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Time-coded, Hardcoded, Decoded: Excavating Variants and Practices in Swiss Film Subtitling

Abstract

This article proposes a model for studying film subtitling as a variant-based audiovisual practice, situated at the intersection of film studies, media archaeology, audiovisual translation (AVT) studies, and digital humanities. Drawing on Siegfried Zielinski's variantology and Descriptive AVT Studies, we combine archival research with the close reading of paratextual sources, manual video annotation as a form of close viewing, and the semi-automated recognition of concepts, persons, and patterns as a form of distant viewing. This integrative framework enables the systematic comparison of film versions and their subtitle variants, which appear not as stable textual supplements but as artefacts of variation shaped by material infrastructures and institutional practices. Framed by the title's conceptual triad – time-coded, hardcoded, decoded – we approach subtitling as a layered object of inquiry. Subtitles are time-coded in their alignment with audiovisual rhythm, hardcoded in their material entanglement with film prints, digital carriers, and projection formats, and decoded through interdisciplinary, semi-automated analysis that excavates the histories and politics of their production and circulation. We apply this framework to the Swiss context between 1920 and 2020, using film and non-film collections from the Cinémathèque suisse. The case of *Die Erschiessung des Landesverrätters Ernst S.* by Richard Dindo and Niklaus Meienberg (CH, 1976) demonstrates how variant-based analysis can be operationalised through integrated archival and computational workflows.

Keywords

Film Subtitling | Video Annotation | Audiovisual Translation | Audiovisual Collections | Media Archaeology | Digital Humanities | Film History

Introduction

Subtitling has accompanied the international circulation of moving images since the early twentieth century, when film distribution required translation across languages and regions. In the silent era, this often took the form of inserted intertitles or separate translation panels.¹ With the advent of

synchronised sound in 1927, subtitling emerged alongside dubbing as a principal method of audiovisual translation (AVT).² From the 1930s onward, particularly in smaller language markets such as Switzerland, technological advances in fixing subtitles onto film stock established subtitling as a durable distribution strategy. From the outset, subtitling was shaped by technological infrastructures, economic conditions, and cultural negotiation.

Throughout the twentieth century, subtitling systems became increasingly precise, multilingual, and format-specific. With the rise of home video formats such as VHS and DVD, optional and multilingual subtitle tracks became standard features. Subtitles also gained renewed visibility as accessibility tools, particularly in the form of SDH (subtitles for the d/Deaf and hard-of-hearing). Since the early 2000s, subtitling has undergone further transformation through computational tools such as automatic speech recognition (ASR) and neural machine translation (NMT). Promoted under the umbrella of artificial intelligence, these technologies promise faster and more scalable subtitling production by enabling near-real-time processing, thereby expanding both the reach and applications of AVT.³ Yet increasing automation risks obscuring the institutional practices, material constraints, and decision-making processes that historically shaped subtitle production and generated variant versions across formats and contexts. Against this backdrop, key questions arise: Who produced subtitles, and under which institutional conditions? Why do subtitled filmic versions vary, even within the same target language? And how can such differences be analysed as historical evidence?

This article proposes a model for studying film subtitling as a variant-based audiovisual practice. We combine archival research with digital tools for analysing multimodal and time-based media, positioning our approach at the intersection of film studies, media archaeology, AVT studies, and digital humanities (DH). Drawing on mixed methods and digital hermeneutics, we combine the close reading of written and paratextual sources with manual video annotation as a form of close viewing, and the semi-automated recognition of concepts, persons and patterns as a form of distant viewing.⁴ This integrative framework enables the systematic comparison of different versions of films and their subtitle variants, which then appear not as stable textual supplements but as sites of variation affected by material infrastructures and institutional practices.

Framed by the conceptual triad of the title – time-coded, hardcoded, decoded – we approach subtitling as a layered object of inquiry. Subtitles are time-coded in their alignment with audiovisual rhythm; hardcoded in their material entanglement with film prints, digital carriers, and projection

formats; and decoded through interdisciplinary, semi-automated analysis that helps excavate the histories and politics of their production and circulation.

