Sign Language Writing System:
Focus on the Representation of Sign Language-Specific Features

Nobuko Kato [†1] , Yuito Nameta [†1], Akihisa Shitara [†2], Yuhki Shiraishi [†1]

†1　Tsukuba University of Technology ,

†2 University of Tsukuba (Japan)

Contact email: nobuko@a.tsukuba-tech.ac.jp

National University Corporation
Tsukuba University of Technology

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Presenter's resume

- Dr. Nobuko Kato is a professor of National University Corporation Tsukuba University of Technology (NTUT *) .

- She has been conducting research on communication support for the deaf and hard of hearing people.

* As Japan's only institution for the higher education of deaf and hard of hearing persons, NTUT has been providing detailed education and support that are highly individualized to suit individual students' disability characteristics and the developmental traits resulting from their disabilities.

Research Interest and Current Projects

- **Research Interest**

  She has been advancing research on supporting smooth communication for the deaf and hard of hearing persons in specialized settings such as higher education institutions.
  Through activities such as SiLa (Sign Language Translation Council based on IT Technologies fo Multicultural Society), they are aiming to realize a multicultural coexistence society that includes sign language.

- **Research Project:**

  ◆ Exploration of Visually Structured Notation Featuring Sign Language Characteristics for Specialized Education

  ◆ Developing a Communication Infrastructure with ICT for a Multicultural Coexistence Society Focusing on Sign Language.

Background

- Achieving universal access in professional settings necessitates the development of computer-assisted input/output systems tailored to sign language, considering the perceptual characteristics of the deaf and hard of hearing individuals.

- Existing writing systems for spoken language (Figure 1d), are ill-suited for sign language, which constitutes a distinct language.

- Unlike hearing individuals who can write while listening (Figure 1a), deaf individuals must write while simultaneously watching sign language (Figure 1b).

- Therefore, the development of a computer-based support system for writing sign language is essential to streamline the writing process.
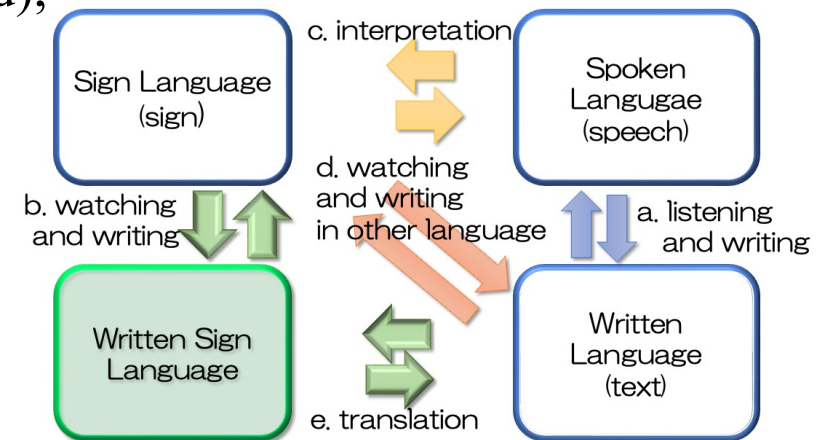
Research questions

- To achieve this, it is imperative to delineate the functions such a system should encompass based on sign language characteristics.

- This study aims to address the following research questions:

RQ1 : What are the sign language-specific features crucial for writing specialized sign language content?

RQ2: How can sign language sentences be written while preserving sign language-specific expressions?

Analysis of News Texts in Sign Language

- To address RQ1, an analysis was conducted to explore sign language-specific expressions in texts containing specialized content.

- Owing to limited material of signed sentences expressing specialized content, sign language news was chosen for analysis.

- We analyzed 44 sentences from Sign Language News, presented by four deaf news anchors at the Japan Broadcasting Corporation.

Results of the Analysis of Signed Language Sentences

- Complex sentences were prevalent in sign language news texts (32 out of 44 sentences).
- Presenting the topic at the beginning of the sentence was frequently used (34 out of 44 sentences).
- Topicisation, wh-cleft sentences, and reason-for sentences were used to introduce the topic.

Although Japanese sentences lacked topics, sign language sentences frequently presented topics using sign language- specific expressions, such as topicalisation/wh-cleft sentences or reason-for sentences explicitly stating the reason at the sentence's onset.

Thus, presenting the topic at the beginning of a sentence emerges as a sign language-specific feature crucial for facilitating comprehension by DHH individuals.

Proposed Method

- To address RQ2, we propose a new writing system that incorporates the identified sign language-specific features.

