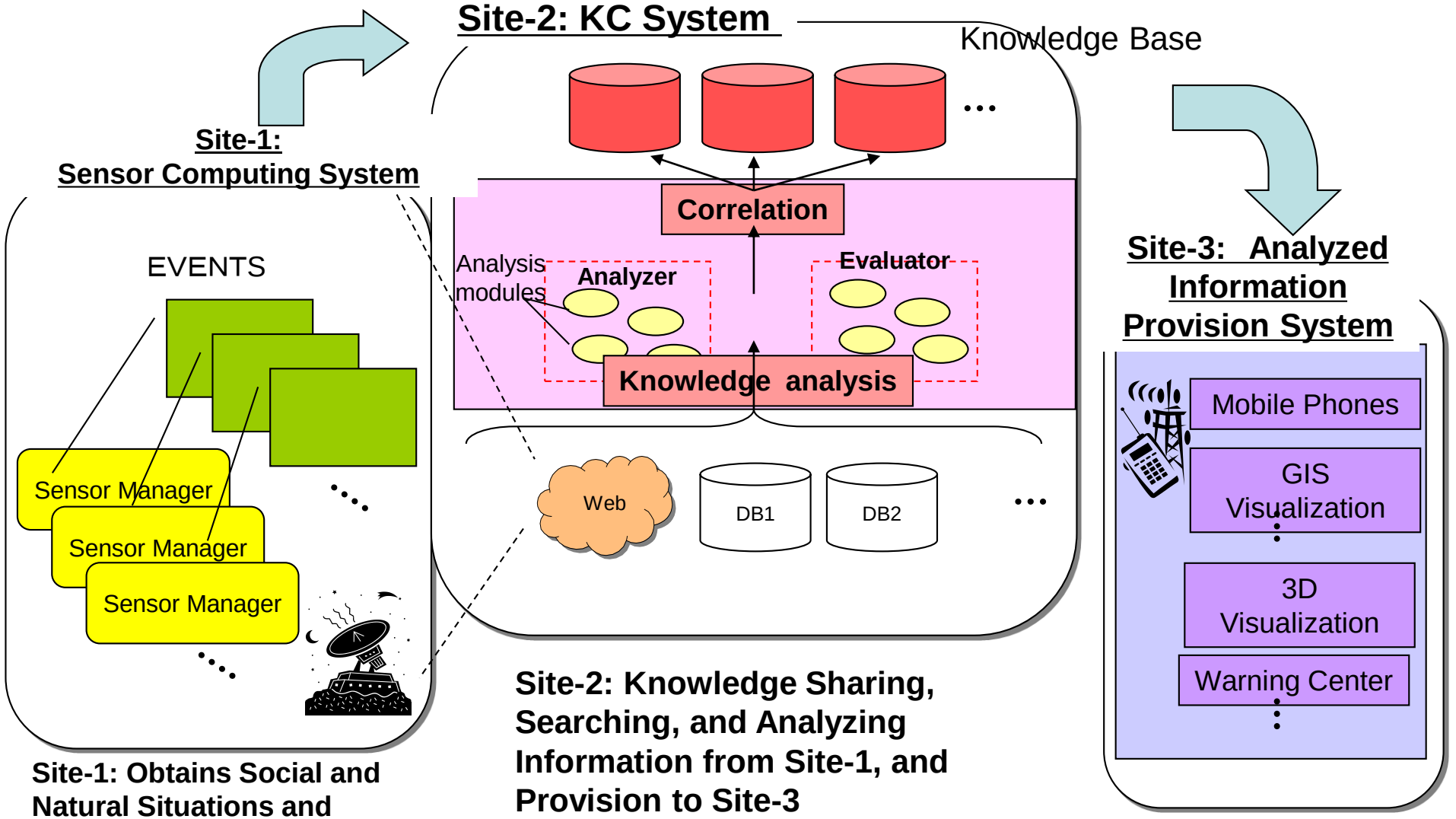
Takafumi Nakanishi, Kim Kyoung-Sook, Rong Zhang,

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 Mechnisms

Knowledge Grid System

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

Mudflow* Eruption Starts!

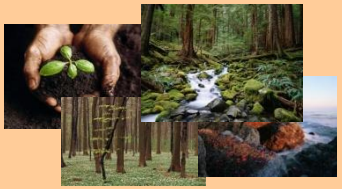
Sidoarjo mud flow Knowledge Base

delivering disaster information quickly to people

Connecting each expert knowledge existing independently

International Economy Knowledge Base

roads damaged by mud (damage to transportation)