Our primary focus is the Swiss context between 1920 and 2020, drawing on film and non-film collections from the Cinémathèque suisse. Switzerland's multilingual structure and circulation networks make it a particularly productive site for studying subtitle variation within and across language regions. This spatial and temporal framing provides analytically controlled parameters for developing context-aware yet modular annotation vocabularies that remain transferable beyond the Swiss case.

The article proceeds in three steps. First, we contextualise film subtitling in Switzerland and review relevant scholarship in film and translation studies, identifying current gaps. Second, we outline our theoretical framework and interdisciplinary methodology. Third, we apply this model to our corpus and to a case study of *Die Erschiessung des Landesverräters Ernst S.* (Richard Dindo and Niklaus Meienberg, CH 1976), a politically engaged Swiss documentary whose circulation across multilingual contexts generated multiple subtitle variants, thereby demonstrating how variant-based analysis can be operationalised through integrated archival and computational workflows.

In doing so, we offer a transferable model for studying variant-based audiovisual practices across formats and histories, expanding the analytical horizons of both film studies and audiovisual translation research.

Studying Film Subtitling in Switzerland and Beyond

Subtitling has long been a core area of inquiry in AVT studies, particularly since the 1990s, when the field began to systematically examine interlingual translation in film and television.⁵ AVT has since become what Luis Pérez-González describes as 'the fastest growing strand of translation studies,'⁶ expanding significantly with the rise of digital media.⁷ As one key mode of AVT, subtitling entails the negotiation of multiple semiotic layers – audio-verbal and nonverbal, visual-verbal and nonverbal – requiring translators not only to render spoken language but also to interpret filmic codes, register shifts, and cultural context.⁸ Frederic Chaume has emphasised the need to link translation studies with film studies and film analysis, arguing that genre, narrative structure, and cinematic devices are integral to what film subtitlers should consider in their professional workflows.⁹

While subtitling has been extensively researched in AVT, it remains marginal within film studies. Whereas subtitled dialogue in international productions – such as *The Passion of the Christ* (Mel Gibson, USA 2004), *Letters from Iwo Jima* (Clint Eastwood, USA 2006), *Inglorious Basterds* (Quentin Tarantino, USA/GER 2009), or *Ripley* (Steven Zaillian, USA 2024) – has attracted attention, such instances are often discussed as aesthetic devices rather than as sites of linguistic mediation. Carol O’Sullivan describes many of these cases as ‘pseudosubtitled,’ since the translated dialogue ultimately derives from an English-language production context.¹⁰ More broadly, subtitles are frequently excluded from analyses of film form and style. As Florian Krautkrämer notes, although subtitles translate dialogue situated within the diegesis, they are often treated as extra-diegetic or external to the film.¹¹ O’Sullivan similarly characterises their ontological status as simultaneously present and peripheral.¹² As a result, most publications on language in film either treat subtitling only in passing or prioritise questions of aesthetics over operational or translational specifics.¹³

In response to this disciplinary separation, several scholars have called for closer dialogue between film and translation studies. Keith Johnston identifies the lack of ‘concerted dialogue’ between the two fields and advocates for collaboration through archival research and reception studies.¹⁴ Aline Remael likewise emphasises the importance of integrating film-specific knowledge into subtitler training.¹⁵ We build on these calls and gaps to suggest our interdisciplinary exchange.

Switzerland presents a particularly productive context for examining subtitling as a localised and materially specific practice. Like Canada or Belgium, it is shaped by longstanding multilingual circulation structures. For theatrical releases, bilingual subtitles providing both German and French translations are common and differ structurally from monolingual subtitle formats, which generally allow two lines. Consequently, the subtitles shown in Swiss cinemas are not identical to those used in neighbouring markets but are produced specifically for the Swiss distribution context. At the same time, the notion of a single ‘Swiss version’ proves unstable: subtitle practices vary across regions, exhibition contexts, and time periods. Therefore, even when the target language of subtitles is the same, translational strategies may diverge between different variants done by different subtitlers. In the case of *Die Erschiessung des Landesverrätters Ernst S.* (hereafter *Landesverräter*), for example, German-language subtitles were adapted to specific linguistic contexts, such as selectively rendering dialect passages into Standard German. Such observations indicate how national distribution frameworks themselves can generate further variation rather than uniformity. Despite the richness of Switzerland’s structural and institutional complexity, which generates subtitle variants across

