

# A Critical Study of Automatic Evaluation in Sign Language Translation

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## Abstract

Automatic evaluation metrics are crucial for advancing sign language translation (SLT). Current SLT evaluation metrics, such as BLEU and ROUGE, are only text-based, and it remains unclear to what extent text-based metrics can reliably capture the quality of SLT outputs. To address this gap, we investigate the limitations of text-based SLT evaluation metrics by analyzing six metrics, including BLEU, chrF, and ROUGE, as well as BLEURT on the one hand, and large language model (LLM)-based evaluators such as G-Eval and GEMBA zero-shot direct assessment on the other hand. Specifically, we assess the consistency and robustness of these metrics under three controlled conditions: paraphrasing, hallucinations in model outputs, and variations in sentence length. Our analysis highlights the limitations of lexical overlap metrics and demonstrates that while LLM-based evaluators better capture semantic equivalence often missed by conventional metrics, they can also exhibit bias toward LLM-paraphrased translations. Moreover, although all metrics are able to detect hallucinations, BLEU tends to be overly sensitive, whereas BLEURT and LLM-based evaluators are comparatively lenient toward subtle cases. This motivates the need for multimodal evaluation frameworks that extend beyond text-based metrics to enable a more holistic assessment of SLT outputs.

**Keywords:** sign language translation, automatic evaluation, LLM evaluators

## 1. Introduction

Sign languages are the primary communication systems for millions of deaf and hard-of-hearing people across the globe. They are highly expressive visual languages that convey meaning through hand signs, facial expressions, mouthings, and body posture (Stokoe, 1980). Automatic sign language translation (SLT) aims to translate sign language videos into spoken language text to help bridge the communication gap between the deaf and hearing communities (Camgoz et al., 2018). However, evaluating SLT systems remains a significant challenge, since current evaluation practices rely solely on textual outputs, offering little insight into how effectively the visual-linguistic nature of sign language is captured. Human evaluation, though often the most reliable and serving as the gold standard in evaluating SLT, is costly and time-consuming, making it difficult to scale. As a result, current SLT models typically rely on text-based automatic evaluation metrics. Consequently, a valid measure of translation quality that properly accounts for cross-modal grounding is still missing in SLT (Müller et al., 2023). In addition to the limitations of current evaluation metrics, SLT systems are also prone to hallucinations (Zhang et al., 2023; HAMIDULLAH et al., 2026), fluent but incorrect translations that misrepresent the signed input. Evaluating how metrics respond to such cases is crucial for understanding their reliability.

When translating from sign language to spoken language text, traditional reference-based lexical overlap machine translation (MT) metrics such as BLEU (Papineni et al., 2002) and ROUGE (Lin, 2004) are commonly adopted. However, these text-based metrics fall short in capturing the multimodal complexity of sign language. To address this gap, recent studies have proposed evaluation metrics tailored to sign language tasks. SignBLEU (Kim et al., 2024), for instance, operates at the gloss level and aligns better with human judgments, while SiLVERScore (Imai et al., 2025) introduces an embedding-based approach for assessing sign language generation. Yet, SignBLEU depends on gloss annotations, and SiLVERScore has not been evaluated in the context of SLT. Beyond these, embedding-based and large language model (LLM)-based metrics developed for text-to-text MT—such as BLEURT (Sellam et al., 2020) and GEMBA (Kocmi and Federmann, 2023) have shown strong correlations with human judgments in text-to-text MT (Freitag et al., 2024). Nevertheless, these approaches remain underexplored in SLT, and there is still no comprehensive analysis of their strengths and limitations for evaluating SLT systems.

In this work, we systematically examine this evaluation gap through a comparative analysis of three lexical overlap metrics (BLEU, ROUGE, and chrF),

one embedding-based metric (BLEURT), and two LLM-based evaluators (G-Eval and GEMBA), applied to four recent off-the-shelf SLT models, one gloss-based (TwoStream-SLT) and three gloss-free (SEM-SLT, SpaMo, and Signformer). The evaluation is performed under three controlled scenarios: paraphrasing (including word reordering), hallucinations in model outputs, and variations in sentence length. All metrics investigated in the paper involve references. We summarize our contributions as follows: (1) we show that automatic lexical overlap metrics such as BLEU, chrF, and ROUGE are sensitive to surface-level lexical variation (paraphrasing) rather than true semantic equivalence. In contrast, the embedding-based metric BLEURT and LLM-based evaluators G-Eval and GEMBA better reflect semantic similarity and meaning preservation in SLT outputs; (2) our analysis shows that all metrics are able to reliably distinguish hallucinated from non-hallucinated outputs. However, BLEU is highly sensitive in cases of extreme hallucination, whereas BLEURT and LLM-based evaluators are able to better capture meaning, though they tend to under-penalize subtle hallucinations when the translation remains fluent; (3) a fine-grained analysis by sentence length indicates systematic inconsistencies between metric types: lexical overlap metrics often rank models differently than BLEURT or LLM-based evaluators, highlighting that evaluation outcomes can vary depending on the chosen metric and sentence length.<sup>1</sup>

## 2. Related Work

### 2.1. Evaluation Metrics

SLT models have traditionally relied on lexical overlap MT metrics for automatic translation. Specifically, BLEU (Papineni et al., 2002) and ROUGE (Lin, 2004) have been widely used following the neural SLT work by Camgoz et al. (2018). Following Müller et al. (2022), studies in SLT have adopted the embedding-based metric BLEURT (Sellam et al., 2020). However, these metrics do not take the visual source input into account. Recently, Kim et al. (2024) proposed SignBLEU, an evaluation metric designed to reduce information loss when assessing SLT outputs. By operating at the gloss level, it achieves stronger alignment with human judgments than prior text-based metrics. Nevertheless, SignBLEU remains constrained to the text modality and relies on manually curated gloss annotations, which limits scalability. More recently, Imai et al. (2025) introduced SiLVERScore, an embedding-based metric that evaluates sign language generation in a multimodal semantic space. While it shows

promising results, SiLVERScore was not evaluated on SLT.