Environment Knowledge Base

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

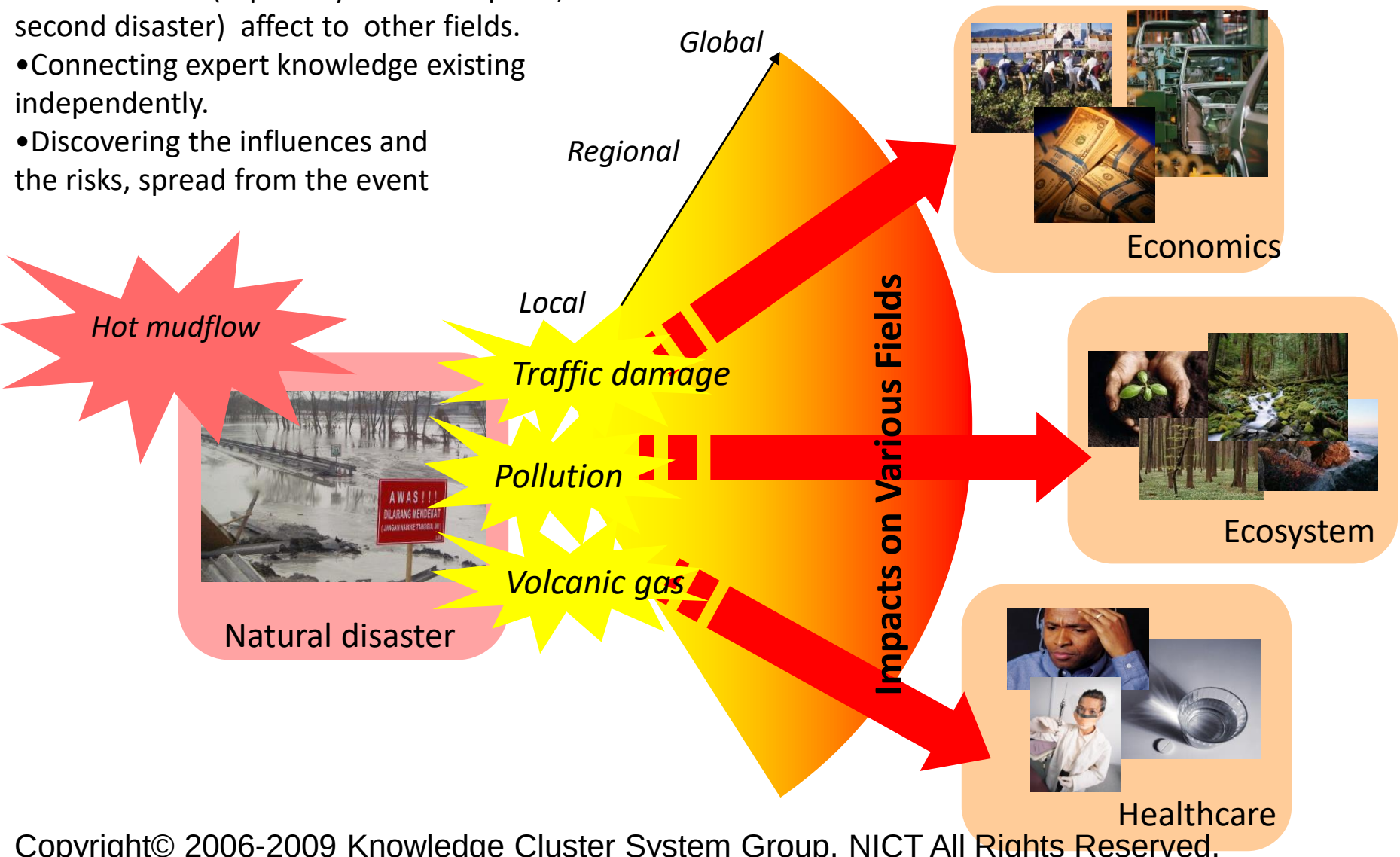
Healthcare Knowledge Base

Damage of sulfur compound gas

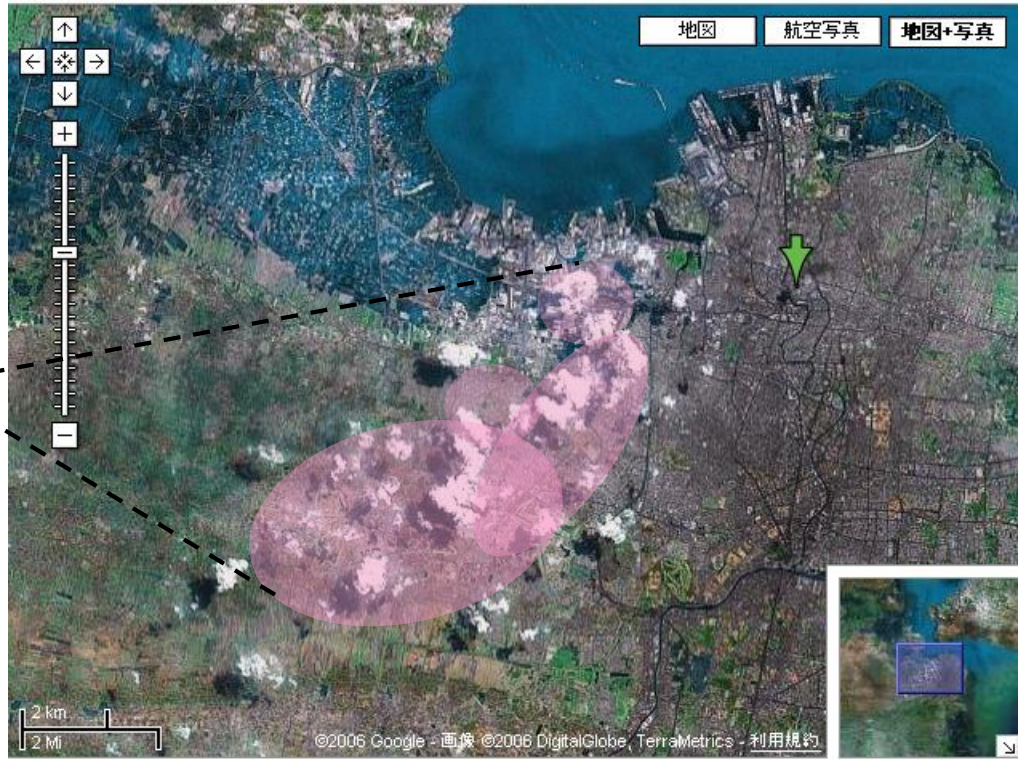
Possibility of secondary disaster and influence on environmental fields, on economy, and infectious disease .etc

