

## Motivation

Spatial information technology and its applications are important and used in a wide variety of fields. Maps and mapping have been evolving fast recently, however there is a big question on the present direction of map evolution based on the environment of modern technology, culture and society. To explore the big question, the commission of ubiquitous mapping has researched on human-centered design for IT tools and services to develop human's spatial capability. Our main achievement will be explained from the following two aspects.

### (A) Constructing the theories on ubiquitous mapping

#### [Original aim]

Place the notion of Ubiquitous Mapping based on real-world map interaction and ICT-based context-aware mapping services in the domain of Theoretical Cartography; examining (1) Primal mapping between geomeidia (real, graphic and language spaces) and human (cognitive space), and (2) Secondary or ICT-based mapping between geomeidia (real, graphic and language spaces) and geodatabase.

Develop the theory of Map Evolution on ICT enabled socio-cultural environment, by (1) Clarifying similarity and difference in comparing variant systems to establish an evaluation scheme, (2) Revealing significant factors such as ubiquity and egocentrism for Map Evolution on ICT, and (3) Creating map evolutionary tree diagrams representing natural selection of maps in past, current and future according to real ICT-based ubiquitous mapping services and socio-cultural environment of different regions and countries.

#### [Achievement]

The commission have held meetings and constructed the theories on ubiquitous mapping. Some of the result are open in public as follows.

- [1] Hideki KAJI, Ken'ichi TSURUOKA, Ruochen Si, Min LU, Masatoshi ARIKAWA, Takashi OGUCHI, 2019. Digital archiving project of paper maps collected for International Map Exhibition 1980, Tokyo, International Cartographic Conference 2019, International Cartographic Association, July 15 to 20, 2019, Tokyo. (Poster Presentation)
- [2] Masatoshi Arikawa, 2018. Human-Centered Ubiquitous Mapping, an invited talk in Institute of Remote Sensing and Geographic Information System, Peking Univ., Sept. 20, 2018.
- [3] Masatoshi Arikawa, Ruochen Si, Min Lu, 2017. Collaborative Spatio-time Referencing for Sustainable Human-centered Digital Content Archive, PNC 2017 Annual Conference and Joint Meetings, Nov. 7-9, 2017, Tainan, Taiwan.
- [4] Masatoshi Arikawa, 2016. Prospect the future of Japan Cartographers Association, Symposium of IMY, Journal of Japan Cartographer Association, Vol. 54, No. 4, pp. 40 (In Japanese).
- [5] Masatoshi Arikawa, Kezo Imai, Hiroshi Ota, Junko Suzuki and Takashi Morita, 2016. Appreciate, Consider and Discuss Maps and Culture. IMY Memorial Symposium, Journal of Japan Cartographer Association, Vol. 54, No. 2, pp. 39-43 (In Japanese).

#### [Steering members:]

Chair: Masatoshi Arikawa (Akita University (2018-2019), Univ. of Tokyo (2015-2018), Japan)

Vice-chair: Yuefeng Liu (Institute of Remote Sensing and GIS, Peking Univ., China)

#### Secretaries:

Min Lu (Center for Spatial Information Science, The University of Tokyo, Japan (2015-2018)),  
Ruochen Si (Center for Spatial Information Science, The University of Tokyo, Japan (2018-2019))

#### Advisors:

Takashi Morita (Honorary professor of Hosei Univ., previous chair),  
Yoshiki Wakabayashi (Tokyo Metropolitan Univ., Japan)  
Executive Committee liaison: Monika Sester

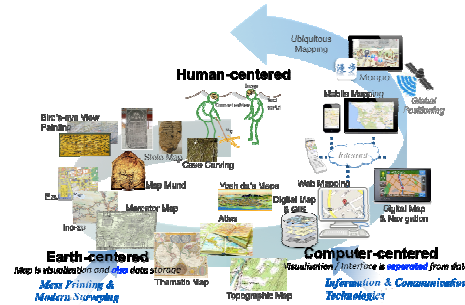


Fig. 1 Diagram of the spiral up evolutions of maps.

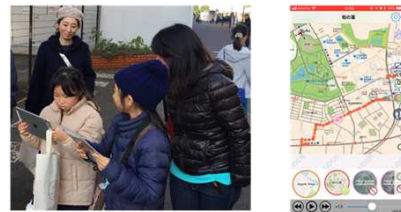


Fig. 3 (left) A Scene of the workshop for children and their parents to learn and explore local history using mobile mapping and geofencing applications in Kashiwa City, Japan on Feb. 17, 2018. (right) An interface of the original smartphone application for recording trajectories and user generated spatial content for the workshop.