languages, formats, and circulation networks, the field remains underexplored. Apart from the *Screen-to-Text* project by Thomas Messerli and Miriam Locher on how subtitled and paratextual discourses mediate meaning and audience engagement¹⁶ – which includes a study of three fiction films demonstrating the subtitles' role in shaping narrative perception and aesthetics¹⁷ – comprehensive historical and material analyses of Swiss subtitling practices remain scarce.

In light of this situation, we approach Swiss subtitling history as both a media-historical and operational phenomenon. We examine two interrelated categories of practice: (a) Swiss productions subtitled domestically and circulated nationally or internationally, and (b) international productions subtitled in Switzerland for domestic or export distribution. By analysing these constellations comparatively, we situate subtitle variants within broader networks of production, circulation, and institutional negotiation.

Such observations indicate that subtitling cannot be adequately addressed within the boundaries of a single discipline. To understand subtitle variants as material, temporal, and institutional formations, an integrated conceptual framework is required. The following section develops this framework by drawing on media-archaeological theory and digital methodologies, outlining a replicable model for other cases and contexts.

Bridging Film Studies and AVT Studies with Media Archaeology

To address the gaps and questions raised earlier, we combine archival research and ethnographic perspectives with digital approaches, including computer-assisted film analysis, semi-automated video annotation, and comparative textual analysis. These methods enable us to trace subtitle variants across versions and formats and render visible the labour, decisions, and norms that shape their production. To account for their complexity, we analyse subtitles along four interrelated dimensions: (1) their ontological and visual relation to the film image (diegetic or extra-diegetic positioning); (2) their linguistic and semantic structures; (3) their diachronic and synchronic variation across time and space; and (4) their conditions of production, including agents, technologies, and institutional frameworks. Together, these dimensions form the analytical scaffold for examining subtitling as a variant-based audiovisual practice and structure the operational steps presented below, including (1) corpus building and metadata aggregation, (2) archival research of film-related and paratextual sources, (3) subtitle extraction and video annotation workflows, and (4) comparative text analysis.

To interrogate this multifaceted object of study, we draw on a media-archaeological approach. Media archaeology is particularly apt for investigating subtitling as a material, socio-technical, and aesthetic practice marked by historical contingency, technological change, and institutional routines. Rather than reproducing the teleological logic often found in conventional film histories, it foregrounds discontinuities, failures, forgotten formats, and minor practices as constitutive elements of media history. It therefore invites us to descend into the technical and material strata of cinema and to account for the layered, situated, and sometimes fragmented forms of knowledge that subtitling involves.¹⁸ Subtitles are thus not treated as neutral or merely supplementary elements, but as material artefacts and discursive objects whose meanings are co-produced by translation processes, infrastructures, and viewing contexts.

Our methodological positioning is informed by historiographic critiques associated with New Film History and New Cultural History, which emerged in the 1980s in response to canonical and purely hermeneutic models of film analysis.¹⁹ In line with revisionist traditions, we treat language, materiality, and knowledge production as historically contingent and epistemologically charged.²⁰ Historical knowledge, in this view, emerges from the comparative reading of plural, sometimes contradictory sources – an approach that aligns with media archaeology and directly informs our handling of heterogeneous metadata and archival traces in the following section.²¹

Furthermore, we adopt a theoretical and methodological stance grounded in restoration theory and the historiography of film versions. Rather than treating a film as a singular, fixed work, we follow scholars such as Nicola Mazzanti, and Paolo Cherchi Usai, who advocate for a version-based ontology of film.²² Film, from this perspective, exists through multiple instantiations marked by time, technology, and context. Giovanna Fossati's notion of film as both a material object and a projected experience further highlights tensions among archival preservation, aesthetic presentation, and historical mediation.²³ To operationalise this ontology for subtitling research, we draw on bibliographic and archival frameworks such as WEMI (Work, Expression, Manifestation, Item), in line with the FIAF moving-image cataloguing rules.²⁴ This allows us to distinguish between the abstract film work, its various subtitled manifestations and versions (e.g., DVD versions, theatrical prints, festival edits), and the specific material items (e.g., subtitled reels, VHS copies, digital files) through which viewers encounter them.