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 –



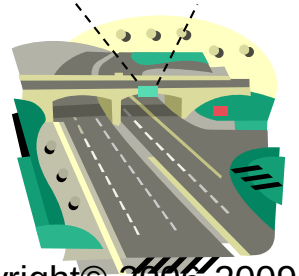
Disaster area

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

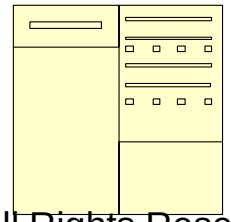
Digital road sign of traffic damage



Mobile phones

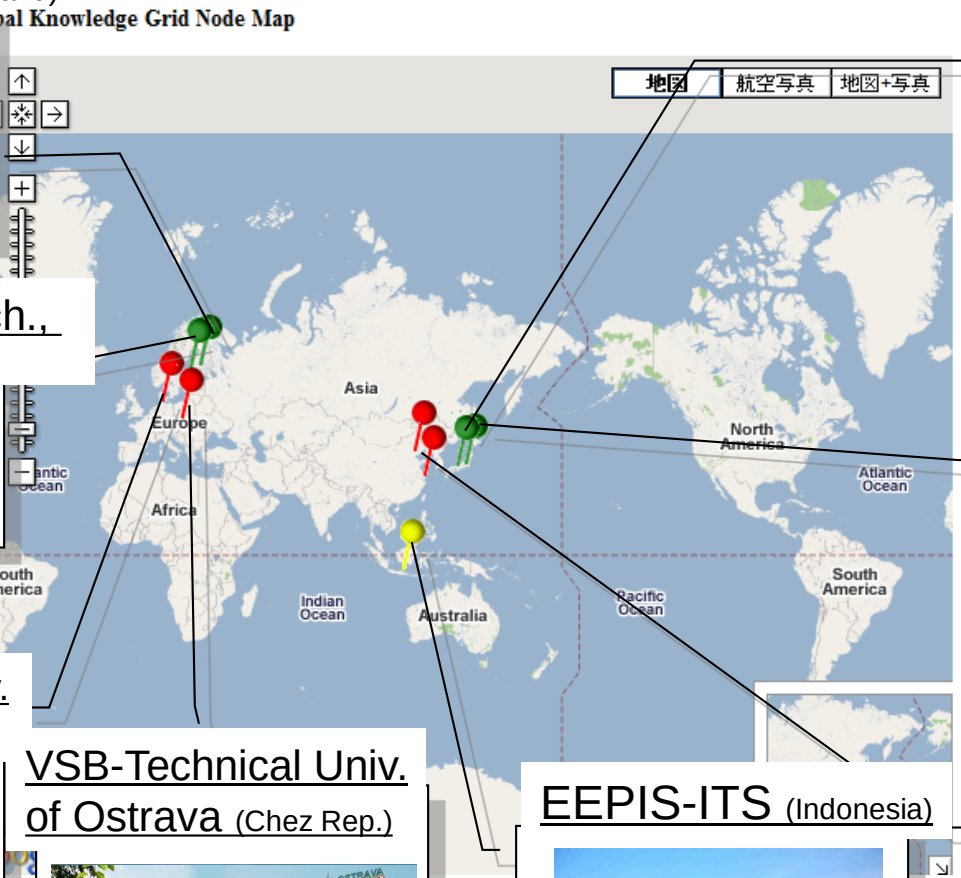
First-aid actions to local people

Risk Management Server



International Research Collaboration for Knowledge Grid System Development

Univ.of Jyväskylä (Finland)



NICT

Tampere Univ. of Tech., (Finland)

Keio Univ. SFC

Christian Albrechts Univ. at Kiel (Germany)

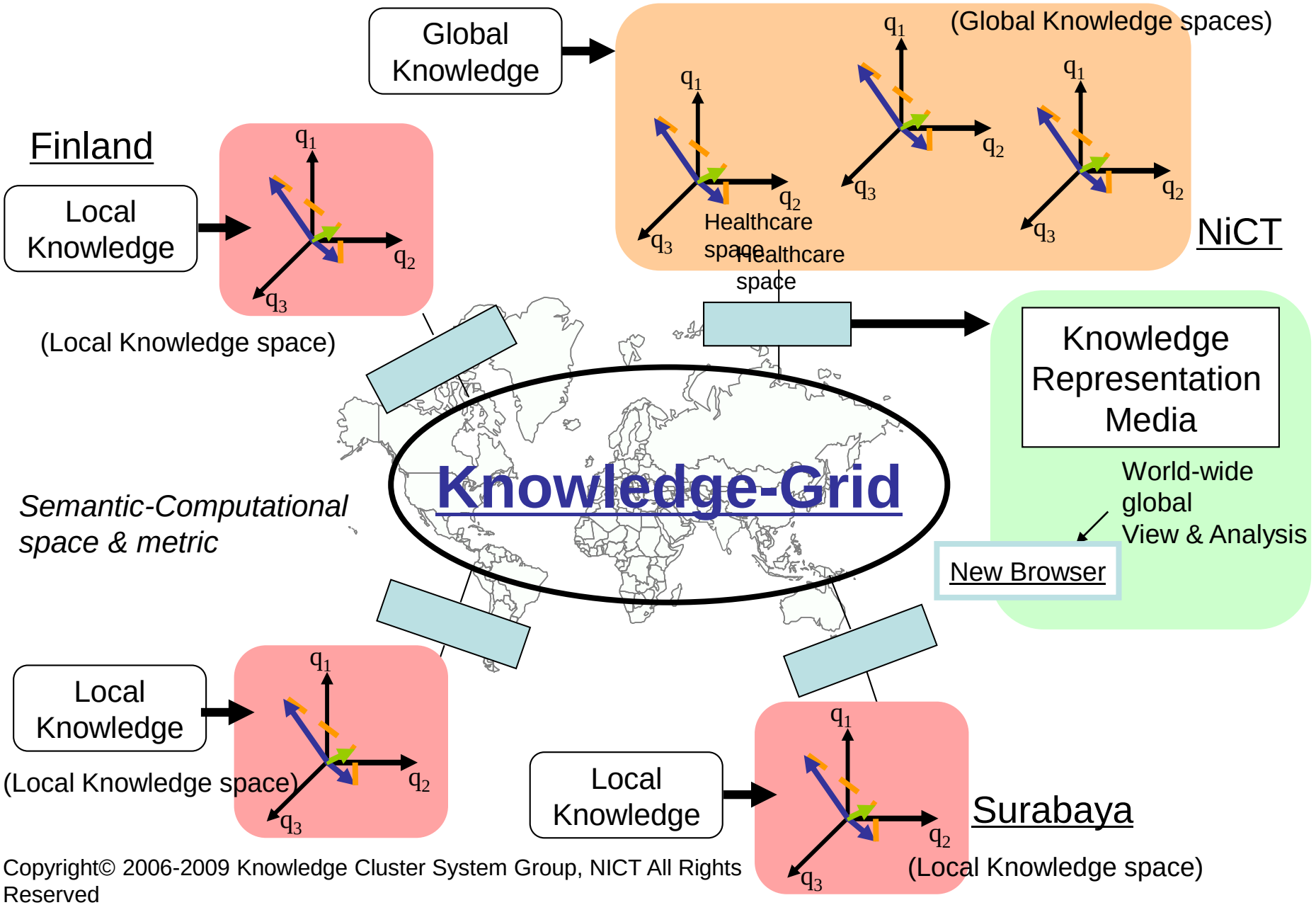
VSB-Technical Univ. of Ostrava (Chez Rep.)