The progress and advancements in LLMs have motivated research into their potential applications for automated assessment across various tasks. Liu et al. (2023) pioneered LLM-based automated assessment by proposing G-EVAL, a framework that uses Chain-of-Thought reasoning (Wei et al., 2022) along with task descriptions and evaluation metrics to evaluate performance on tasks including text summarization and dialogue generation. Following this direction, Kocmi and Federmann (2023) proposed GEMBA, a GPT-based evaluation metric to assess the MT quality both with- and without reference in a zero-shot prompting fashion. Recently, inspired by G-EVAL, Tong et al. (2025) extended the framework to image and video caption evaluation using GPT-4o, achieving a high correlation with human judgments.

### 2.2. Sign Language Translation

SLT aims to convert sign language videos into spoken language text. SLT models are often categorized into gloss-free and methods with gloss supervision. Camgoz et al. (2018) pioneered SLT by framing it as a neural machine translation (NMT) task, and further extending it by leveraging transformers for end-to-end SLT (Camgoz et al., 2020). MSKA-SLT (Guan et al., 2025) sets a new state-of-the-art on the Phoenix-2014T (Camgoz et al., 2018) and CSL-Daily (Zhou et al., 2021) benchmarks as a gloss-based model, with BLEU scores of 29.03 and 25.52, respectively. The approach models keypoints extracted from the face, body, and both hands using an attention mechanism, and is jointly optimized with a CTC loss and a self-distillation loss. However, glosses require manual human annotation, which is labor-intensive and difficult to scale. In contrast, recent approaches attempt to model SLT at the sentence level and a gloss-free fashion. Building on this objective, recent works have incorporated LLMs into SLT frameworks (Gong et al., 2024; Wong et al., 2024; Chen et al., 2024), employed contrastive learning objectives (Cheng et al., 2023), replaced gloss supervision with sentence-level embeddings (Hamidullah et al., 2024), and extended SLT to multilingual scenarios (Yin et al., 2022; Yazdani et al., 2025; Tan et al., 2025; Hamidullah et al., 2025).

### 2.3. Hallucination

A model is said to hallucinate when it generates content that either lacks logical coherence or diverges from the source material, asserting information or events that are unfounded or inconsistent with the known facts (Ji et al., 2023). While hallucination detection has received increasing attention in the

<sup>1</sup>Our code and prompts are available at <https://github.com/shakibyzn/critical-eval-slt>.

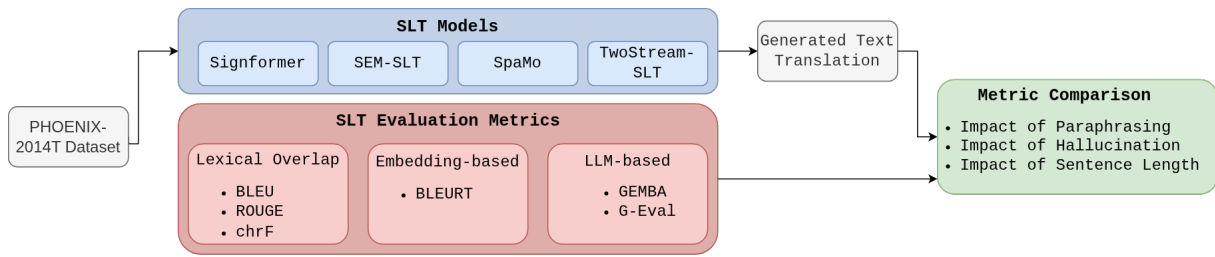


Figure 1: Schematic representation of our experimental setup in Section 3.

MT community, with studies on multilingual comparisons (Guerreiro et al., 2023) and LLM-based approaches for both low- and high-resource languages (Benkirane et al., 2024), research on hallucination in SLT remains limited. Zhang et al. (2023) reported, based on manual analysis, that SLT models such as SLTUNET suffer greatly from hallucinations, where the generated translations often show limited correlation with the sign video. More recently, HAMIDULLAH et al. (2026) proposed a hallucination detection framework and further demonstrated that gloss-free SLT models are particularly prone to severe hallucinations compared to their gloss-based counterparts. These findings highlight the need for a deeper understanding of how evaluation metrics respond to hallucinated outputs and how robust current SLT models are under such conditions.

### 3. Experimental Setup

#### 3.1. Task and Datasets

In our experiments, we evaluate the limitations of current SLT metrics with respect to paraphrasing (including word reordering), hallucination sensitivity, and variation in translation length. We use the Phoenix-2014T<sup>2</sup> dataset (Camgoz et al., 2018), covering weather forecasts in German sign language (DGS) to evaluate and compare the performance of various models. A high-level overview of our study design is presented in Figure 1.