More specifically, we draw on media archaeology as a field and framework defined less by a fixed methodology than by its constitutive openness to inter- and transdisciplinary inquiry.²⁵ This enables

us to unite a variety of approaches – from production studies and archival research to digital humanities – and to pursue complementary modes of investigation adapted to our research interests. In this spirit, Siegfried Zielinski’s concept of ‘variantology’ is particularly productive: it rejects linear models of media history and instead foregrounds discontinuity and the analytical value of individual variations.²⁶ This perspective legitimises the comparative study of differences – not as noise or deviation from an ideal version, but as historically meaningful articulations. Hereafter, we use “version” to refer to the level of manifestation and “variant” to refer to the item level. Each film version may contain multiple subtitle variants across languages, and, crucially, multiple variants within the same subtitle language, which we compare across manifestations.

Understanding subtitles through this framework enables us to examine which variants exist and how they change across versions, platforms, and languages, and to ask what motivates continuities or shifts in technical, linguistic, and aesthetic conventions. Drawing on Translation Industry Studies²⁷ and Descriptive AVT Studies,²⁸ we approach subtitling as a set of production networks,²⁹ considering translators’ social and workplace interactions³⁰ as well as the broader economic, institutional, and market factors. Wolfgang Ernst’s operational view of media and Erkki Huhtamo’s concept of ‘media topoi’ further help situate subtitling within broader socio-technical and cultural formations.³¹

Lastly, our framework resonates with recent calls in digital film historiography to treat archival fragments, paratexts, and distribution formats not as secondary materials but as primary evidence of a film’s historical life.³² Subtitles, in this sense, are historically situated inscriptions of mediation that render films legible across languages, audiences, and technologies. The digital methods we employ enable us to analyse subtitles as temporal, spatial, visual, and material phenomena embedded in audiovisual media. In doing so, we follow Elsaesser’s call to attend not only to canonical works but to the archival fragments and ostensible ‘detritus of film culture’ as sources of historical knowledge while remaining attentive to the constraints of digital infrastructures – for instance, inconsistent metadata, missing files, and the limits of automated extraction – that condition what can be compared and how.³³

Subtitling Decoded: Doing Digital Film Research and the Case of *Die Erschiessung des Landesverräters Ernst S.*

In the tradition of ‘doing digital film history,’ we treat digital tools not as ends in themselves but as instruments for answering humanities questions about versions, variants, and production

practices.³⁴ Digital methods extend media-archaeological inquiry by enabling systematic comparison across manifestations and item-level subtitle variants while retaining the interpretive precision of expert annotation.³⁵ The value of such an approach lies both in what it makes comparable and in how it renders methodological choices explicit: Which steps can be automated? Where does manual intervention remain necessary? How do these decisions shape the result?

One central challenge in Swiss film historiography is the absence of systematic metadata on film manifestations and subtitle variants. Information about which films were subtitled, into which languages, and for which contexts (cinema, festival circulation, non-theatrical distribution) is often scattered across collections or undocumented. The need for such a resource is widely acknowledged in AVT research and is particularly evident when dealing with metadata from heterogeneous and inconsistently structured sources. Furthermore, missing subtitle information leads to the redundant or unnecessary production of new subtitles, increasingly under time pressure and with reliance on automated tools, which can result in diminished quality.

Our research investigates subtitling through both filmic and non-filmic archival sources. We first describe how we collect and harmonise film-related metadata to identify multiple manifestations of the same work and to constitute a corpus of Swiss films with comparable subtitle material. We then outline workflows for excavating subtitle variants – from acquisition and extraction to annotation and comparative analysis – illustrated through the case of *Landesverräter*.