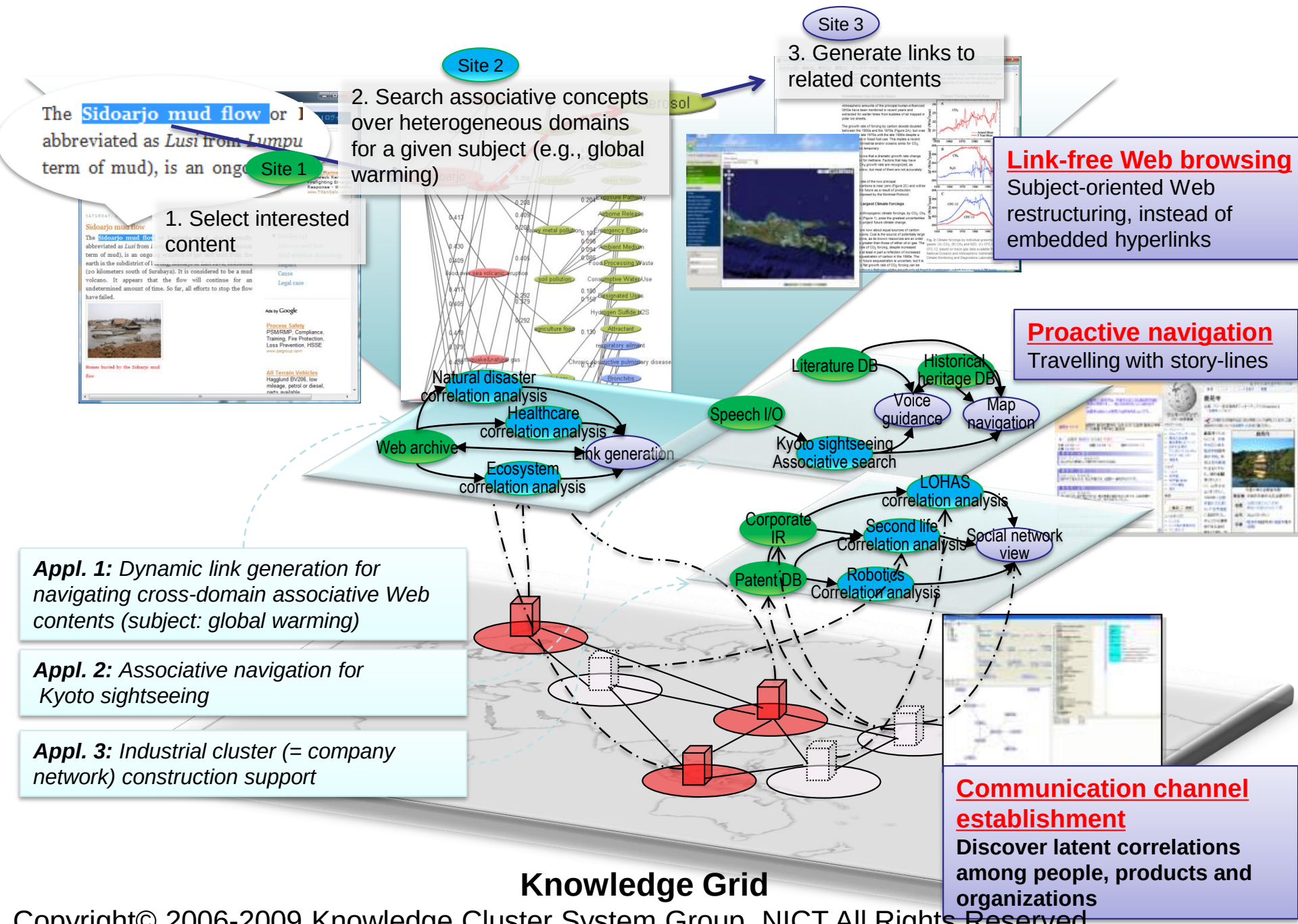
EEPIS-ITS (Indonesia)

(Planned)