**Impact of paraphrasing on SLT evaluation.** For this aspect of our study, we compare recent off-the-shelf SLT models (Sec. 3.3) across both traditional evaluation metrics and LLM-based ones (Sec. 3.2) when we paraphrase the translation predicted by the model. We focus on paraphrasing, which naturally captures surface-level variations such as synonym substitution. We use GPT-4o-mini (et al.,

<sup>2</sup>Phoenix-2014T was selected because it is the most widely used benchmark in SLT research and contains gloss-level annotations necessary for evaluating gloss-based models.

2024) with the following prompt to generate paraphrased versions of model translations, which are then compared against their original references.

Paraphrase the following sentence into a natural and fluent form. Do not alter any numbers written in words into digits or vice versa - keep the format as it is in the original text.

For lexical overlap metrics (BLEU, chrF, and ROUGE) and embedding-based BLEURT, and to ensure robustness against paraphrasing variations, we also include an additional multi-reference evaluation in which the model’s translated and paraphrased output is compared against an augmented set of eleven references comprising the original human reference and ten gold-standard paraphrases. We use GPT-4o-mini with a temperature of 0.7 to produce the ten gold-standard paraphrases used in this augmented set.

**Impact of hallucination on SLT evaluation.** SLT models are prone to hallucinations, where the generated text diverges from the visual input. Yet, there has been no systematic investigation into how such hallucinations affect translation quality or the reliability of automatic SLT evaluation metrics. Motivated by findings from Benkirane et al. (2024), which demonstrate the effectiveness of LLMs for hallucination detection in MT, we employ Llama-3-70B to identify hallucinated outputs in a reference-based setting.<sup>3</sup> To analyze how evaluation metrics behave under varying degrees of hallucination and following the findings of Benkirane et al. (2024), we consider a **Severity Ranking** scheme that categorizes outputs into four levels: *No Hallucination*, *Small Hallucination*, *Partial Hallucination*, and *Full Hallucination*.

**Impact of sentence length on SLT evaluation.** In SLT, most studies report only the average evaluation score over the entire dataset, which can obscure important performance variations. To investigate the sensitivity of evaluation metrics to

<sup>3</sup>The prompt used for hallucination detection is available in Appendix A.1.

sentence length, we conduct a fine-grained analysis by segmenting the test set based on the number of words per sentence. Specifically, we group sentences into five ranges: 1–6 (42 sentences), 7–12 (286 sentences), 13–18 (220 sentences), 19–24 (78 sentences), and 25–31 (16 sentences). This segmentation allows us to investigate how translation quality varies with sentence complexity and length, providing deeper insights into where existing models struggle and how hallucination patterns may correlate with sentence structure.

### 3.2. Evaluation Metrics

For our analysis, we consider the metrics as per Müller et al. (2022); Müller et al. (2023), specifically BLEU<sup>4</sup> (via SacreBLEU; Post, 2018) for lexical overlap, ROUGE (Lin, 2004)<sup>5</sup> for recall-oriented n-gram overlap, chrF (Popović, 2015)<sup>6</sup> that uses character n-grams, and embedding-based BLEURT (Sellam et al., 2020)<sup>7</sup> for semantic quality. Note that all metrics evaluated in our study are reference-based. We use bootstrap resampling for statistical significance reporting.

We also extend the traditional range of SLT evaluation metrics by presenting a sign language adapted version of G-Eval (Liu et al., 2023). G-Eval introduces a framework that leverages prompting techniques to generate evaluation scores that strongly correlate with human preferences. The prompt is organized into three modules: (1) evaluation dimensions, which specify the aspects to be judged; (2) step-by-step reasoning, where Chain-of-Thought (CoT) (Wei et al., 2022) guides the LLM through the evaluation procedure; and (3) scoring with references, which constrains the output format and incorporates human translations as ground truth. Following Sato et al. (2024), we prompt the LLMs to evaluate the translation quality of the models in Section 3.3 for **Adequacy** and **Fluency**, each rated on a 5-point Likert scale (1–5). Following Fomicheva et al. (2022); Kocmi and Federmann (2023), we further include GEMBA zero-shot **Direct Assessment** (Kocmi and Federmann, 2023), where the LLM is prompted to evaluate each translation hypothesis and provide a quality score ranging from 0 (completely incorrect) to 100 (perfect translation). Our LLM experimental setup includes four models: GPT-4.1-nano, Qwen3-8B, Llama-3.1-8B, and QWQ-32B. These were chosen to include both a proprietary LLM and also the open-

source ones.<sup>8</sup>

### 3.3. SLT Models

SLT models are either gloss-based or gloss-free. We include three gloss-free models: **SpaMo** (Hwang et al., 2025), **SEM-SLT** (Hamidullah et al., 2024), and **Signformer** (Yang, 2024). Additionally, we include **TwoStream-SLT** (Chen et al., 2022b) as a gloss-based model. We retrain these models to reproduce their reported results when the original model checkpoints are unavailable; however, our reproduced scores differ slightly from those originally reported.

**SpaMo.** This model works by combining spatial and motion visual features using a multi-layer perceptron (MLP) and feeding them together with a prompt to an LLM for decoding and translation. Following the original setup, we set learning rate to  $6 \times 10^{-4}$  and train for a maximum of 100 epochs.

**SEM-SLT.** SLT models have traditionally relied on glosses for training. SEM-SLT avoids this reliance by supervising on sentence embeddings instead of glosses. The full pipeline sign2(sem+text) module, with an mBART decoder from SEM-SLT, was trained with a per-device batch size of 4 for both training and validation. The learning rate was set to  $1 \times 10^{-5}$ . Training was carried out with all other hyperparameters left at their default Hugging Face Trainer settings.