- We proposed a method to represent the spatial structure of sign language on a 2-dimensional plane using symbols, such as spatial representation of subject and object [1][2].

- This time, we focus on the macroscopic structure of sign sentences, aiming to highlight and visualize the topic in a manner conducive to DHH comprehension.

- In specialized contexts, it is essential to accurately understand technical terminology in the spoken language. Hence, spoken language text is used as labels for sign words.

[1] N. Kato, Y. Hotta, A. Shitara, and Y. Shiraishi, "Visually-structured written notation based on sign language for the deaf and hard-of-hearing," in *Proceedings of the 15th International Conference on Computer Supported Education (CSEDU)*, 2023, pp. 543–549. doi: 10.5220/0011988700003470.
[2] M.Tamura, Y.Shiraishi, "Proposal of Information Support by Writing System Considering Spatial Characteristic of Sign Languages", *IEICE Technical Report WIT*, 2015, 114(512), pp.29–32 (In Japanese) .

Examples written using the proposed method
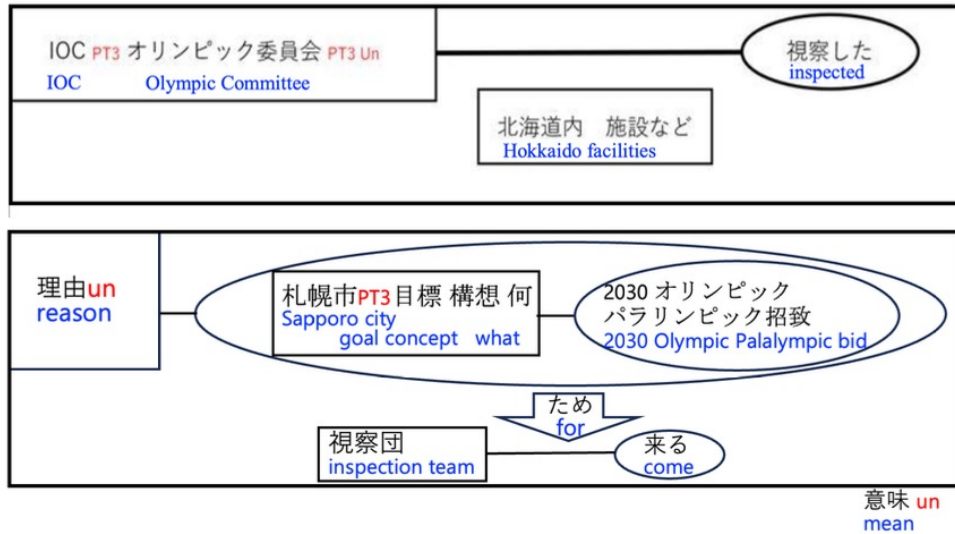
(a) Proposa A

(b) Proposal B

In Proposal A, the top left square emphasizes the topic.
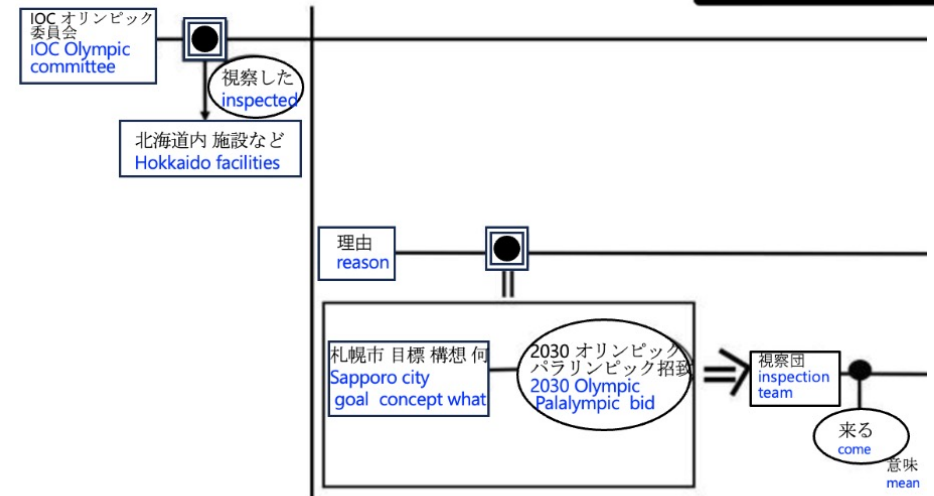
Proposal B uses a single line to maintain word position in sign space across sentences, and a double square around the branching point indicates the subject as the topic.