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

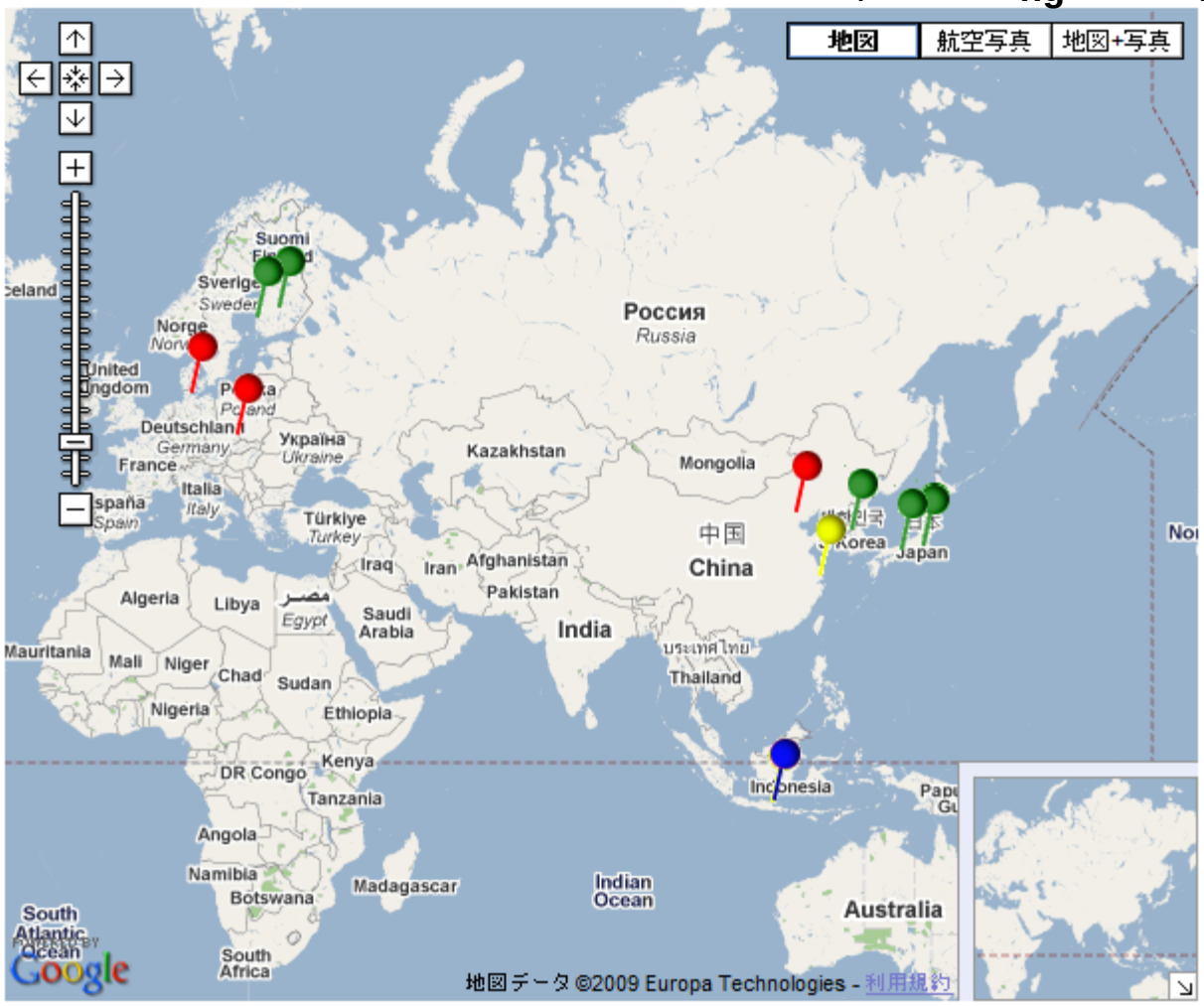
A Framework of our Knowledge Grid System





Operational Status of Global Knowledge Grid

Global Knowledge Grid Node Map



Legend : Running | Maintenance | Down | Under construction

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

Appendix (MMM)

Important Issue

- *Context Computing for Semantics and "Kansei (感性)"*

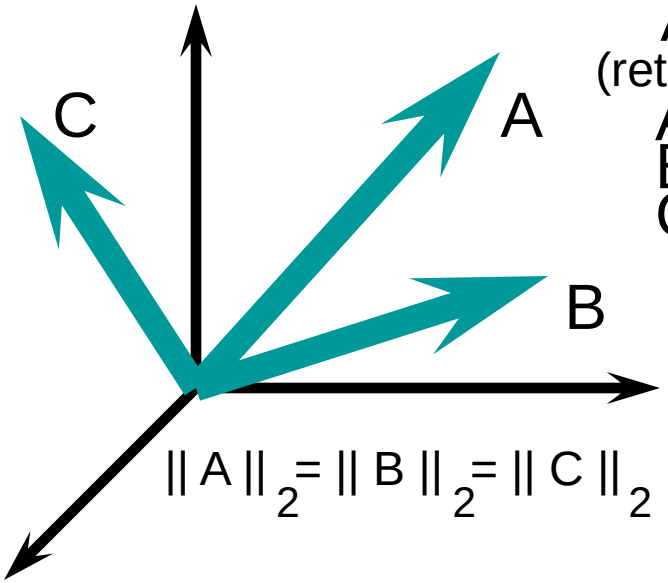
How to compute CONTEXTS?

Essential Combination for Computing
CONTEXT :

"Semantic Space Creation"
and
"Metric Setting"

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

impression words (as a context): *light, bright*



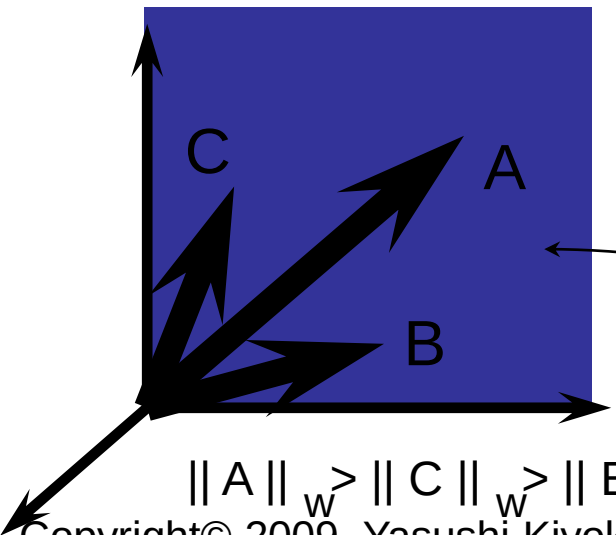
$\| A \|_2 = \| B \|_2 = \| C \|_2$

A,B,C: image data vectors (retrieval candidate image data)
A: a sunny image
B: a silent image
C: a shady image

impression words (as a context): *dark, black*

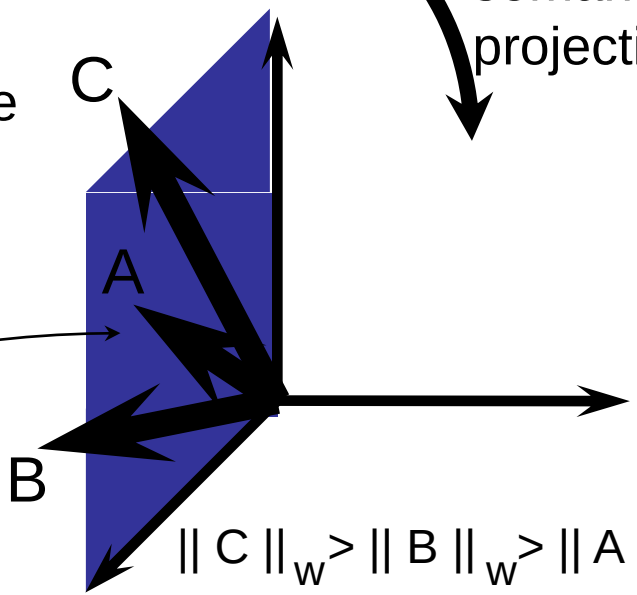
semantic projection

semantic space: 2,000 dimensional space (presently)