Fig. 5 Group Photo of FIU2019 on July 13, 2019, Akita University, Japan

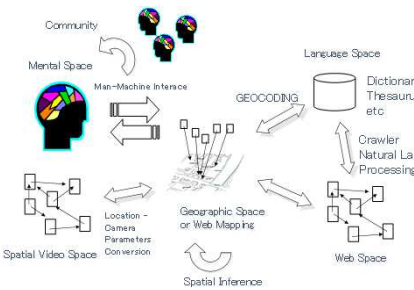


Fig. 2 Ubiquitous Spatial Mapping (Spatial Content Fusion)



Fig. 4 (left) A Scene of the workshop for children and their parents to learn local history of the world war two around Kashiwa Airport using mobile mapping and geofencing applications in Kashiwa City, Japan on Feb. 17, 2018. (right) An interface of the original smartphone application for ubiquitous field experience and recording for the workshop.



Fig. 6 Group Photo of Technical Tour of FIU2019 on July 14, 2019, Hachiro-gata Memorial Water Level Tower (140E, 40N), Akita Prefecture, Japan.

### (B) Activating and leading a research community on ubiquitous mapping in the world

#### [Original aim]

The commission are organizing regional workshops including site observation to comprehend contemporary situation of ubiquitous mapping. Particularly, this commission focuses on East Asian modern cultures such as visual style and storytelling tailored for various user groups in Cartography, which is important as a growing economic-center and clarifies the regional differences between Eastern and Western situations of Cartography. We will investigate the diversity and soundness in the evolution of Cartography in the world.

#### [Achievement]

We have held the following international symposium and workshops on ubiquitous mapping.

- [1] The exhibition workshop on history of interpretation of the world and Japan through maps and globes was held on Oct. 21st, 2016 at Kashiwa Campus Library of the University of Tokyo as an IMY event organized by Honorary Professor Osamu Nishikawa and the commission of Ubiquitous Mapping in cooperation with Center of Spatial Information Science, Kashiwa Campus Library and DNP (Dai-Nippon Printing Co., Ltd.). In addition to historical analogue maps, atlases and globes, an interactive digital historical globe of Behaim (1492) on a tablet computer was also exhibited in public as a high-resolution 3D digital archive created by DNP and BnF (Bibliothèque nationale de France).
- [2] There was a pre-conference in the conjunctions with ICC2017 at College of William and Mary, Williamsburg, Virginia from June 30th to July 1st, 2017 co-organized by ICA three commissions, Maps and Internet, Education and training, and Ubiquitous Mapping.
- [3] We held an outdoor workshop for children and their parents to create their own original maps around Kashiwanoha Area of Kashiwa City, Japan using mobile mapping and geofencing applications on Nov. 23, 2017. It was cooperated with Urban Design Center of Kashiwanoha, Kashiwa City, Japan.
- [4] We held an outdoor workshop for children and their parents to learn local history of the world war two around Kashiwa Airport using mobile mapping and geofencing applications in Kashiwa City, Japan on Feb. 17, 2018. The number of children joining it is 18.
- [5] We organized a special session on "Spatiotemporal Knowledgebase" as collaboration with ICA commission of Ubiquitous Mapping, Center of Spatial Information Science, the University of Tokyo, and Center for Southeast Asia Studies, Kyoto University in PNC2017 Annual Conference on Nov. 7 to 9, 2017 in National Cheng Kung University, Tainan City, Taiwan. The mission of the Pacific Neighborhood Consortium (PNC) is to facilitate information exchanges among institutions of higher education in the Pacific Rim through computing and communications technology.
- [6] We organize a workshop for life long education to learn the principle of GPS and geofencing using smartphones as part of Open University of Japan at Akita University on July 21, 2018 in Akita City, Japan. The number of the participants is 17. The average age of the participants about 52 years old.
- [7] ICA Joint Workshop on Future Internet and Ubiquitous Cartography 2019 (FIUCarto2019) in Akita, Japan during July 12 to 14, 2019, Organized by ICA commissions of Maps and Internet, and Ubiquitous Mapping, and Cooperated with Human-Centered Computing Course of Akita University