**Signformer.** With the goal of edge AI, Signformer uses a combination of novel convolution, attention, and positional encoding to achieve competitive performance compared to gloss-based models while being quite smaller. Since the original paper did not specify how video features were extracted, we instead employ the S3D model pre-trained on both WLASL for ASL word recognition (Li et al., 2020) and the Kinetics-400 dataset for human action recognition (Kay et al., 2017), following the approach by (Chen et al., 2022a). We set learning rate to 0.001 and train it for a maximum of 100 epochs.

**TwoStream-SLT.** Unlike most SLT methods that extract visual embeddings from raw videos only, TwoStream-SLT leverages both key points (of hands, face, and upper body) and visual embeddings from raw videos to train a novel gloss-based network for sign language recognition and SLT. We used the pretrained Sign2Gloss and the Gloss2Text modules from the TwoStream-SLT repository to reproduce their results and outputs.

<sup>8</sup>All prompts used for G-Eval and GEMBA are provided in Appendices A.2 and A.3.

<sup>4</sup>BLEU|nrefs:1|bs:25|tok:none|eff:no|case:mixed|smooth:exp|version:2.5.1

<sup>5</sup>ROUGE|metrics:rougeL|nrefs:1|stemmer:true|bs:25|version:0.1.2

<sup>6</sup>chrF|nrefs:1|bs:25|case:mixed|eff:yes|nc:6|nw:2|space:no|version:2.5.1

<sup>7</sup>BLEURT v0.0.2 using checkpoint BLEURT-20.

Method	Setting	BLEU	chrF	BLEURT	ROUGE
Signformer	Original	14.8±1.4	35.0±1.2	0.425±0.016	32.8±2.0
	Paraphrased	5.7±0.8	31.7±0.9	0.452±0.015	27.7±1.8
	Multi-Ref	18.6±1.4	38.8±1.3	0.509±0.016	36.5±1.8
SEM-SLT	Original	23.7±2.1	45.8±1.6	0.484±0.012	47.9±1.9
	Paraphrased	10.0±1.3	38.3±1.1	0.537±0.014	38.0±1.6
	Multi-Ref	26.8±2.4	47.0±1.7	0.594±0.013	49.8±1.8
SpaMo	Original	22.2±2.0	44.2±1.2	0.542±0.015	43.2±2.1
	Paraphrased	9.3±1.0	38.6±0.9	0.558±0.013	35.3±1.7
	Multi-Ref	26.1±1.8	48.1±1.1	0.618±0.015	46.7±1.3
TwoStream-SLT	Original	28.2±2.1	50.5±1.4	0.597±0.013	50.3±2.1
	Paraphrased	12.7±0.8	43.3±0.9	0.604±0.011	40.5±1.6
	Multi-Ref	34.2±1.6	54.5±1.1	0.670±0.009	53.7±1.4

Table 1: Performance comparison of SLT models on the Phoenix-2014T test set under original, paraphrased, and multi-reference conditions across multiple evaluation metrics.

Method	Model	G-Eval Adequacy (Orig / Para)	G-Eval Fluency (Orig / Para)	GEMBA (Orig / Para)
Signformer	gpt-4.1-nano	2.54 / 2.57	3.34 / 3.48	38.45 / 38.33
	qwen3:8b	2.70 / 2.71	3.49 / 3.60	74.82 / 75.27
	qwq:32b	2.76 / 2.83	3.73 / 3.87	64.56 / 67.25
	llama3.1:8b	3.50 / 3.56	4.65 / 4.60	57.44 / 59.58
SEM-SLT	gpt-4.1-nano	2.76 / 2.91	3.26 / 3.60	47.53 / 53.17
	qwen3:8b	2.97 / 3.21	3.50 / 3.95	79.79 / 81.93
	qwq:32b	3.00 / 3.20	3.59 / 3.92	63.50 / 71.04
	llama3.1:8b	3.42 / 3.86	4.25 / 4.63	60.63 / 65.99
SpaMo	gpt-4.1-nano	3.00 / 3.06	3.66 / 3.73	55.36 / 57.31
	qwen3:8b	3.33 / 3.40	4.02 / 4.12	82.26 / 83.11
	qwq:32b	3.29 / 3.31	3.99 / 4.00	73.66 / 75.52
	llama3.1:8b	3.95 / 4.07	4.79 / 4.72	68.32 / 70.25
TwoStream-SLT	gpt-4.1-nano	3.28 / 3.33	3.77 / 3.82	64.63 / 66.69
	qwen3:8b	3.67 / 3.76	4.26 / 4.38	85.67 / 85.98
	qwq:32b	3.61 / 3.61	4.09 / 4.06	77.85 / 79.32
	llama3.1:8b	4.20 / 4.33	4.81 / 4.70	73.85 / 75.33
Signformer (Avg)	-	2.88 / 2.92	3.80 / 3.89	58.82 / 60.11
SEM-SLT (Avg)	-	3.04 / 3.30	3.65 / 4.03	62.86 / 68.03
SpaMo (Avg)	-	3.39 / 3.46	4.12 / 4.14	69.90 / 71.55
TwoStream-SLT (Avg)	-	3.69 / 3.76	4.23 / 4.24	75.50 / 76.83

Table 2: G-Eval adequacy and fluency scores, along with GEMBA, for original and paraphrased translations on the Phoenix-2014T test set.