$\| A \|_w > \| C \|_w > \| B \|_w$

semantic subspace



$\| C \|_w > \| B \|_w > \| A \|_w$

semantic projection

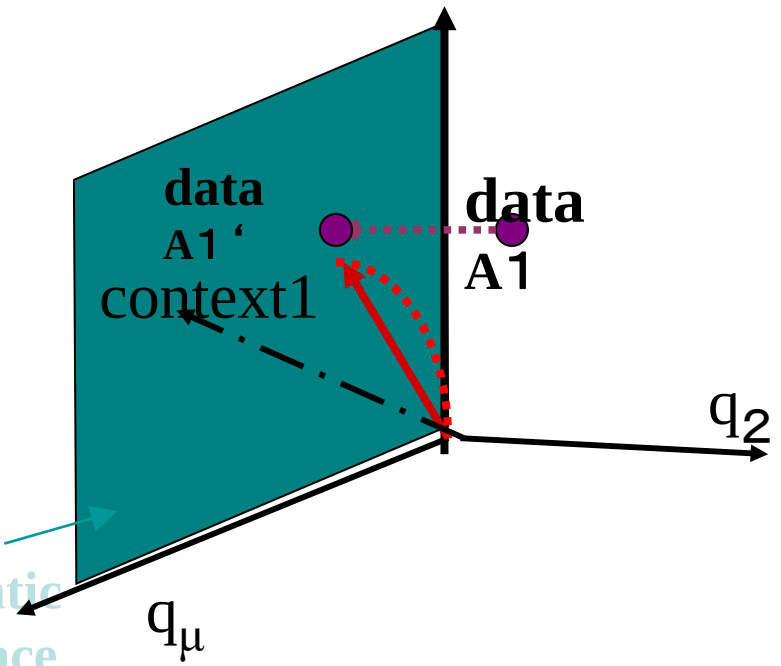
USP: 6,138,116

Context Recognition Mechanism in MMM

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

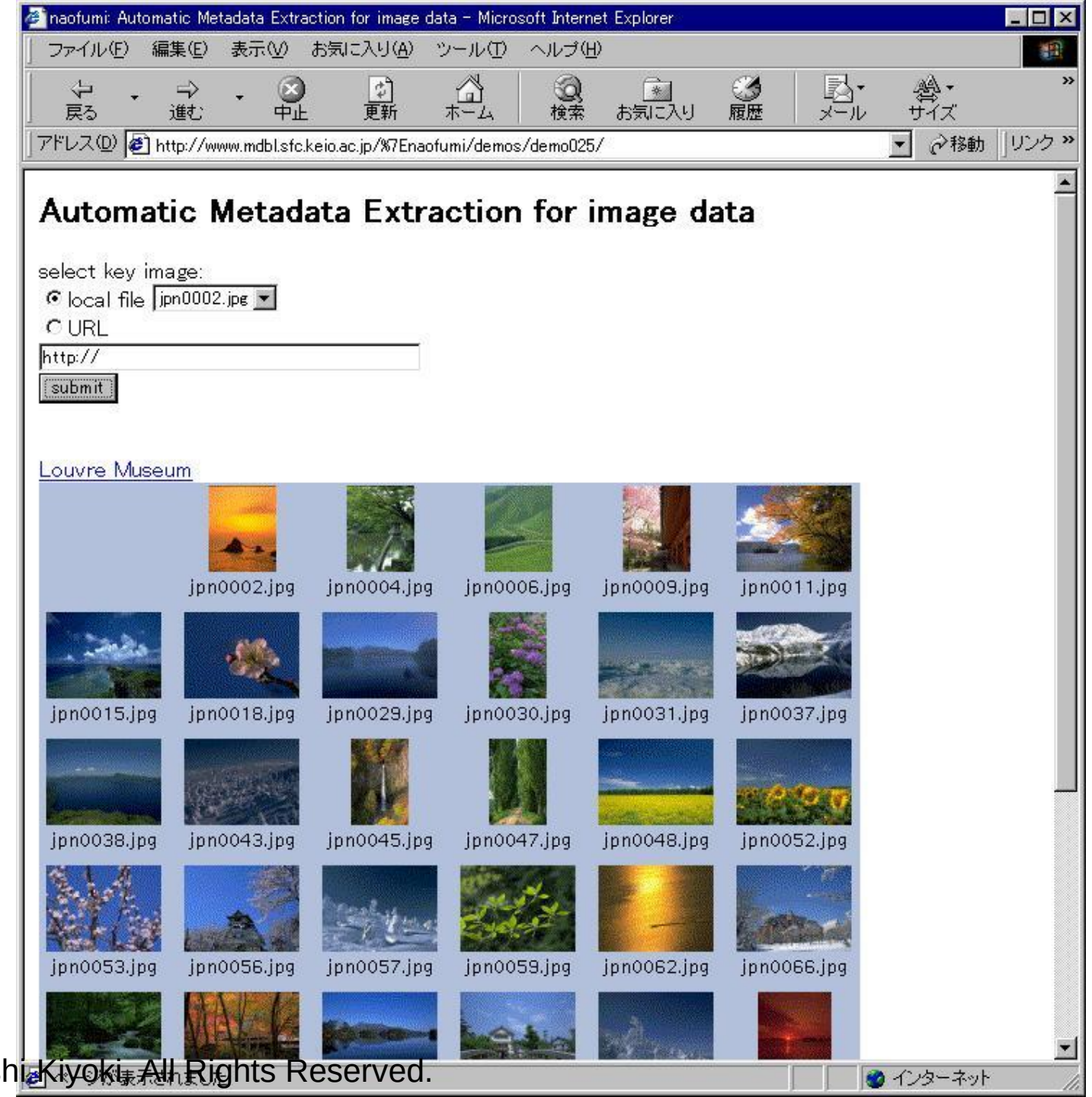
(2) A subspace is selected according to the given context. (Context Recognition)

(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.