Identifying Subtitled Works and Versions via Metadata

To identify which subtitles exist – and in which manifestations – we compared the most recent digitisations of Swiss films listed by the Filmo initiative with analogue holdings at the Cinémathèque suisse and with commercial and broadcast formats available in the Department of Film Studies' (FIWI) video library (DVDs, Blu-rays, TV recordings) at the University of Zurich.³⁶ By matching film titles across the FIWI catalogue and the Filmo dataset, we constituted a research corpus of approximately 100 Swiss films for which at least two subtitle tracks are available in the same subtitle language. In what follows, we describe the corpus-building process and the analytical possibilities opened by this aggregated metadata.

Our corpus comprises films produced or subtitled in Switzerland between 1920 and 2020, including feature films and documentaries, complemented by paratextual materials and company histories. This combination allows us to trace subtitling practices diachronically and to compare subtitle variants across platforms and formats. Filmo has played a significant role in making Switzerland's audiovisual heritage publicly available; at the same time, it illustrates a broader challenge in digitisation and access: projects often implicitly stabilise a film as a single 'definitive' version. Corpus construction, therefore, began with version-sensitive questions: Which films are available in at least two manifestations? Which subtitle languages and subtitle variants are available in each manifestation? And which film titles have multiple same-language subtitle entries?

The corpus-building process is anchored in the 184 Swiss films digitised by Filmo, which serve as an entry point for identifying alternative or earlier manifestations of the same works, particularly those containing subtitles.³⁷ We scraped the Filmo website and extracted metadata from the returned HTML files. A crucial comparative layer is provided by DVD and Blu-ray editions preserved in the FIWI video library at the University of Zurich. FIWI currently holds 4,377 entries (4,326 unique film titles) across formats, making it an extensive, largely untapped metadata resource for versional comparison. A Python-based cross-reference between Filmo and FIWI holdings identifies 167 overlapping titles (see figure 1).

Comparison of Overlaps

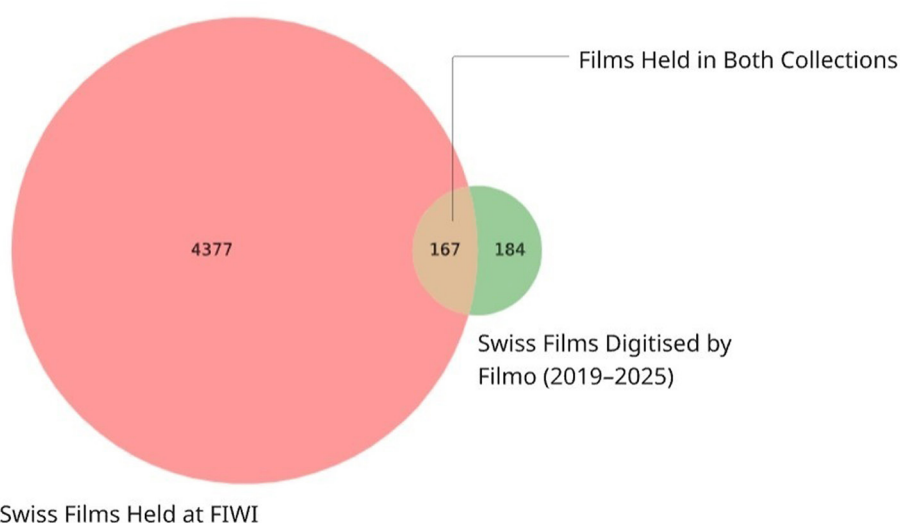


Figure 1. Venn diagram showing the overlap between Swiss films in the FIWI collection and those digitised by Filmo (2019–2025), with 167 titles held in both collections.

These 167 overlapping titles correspond to 342 catalogue entries across the two collections and provide a starting point for examining how subtitling is distributed across cinema and home-viewing contexts, and how subtitle availability relates to particular manifestations (e.g., digitised streaming releases versus physical media editions).