## 4. Evaluation Results

### 4.1. Impact of Paraphrasing on SLT Evaluation

One of the main limitations of lexical overlap metrics is their sensitivity to paraphrasing. We provide a comparison of the scores with and without paraphrasing for every metric and model in Table 1. Most prominently, we observe that lexical overlap metrics (BLEU, chrF, and ROUGE) are highly sensitive to variations in word order, even though our paraphrasing prompt preserves the overall sentence structure. Notably, the BLEU score drops to slightly less than half of its original value, while met-

rics such as chrF and ROUGE also decrease but to a much lesser extent. Interestingly, embedding-based BLEURT scores increase across all methods when comparing paraphrased translations to the original ones. This increase is particularly pronounced for SEM-SLT, increasing from 0.484 to 0.537. This is most likely because the SEM-SLT model is trained with a contrastive learning method using sentence-level embeddings, which allows it to generalize better to semantically equivalent paraphrases. To alleviate the sensitivity of lexical overlap metrics to paraphrasing and failure of capturing the overall semantics, we compare the metrics in a multi-reference setting, as shown in Table 1. We observe that including a multi-reference setting en-

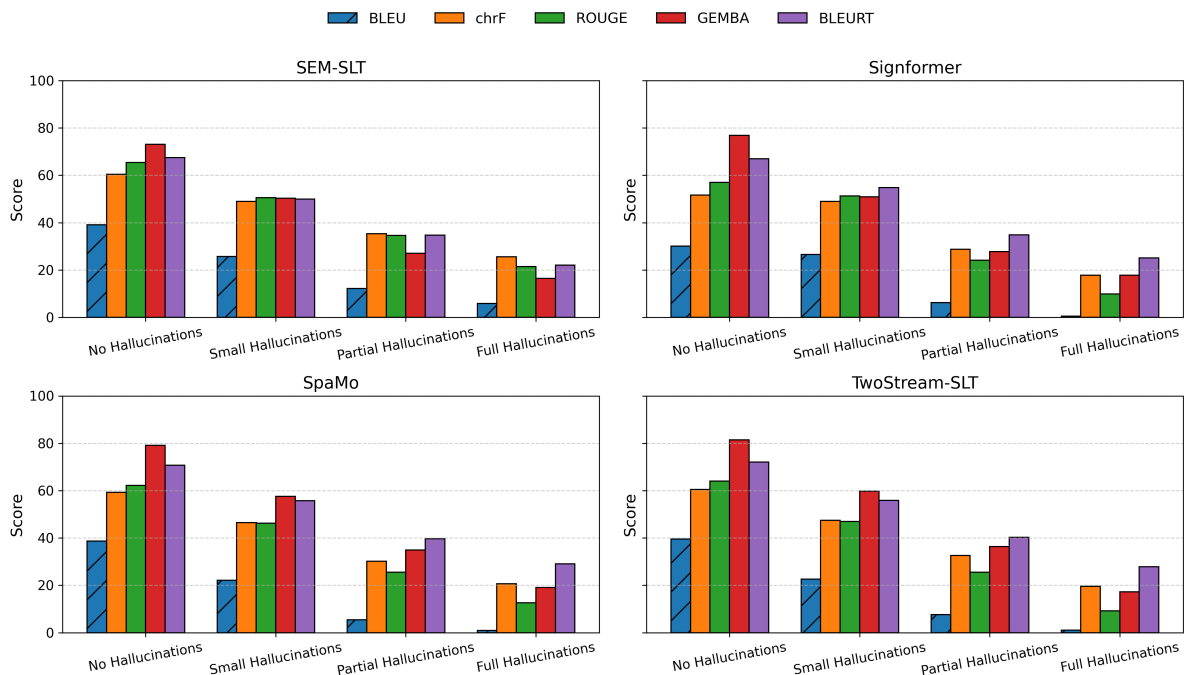


Figure 2: Examination of the sensitivity of evaluation metrics, including BLEU, chrF, ROUGE, GEMBA, and BLEURT, to hallucinations in SLT outputs on the Phoenix-2014T test set.

tures that evaluation metrics fairly reward semantic equivalence when evaluating models that exhibit high surface-level variation, such as those subject to paraphrasing.

We present the results of LLM-based evaluators, G-Eval (Adequacy and Fluency) and GEMBA, comparing paraphrased and original translations on the Phoenix-2014T test set in Table 2. Most notably, paraphrasing generally improves G-Eval Adequacy and Fluency and GEMBA scores, consistent with the pattern observed for BLEURT. `Llama3.1:8b` is the only model that rates paraphrased translations as less fluent than the original ones. Among all evaluated LLMs, `Llama3.1:8b` tends to assign the highest Adequacy and Fluency scores, whereas `gpt-4.1-nano` assigns the lowest. We observe that LLM-based evaluators tend to prefer paraphrased translations over the original ones. This tendency likely arises because the paraphrases are themselves generated by an LLM, which may introduce stylistic patterns or linguistic preferences that align with the evaluator’s own training distribution, thereby biasing its judgments. Interestingly, this observation aligns with previous studies suggesting that LLMs exhibit a bias toward LLM-generated or paraphrased text (Xu et al., 2024; Liu et al., 2023). To be able to make more general statements about evaluation metrics, we show the Pearson correlation between the lexical metrics, BLEURT, and GEMBA, computed using the average scores from Table 2 in Figure 4. We notice a high correlation among lexical overlap metrics, and GEMBA is also

highly correlated with BLEURT, as both incorporate learned language model representations in their scoring. Our previous observations from Tables 1 and 2 are confirmed, with lexical metrics (BLEU, chrF, ROUGE) yielding consistent rankings, while LLM-based evaluations align closely with BLEURT, ranking TwoStream-SLT highest, followed by SpaMo, SEM-SLT, and Signformer.