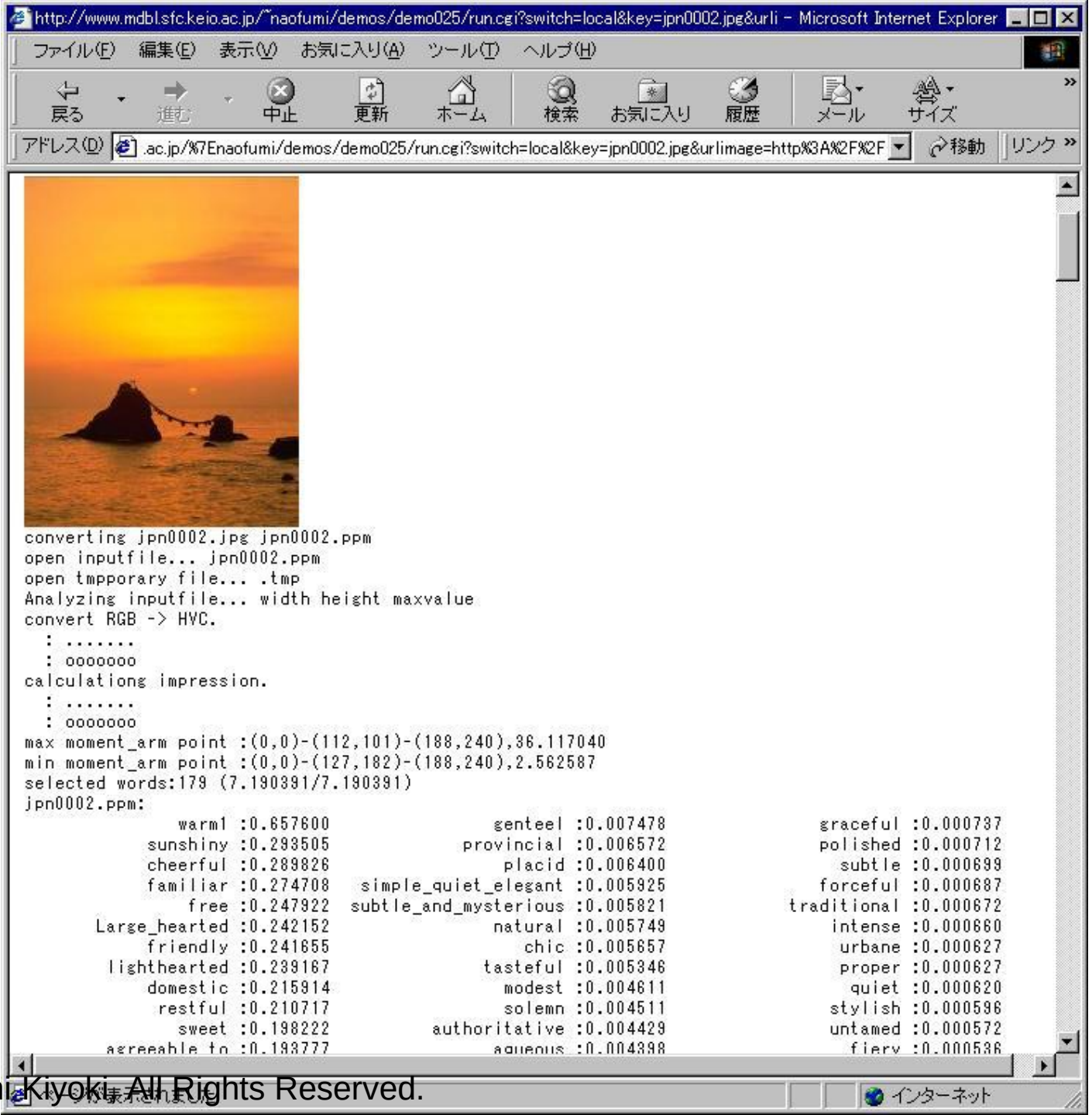


the correlation of data A1 for given context1=(sad,silent)