In the working dataset, we treated entries with identical titles and matching director attributions appearing at least twice as indications of multiple manifestations of the same work. After harmonisation, we identified 301 entries belonging to multi-entry clusters and 43 entries that appeared only once. This adjusted metadata provides the basis for exploratory queries that inform corpus selection and subsequent comparison of subtitle variants.

As an exploratory step, we visualised the distribution of multi-entry clusters across years (1920–2019). The resulting bar chart (see figure 2) shows a pronounced peak around 1969 and an overall upward trend. At this stage, the point is not to infer causality but to generate historically specific questions for targeted follow-up: does the peak reflect production volume, digitisation priorities, distribution practices, or cataloguing conventions?

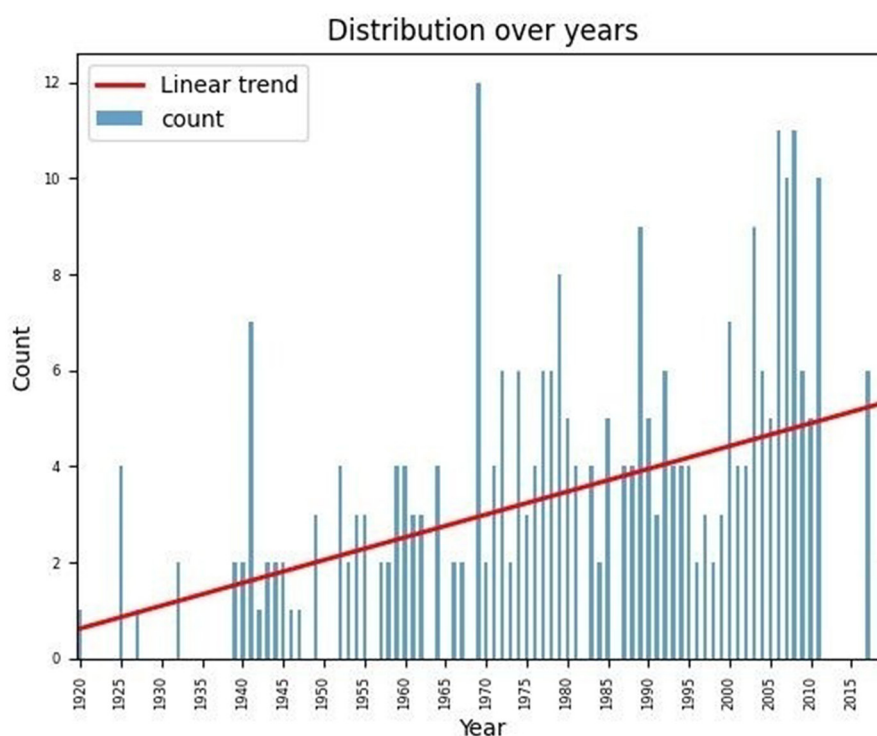


Figure 2. Bar chart illustrating the distribution of film releases, showing a linear trend over the period 1920–2019.

Finally, subtitle availability is central to corpus construction. In the current metadata, subtitle material is documented for 234 entries either as downloadable digital subtitle files or as hardcoded subtitles, corresponding to 77.7% of the multiple manifestations. Focusing specifically on cases with at least two subtitle variants in the same subtitle language, we identified 92 film titles (184 entries) that meet this criterion.

The refined metadata constitute the basis for corpus building and enable a targeted, in-depth exploration of historically grounded research questions: Have some films circulated in different subtitle languages or subtitle formats over time, and if so, why? Are there further manifestations in the Cinémathèque suisse holdings – for instance, subtitled prints not yet digitised – that may have served as reference points for later releases? At the same time, working with heterogeneous metadata highlights the need for their systematic, version-sensitive aggregation, for example in a database specifically designed to link catalogues, manifestations, and item-level subtitle variants.