## 4.2. Impact of Hallucination on SLT Evaluation

We first analyze how hallucinations impact automatic metrics and then examine how robust SLT models are in the case of hallucination. Figure 2 illustrates the impact of hallucinations, categorized by their severity ranking, on various evaluation metrics across four SLT models. We omitted G-Eval in this setting because its results are reported on a Likert scale.<sup>9</sup> Moreover, we report hallucination detection results for GEMBA using `gpt-4.1-nano`. Notably, results show that there is a monotonic decline across all metrics, meaning that as hallucination severity level increases, translation quality drops. However, BLEU is an extremely sensitive metric; in cases such as *Partial Hallucinations* or *Full Hallucinations*, even minor rephrasings that remain semantically correct can cause a sharp decrease in BLEU scores. ROUGE and chrF decline more smoothly, since they account for partial over-

<sup>9</sup>Typically ranging from 1 (strongly disagree/poor) to 5 (strongly agree/excellent) (Likert, 1932).

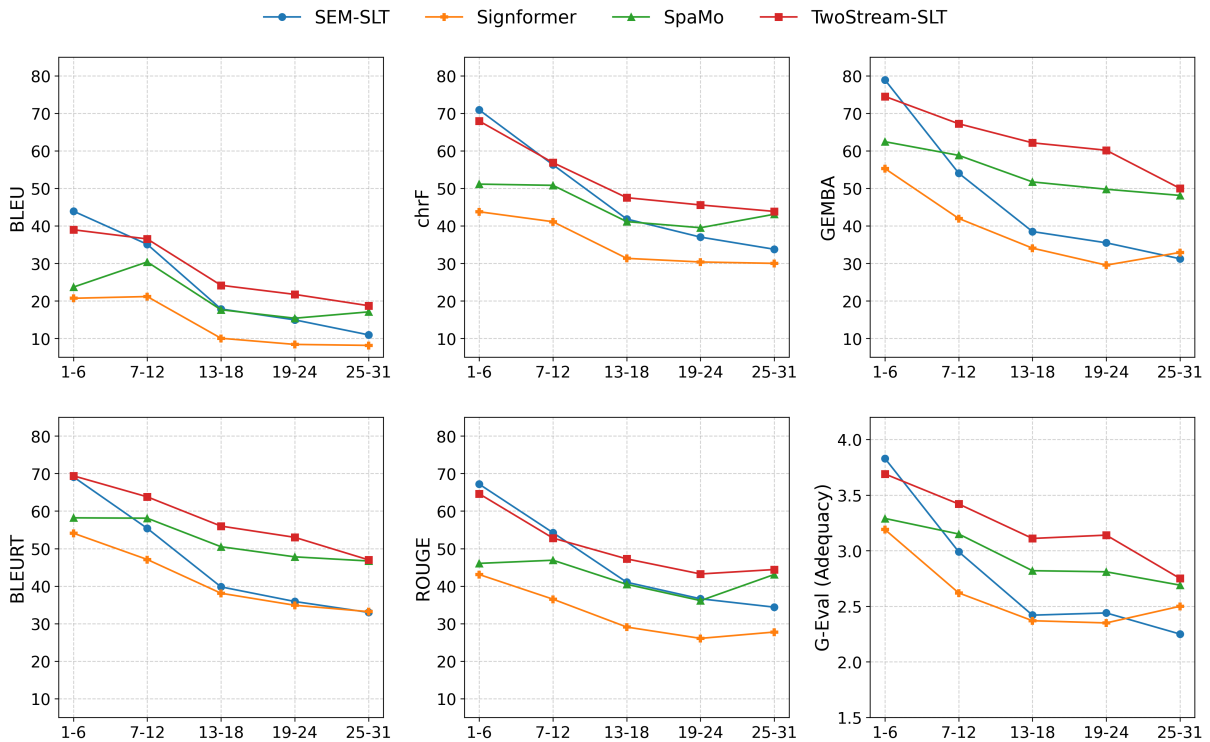


Figure 3: Evaluation of four SLT models (SEM-SLT, Signformer, SpaMo, TwoStream-SLT) across sentence length bins (1–6, 7–12, 13–18, 19–24, 25–31) on the Phoenix-2014T test set.

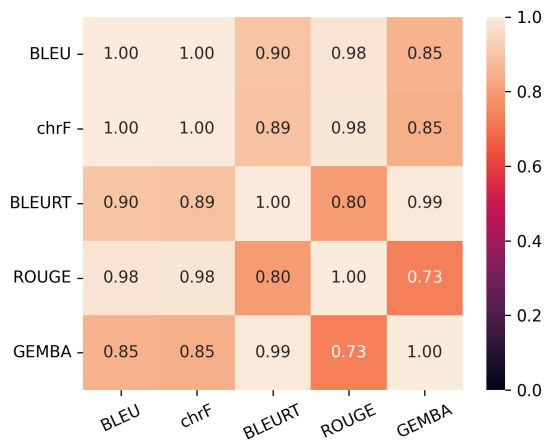


Figure 4: Pearson correlation between lexical metrics (BLEU, chrF, ROUGE), BLEURT, and GEMBA.

laps at the subword or character level, respectively. GEMBA and BLEURT follow a similar trend, as they can still capture some semantic meaning even in extreme *Full Hallucination* cases where the surface wording differs substantially. However, we suspect that these metrics may under-penalize subtle hallucinations when the generated text is fluent, thereby overestimating the overall score. Similar observations regarding BLEURT’s overestimation and the data leakage issues in LLMs have been discussed by Zeng et al. (2024).