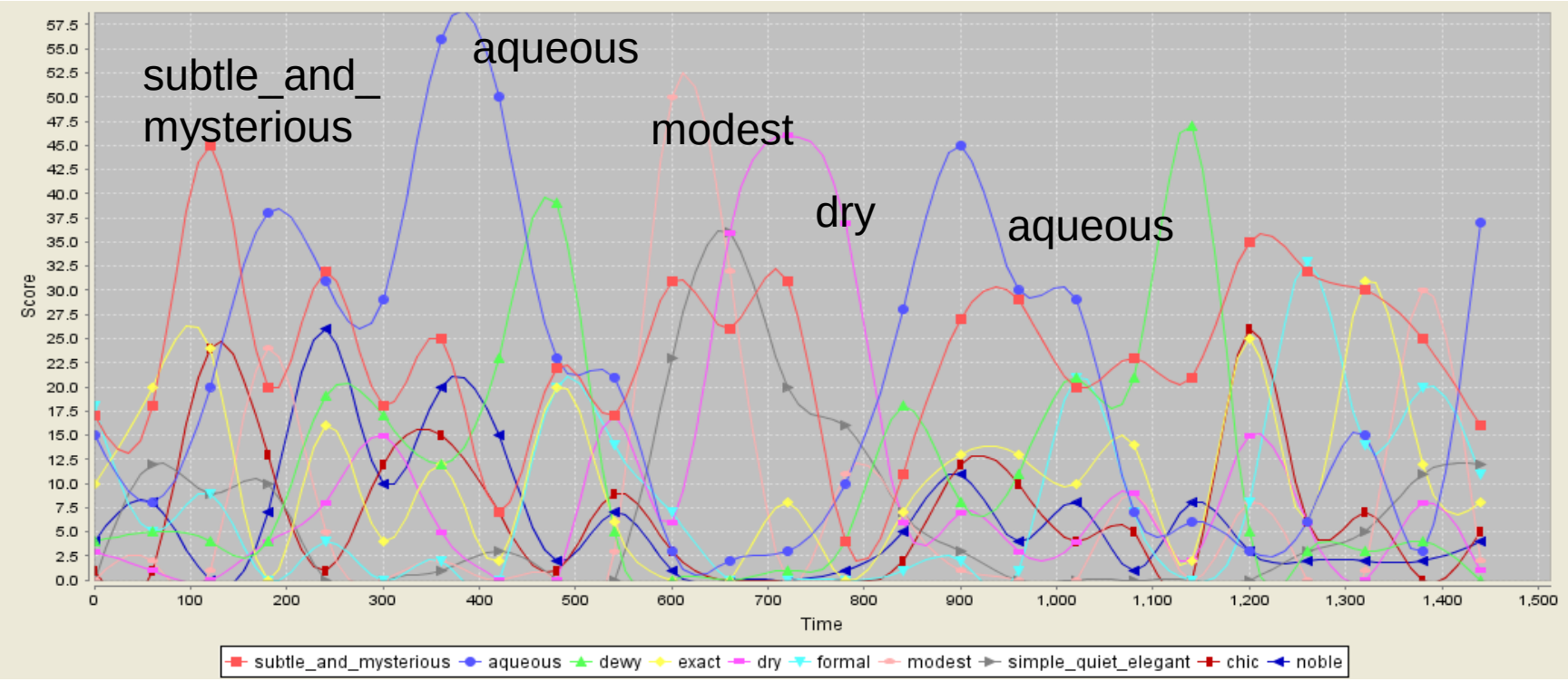
Automatic Metadata Extraction [1/2]



Automatic Metadata Extraction [2/2]

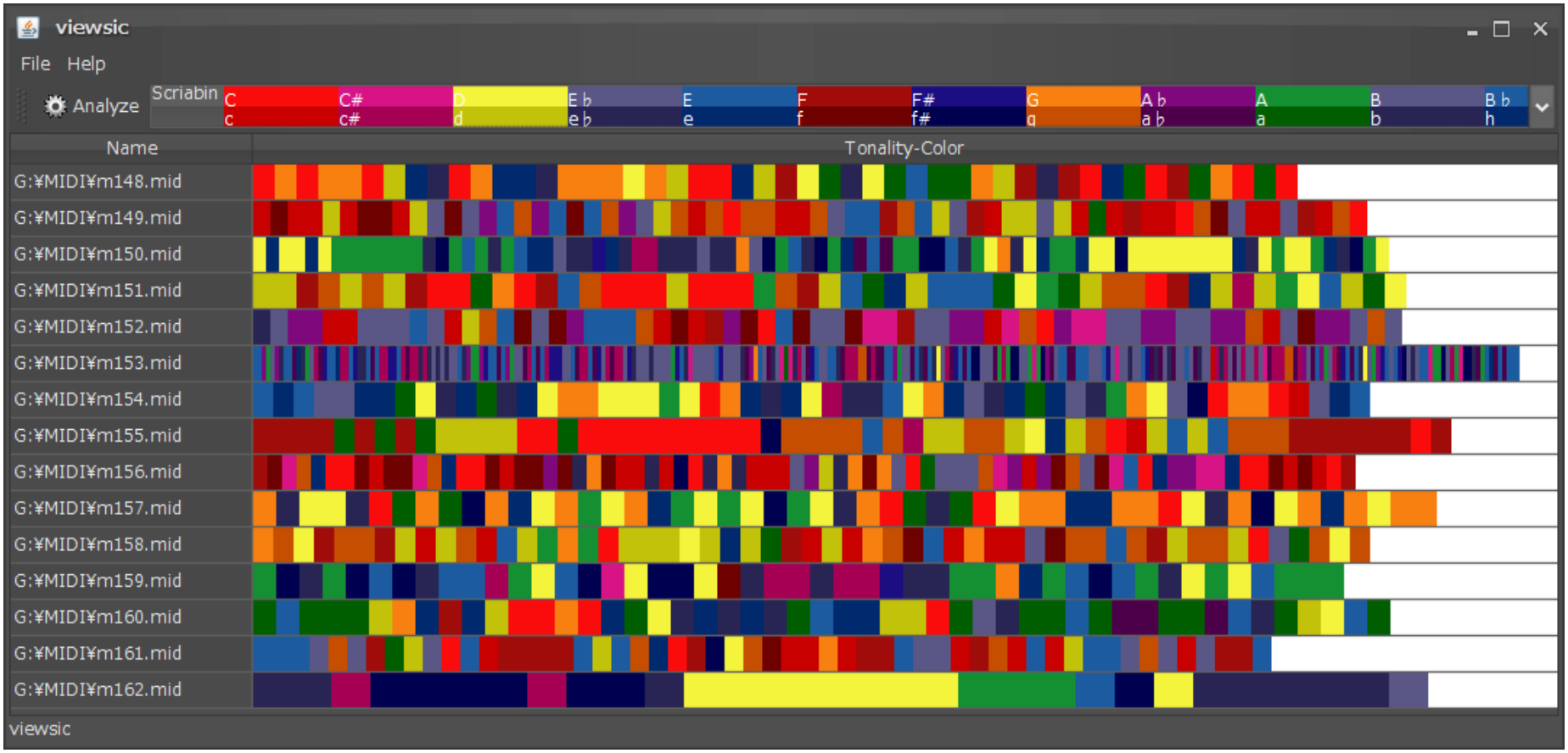


Visualization of Video in Impression-transition



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).