Figure 2. Examples of a topicalization sentence and example of a reason sentence
(Blue letters indicate translated English).
"The IOC Olympic member inspected facilities in Hokkaido. Because Sapporo City is aiming to bid for the 2030 Olympic and Paralympic Games."
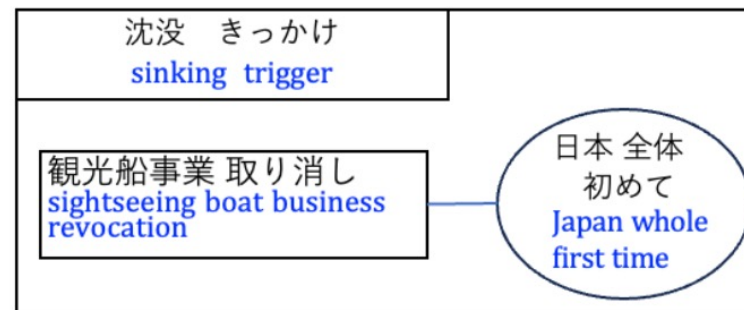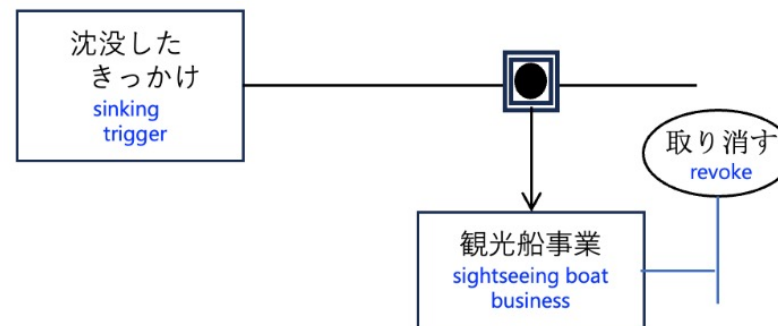
Experiment Method

- We conducted an experiment to test the efficacy of the proposed sign language writing methods, specifically based on Proposals A and B.

- The participants comprised 12 university students who were either deaf or hard of hearing.

- Participants viewed a sign language news program video; the first two sentences had a main points ticker, while the third was in sign language only, without a ticker.
  They were then asked to transcribe the third sentence using their preferred writing method, Proposal A or Proposal B .

Experiment Results

- 10 out of 12 participants opted for Proposal A, while two participants preferred Proposal B.

- 7 out of 10 participants using Proposal A correctly used the method to reflect the topic in the sentence (Figure 3(a)).

- 11 out of 12 participants chose technical terms as labels for sign words.

- However, errors in symbol selection and placement were observed (Figure 3(b)).

沈没　きっかけ
sinking trigger

観光船事業 取り消し
sightseeing boat business revocation

日本 全体
初めて
Japan whole first time

(a) Example 1 using Proposal A.

沈没した
きっかけ
sinking trigger

観光船事業
sightseeing boat business

取り消す
revoke

(b) Example 2 using Proposal B.

Figure 3. Examples of participants writing from a sign language video using the proposed method (Reproduced from handwritten results.)

Discussion

- We propose a method
  that projects spatial and time-series representations onto a 2D plane
  and uses symbols to represent grammatical and logical structures.

- In addition to the basic spatio-temporal representation, our approach focuses on the macroscopic structure of sentences, represented by Non-Manual Markers (NMMs) and other visual cues.

- Experiments revealed that the method of emphasising the topic at the beginning is prefered.

- Regarding sign labels, 11 out of 12 participants used technical terms in real-time sign writing. In order to use technical terms as a label, we need to consider how the sign language and slides are presented.

- The experiment revealed difficulties in selecting and positioning symbols, highlighting the need for computer support, such as automatic placement and insertion of symbols.

Conclusion

- This study aimed to develop a computer-assisted writing system tailored to the perceptual characteristics of DHH individuals, considering the visual and spatial nature of sign language and the unique characteristics of signed text.

- Analysis of news sentences in sign language revealed frequent use of sign-specific expressions like topicalized and wh-cleft sentences.

- The results of the experiment demonstrate that by using the proposed method, participants could actually write signed sentences with sign language-specific features.

- In the future, we intend to expand our research by conducting a broader survey involving a larger sample of sentences. This will enable us to further refine our proposed writing system and provide support for communication and learning for the DHH people.

Thank you!