Different from the main focus of the paper that concentrates on evaluating evaluation metrics, here we briefly take the opportunity to investigate the behavior of SLT models when hallucinations occurs. Overall, TwoStream-SLT and SpaMo demonstrate a consistent trend across all evaluation metrics, showing less hallucinations compared to other models. In contrast, Signformer exhibits notably lower average performance, aligning with the results presented in Table 1. To analyze the extent to which SLT models produce hallucinations, we present in Table 3 a breakdown of the number of hallucinated translations according to severity level. The results reveal that gloss-based TwoStream-SLT yields the lowest *Full Hallucinations* (24), indicating higher robustness to severe errors, whereas Signformer produces the highest number (177), confirming our earlier observations regarding its overall vulnerability to hallucination. This finding is in line with previous work showing that gloss-free models exhibit higher hallucination rates than gloss-based models (HAMIDULLAH et al., 2026).

### 4.3. Impact of Sentence Length on SLT Evaluation

To highlight the limitations of text-based automatic metrics in SLT, we evaluate their performance across five sentence-length bins, as shown in Figure 3. We omitted G-Eval (Fluency) for this

Model	No	Small	Partial	Full
Signformer	87	193	185	177
SEM-SLT	187	222	174	59
SpaMo	204	231	138	69
TwoStream-SLT	296	228	94	24

Table 3: Number of hallucinations based on severity level (No, Small, Partial, and Full Hallucinations) across SLT models.

experiment as we are concerned with the overall translation quality. Across all evaluation metrics, performance consistently decreases with sentence length, indicating that longer sentences pose greater challenges for current SLT models, though the rate and shape of decline vary by metric. Notably, we observe that SEM-SLT ranks third according to BLEURT or LLM-based (GEMBA and G-Eval) metrics but first or second under lexical overlap ones, revealing a metric inconsistency.

Additionally, we analyze how translation quality varies with sentence length across different SLT models. Notably, gloss-based TwoStream-SLT demonstrates the strongest overall performance and exhibits the least sensitivity to longer sequences. SEM-SLT performs competitively on short sentences (1–6 tokens) but its performance declines more sharply for longer sentences, particularly on BLEU, GEMBA, and G-Eval. SpaMo shows moderate yet consistent performance, with relatively smaller drops for longer sequences compared to the other models. Finally, Signformer underperforms across all metrics and sentence-length bins, consistent with the trends observed in our earlier experiments.

## 5. Qualitative Analysis

To better understand the impact of paraphrasing and hallucination on translation quality, we analyze specific examples exhibiting extreme cases of hallucination. Specifically, *Partial Hallucinations* and *Full Hallucinations*, where the GEMBA score exceeds 50. Notably, we did not find any instances of *Full Hallucinations* with a GEMBA score above 50 across all SLT models. Table 4 presents one illustrative example per SLT model. We observe that paraphrasing tends to increase the GEMBA score in cases of *Partial Hallucinations* across all models. By examining the paraphrased examples, we find that paraphrased translations are generally more fluent and natural than the original outputs, even though hallucinations persist. However, this is not always the case, as in most examples, paraphrasing either leaves the GEMBA score unchanged or leads to a decrease.

Model	SpaMo
GEMBA	65 → 85
Ref.	am wochenende beruhigt sich dann das wetter langsam . (Over the weekend, the weather gradually calms down.)
Pred.	am wochenende erwartet uns dann <b>verbreitet</b> ruhiges <b>recht trockenes winterwetter</b> .
Paraph.	am wochenende erwartet uns <b>weitgehend</b> ruhiges und <b>recht trockenes winterwetter</b> .
Model	SEM-SLT
GEMBA	65 → 85
Ref.	im norden und nordosten bleibt es meist bedeckt mitunter fällt dort etwas regen . (In the north and northeast, it mostly stays cloudy, with occasional light rain there.)
Pred.	im norden und nordosten fällt regen <b>sonst ist es meist trocken</b> .
Paraph.	im norden und nordosten regnet es, <b>während es andernorts meist trocken bleibt</b> .
Model	TwoStream-SLT
GEMBA	75 → 85
Ref.	in der südhälfte muss dazu mit nachtfrost gerechnet werden . (In the southern half, one must expect nighttime frost.)
Pred.	im süden <b>gibt es heute nacht teilweise strengen</b> frost .
Paraph.	im süden wird es <b>heute nacht teilweise sehr</b> frostig sein .
Model	Signformer
GEMBA	75 → 85
Ref.	südlich des mains morgen verbreitet freundlich . (South of the Main, it will be generally sunny tomorrow.)
Pred.	<b>vor allem in der südwesthälfte</b> ist es <b>länger</b> freundlich .
Paraph.	<b>insbesondere in der südwestlichen hälfte</b> bleibt es <b>länger</b> freundlich .

Table 4: Qualitative examples in the presence of *Partial Hallucinations* with paraphrased predictions.