Nevertheless, filmographic metadata can answer only a limited range of questions. To address practices and histories, we therefore combine metadata analysis with non-film archival sources such as production documents, correspondence, subtitle lists, and company records. From the wider corpus, we focus here on *Landesverräter*, for which substantial subtitle-related documentation is preserved at the Cinémathèque suisse. This case enables analysis across multiple scales, from the micro level of individual subtitling products to the meso level of company histories and practices, that can subsequently be extended comparatively across the broader corpus for macro-level inquiry.

Tracing Subtitling Practices, Processes, and Histories

Complementing our product-oriented analyses, we investigate subtitling as a historically contingent production process shaped by individual, institutional, and technological dynamics. While empirical research in AVT has explored how subtitles are created, how viewers perceive quality, and how subtitling professionals navigate changing working conditions, less attention has been paid to the archival traces and paratextual sources that illuminate decision-making in subtitling production.³⁸

Drawing on archival collections at the Cinémathèque suisse and related institutions, complemented by interviews with professionals, we reconstruct the workflows, infrastructures, and socio-technical arrangements that governed Swiss subtitling practices across analogue and digital

contexts. A particular focus is given to the subtitling companies Titra (Geneva) and Cinetyp (Lucerne), which played a central role in the Swiss market until the digital transition. Because their institutional histories, production routines, and collaboration networks are only sparsely documented in existing scholarship, archival materials and oral-history perspectives become essential for tracing how subtitling was organised, how standards evolved, and how subtitlers negotiated technical, linguistic, and cultural constraints in specific contexts.

Additional evidence for subtitling products and processes can be gathered from non-film collections at the Cinémathèque suisse, stored in Zurich and Penthaz. These holdings are crucial for reconstructing not only how subtitles were produced and distributed, but also how they were framed paratextually and received within their historical contexts.

Our work on *Landesverräter*, for which the metadata list contains two entries tagged with the subtitle language ‘German’, began with a systematic survey of the Cinémathèque suisse’s catalogue of non-filmic resources.³⁹ We conducted keyword searches (e.g., ‘subtitles’ in multiple languages) and manually screened the resulting entries to identify files containing paper subtitle material. On this basis, Dindo and Meienberg’s film emerged as a relevant case study because subtitle-related documents are explicitly present in its archival record. The catalogue survey established a macro-level inventory of available materials, subsequently verified and expanded through on-site consultation at the non-film archive in Zurich. While not all documents have yet been fully consulted, the inventory provides a structured overview of the holdings and a methodological starting point for targeted archival work.

The archive’s film-related collections comprise production and distribution documents (including expense lists and correspondence with distributors and legal representatives), descriptive production materials (e.g., interviewee lists and shot descriptions), multilingual press coverage, and interviews with Dindo. With regard to subtitling, the holdings include several subtitle lists in German, French, and English, annotated scripts, and documents relating to the commissioning of subtitle versions by Cinetyp. Together, these materials allow us to formulate historically grounded questions about when, how, and why different subtitle versions were commissioned, which audiences and distribution contexts they targeted, and how the film’s multilingual circulation was institutionally organised.

At a micro level, preserved paper subtitle lists enable qualitative comparison between draft materials and the subtitles present in surviving film copies. The archive contains a German subtitle list from 1976; at least two French subtitle lists from 1976 (one with handwritten corrections and

references to later copies from 1977 and 1991); an annotated French script; and an annotated English subtitle list. Establishing an inventory of these documents and cross-referencing them with extant film copies allows us to test whether archived variants correspond to subtitles in specific distributed manifestations. From an AVT perspective, this comparison is methodologically significant: it enables the tracing of translation and revision processes, the identification of divergences between draft and realised versions, and the situating of subtitling decisions within their institutional and temporal contexts. Documents relating to commissioning and production further illuminate the roles of agents, such as subtitling companies and distributors, in shaping the translated text.

This process-oriented perspective foregrounds the operational and infrastructural labour behind subtitling, embedded in production and distribution workflows and shaped by economic constraints and divisions of responsibility among filmmakers, distributors, subtitlers, and subcontractors. At the same time, many questions raised by archival documentation can only be answered by analysing subtitle variants in the filmic items themselves, which requires workflows for extracting and annotating subtitles from specific manifestations.