## 6. Conclusion

In this work, we present a systematic analysis of text-based automatic evaluation metrics for SLT, including traditional lexical overlap metrics such as BLEU and ROUGE, and recent embedding- and LLM-based metrics such as BLEURT, GEMBA, and G-Eval. Our results highlight the limitations of both categories: lexical metrics (BLEU, chrF, ROUGE) often fail to capture semantic adequacy, particularly under paraphrasing, whereas embedding-based BLEURT and LLM-based evaluators (G-Eval and

GEMBA), despite being more semantically aware, tend to overestimate the quality of fluent but hallucinated outputs. Based on these findings, we recommend using BLEURT or LLM-based evaluators such as GEMBA and G-Eval along with traditional lexical overlap metrics. Furthermore, we advocate for the development and adoption of multimodal evaluation frameworks that extend beyond text-based metrics to provide a more holistic and comprehensive assessment of SLT outputs.

## Limitations

In this work, we investigate the limitations of text-based automatic evaluation metrics in SLT through empirical experiments. While our study covers large and controlled settings, it has several limitations. First, our evaluation relies solely on automatic metrics, as no human evaluation was conducted to serve as a gold standard. This limitation stems from the lack of available native signers for large-scale annotation. Future work should include human judgments from native sign language users to establish a more reliable evaluation benchmark. Second, our experiments are restricted to the Phoenix-2014T dataset, which contains German Sign Language (DGS) data primarily focused on weather forecasts. This narrow domain may limit the generalizability of our findings to broader SLT contexts. Finally, although our results consistently highlight the weaknesses of lexical overlap metrics, we rely primarily on BLEU for quantitative evaluation. However, BLEU scores can be unreliable when computed on small test sets: prior work has shown that BLEU's correlation with human judgments becomes unstable when sample sizes are low (Mathur et al., 2020). To mitigate this issue, we applied bootstrap resampling to estimate confidence intervals, which provides a more robust assessment of metric stability and significance.

## Acknowledgments

CEB acknowledges her AI4S fellowship within the “Generación D” initiative by Red.es, Ministerio para la Transformación Digital y de la Función Pública, for talent attraction (C005/24-ED CV1), funded by NextGenerationEU through PRTR.

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## A. Prompts

### A.1. Hallucination Detection

System:

You are an expert evaluator of Sign Language Translation (SLT) outputs.

You will be given:

- A human reference translation
- A model predicted translation

Your task is to determine **how severe** the hallucination is in the predicted translation.

Definition:

A word in the translated text is considered a hallucination if it introduces information that is completely unrelated to the source text.

Assign one severity level according to these guidelines:

- No hallucination: The translated text does not contain any hallucinated words.
- Small hallucination: The translated text contains 1-2 hallucinated words.
- Partial hallucination: The translated text includes at least 3 hallucinated words, but not all words are hallucinated.
- Full hallucination: Nearly all words in the translated text are hallucinated, with the exception of perhaps 1-2 words.

Note: The labels are mutually exclusive; for example, a translation with a partial hallucination does not qualify as a full hallucination.

User:

Reference Translation: {ref\_text}

Predicted Translation: {mt\_text}

Provide exactly one of the following labels as your response. Do not include any additional text or explanation:

- No hallucination
- Small hallucination
- Partial hallucination
- Full hallucination

### A.2. G-Eval

You will be given a generated translation for a short sign language video segment, along with reference translation.

Your task is to rate the generated translation based on its Adequacy and Fluency in capturing the intended meaning of the original signing as conveyed in the reference translation.

Evaluation Criteria:

Score Range: 1 to 5 (integer) - The generated translation should:

- Correctly convey the meaning expressed in the reference translation.
- Include all key information without introducing unrelated or incorrect content.
- Be written in clear and natural language.
- Stay true to the meaning of the original signing.

Evaluation Dimensions:

1. Adequacy - Does the translation correctly convey the meaning?
2. Fluency - Is the translation grammatically correct, coherent, and easy to read?

#### Evaluation Steps:

1. Examine the reference translation to understand the meaning, key elements, and tone.
2. Read the generated translation thoroughly.
3. Compare the generated translation with the references and judge how well it:
  - Captures meaning accurately.
  - Covers all important elements.
  - Maintains grammatical fluency.
  - Stays faithful to the original intent.
4. Penalize for:
  - Missing key elements.
  - Introducing unrelated or incorrect details.
  - Awkward or unclear phrasing.
  - Changing the tone or meaning.
5. Assign an integer score from 1 to 5 for each dimension:
  - Adequacy score
  - Fluency score

Reference Translation:

{{Reference}}

Generated Translation:

{{Translation}}

Format of Output:

You should first give an explanation for each score, then end with two separate sentences:

..... The Adequacy score: {{Adequacy\_score}}  
..... The Fluency score: {{fluency\_score}}

### A.3. GEMBA

Score the following translation from German Sign Language to German with respect to the human reference, on a continuous scale from 0 to 100, where 0 means no meaning preserved and 100 means perfect meaning and grammar.

Scoring guidelines:

0-10: Incorrect translation (no relation to the source meaning).

11-29: Contains a few correct keywords, but the overall meaning differs significantly.

30-50: Major mistakes that distort meaning.

51-69: Understandable and conveys the main meaning but includes noticeable grammatical or lexical errors.

70-90: Closely preserves the semantics of the source sentence, with only minor issues.

91-100: Perfect translation—fully accurate, fluent, and natural.

Human reference:

{{Reference}}

Model translation:

{{Translation}}

..... Score: {{score}}