Hardcoded Challenges: Extracting Subtitle Variants from Filmic Versions

To compare subtitle variants within the same target language, filmographic metadata at the work or manifestation level is insufficient. Therefore, we must also analyse the digitised items themselves, where subtitle timing, layout, and material realisation become observable. In the case of *Landesverräter*, we work with two digital manifestations: a 2013 DVD release (Limmat Verlag), preserved in the FIWI collection, and the 2020 Filmo digitisation, available in Switzerland via Play Suisse.⁴⁰ Both releases draw on analogue film material held at the Cinémathèque suisse in Penthaaz and include German subtitles. These two manifestations, therefore, provide an instructive test case for the workflows required to extract and compare subtitle variants of the same target language for different audiences, with an initial focus on technical and linguistic parameters central to AVT analysis.

The two manifestations also illustrate why subtitle extraction is method-dependent. In the 2020 version, German subtitles are available as downloadable SRT files, which contain the textual content and timecodes required for systematic comparison. In contrast, hardcoded subtitles are embedded in the image and must be reconstructed from the audiovisual stream, including both text content and spotting information (see figure 3).



Figure 3. Side-by-side comparison of two screenshots from the same scene in *Landesverräter*, with the hard-coded DVD subtitles on the left and the Play Suisse SRT subtitles on the right.

To develop a feasible workflow for digitising hard-coded subtitles, we tested semi-automated text reconstruction via optical character recognition (OCR). We extracted 941 screenshots from the film and compared two engines to determine the best possible OCR results. Because character recognition depends on high contrast and a stable text region, we preprocessed the images by cropping the subtitle area (subtitles consistently appear in the lower third of the frame), converting the cropped region to greyscale, and binarizing it to maximise contrast between characters and background. This preprocessing was implemented in Python (Pillow) and can, in principle, be adapted to additional items.⁴¹

We then tested character recognition using Tesseract (via Pytesseract) and ABBYY FineReader.⁴² Both approaches produced recognition errors on German-language subtitles, as illustrated by an excerpt from the end of the film (see figure 4). Without custom training, Tesseract would require extensive manual post-correction.

FineReader produced more usable results. We therefore used its OCR output as the basis for reconstructing the hard-coded subtitle text. Post-correction combined automatic fixes for recurring errors (e.g., missing spaces after punctuation; systematic misreadings such as “Emst” for “Ernst”) with manual correction and reconstruction of missing text. A final proofreading pass supported by automated error detection addressed residual mistakes.

This semi-automated workflow provides a basis for further digitising hard-coded subtitles, but it will require iterative adjustments as film material and subtitle quality vary. Crucially, reconstructing

Nachher sind wir miteinander nach Hause gegangen	Nachher sind wir miteinander nach Hause <u>oeeanaen</u>
; <u>Eswae keme chhe</u> ; und möht3 E	und nichts
Der Vater war immer " ein Humorist	<u>Oer</u> Vater war immer ein Humorist
aber vom Augenblick an, als sie Ernst erschossen hatten	aber vom Augenblick an, als sie Ernst erschossen hatten
begann er abzugeben, da wurde er älter	begann er abzugeben, da wurde er alter
das hat ihm den Eiter genommen	das hat ihm den Eifer genommen

Figure 4. Side-by-side comparison of the optical character recognition results produced with Tesseract (left) and Abbyy FineReader (right).

hardcoded subtitles involves not only text but also timing: start and end points for each subtitle display must be re-established through spotting. Because subtitle appearance does not reliably trigger standard shot-boundary metrics, display intervals cannot be derived from pixel-change thresholds alone and must be annotated manually. To maximise precision and ensure interoperability with subsequent analyses, we use the video annotation and analysis software VIAN to annotate spotting information and to generate screenshots for OCR.

Video Annotation of Subtitle Variants with VIAN

To address the methodological challenges of analysing subtitling as both audiovisually and historically situated, we adopt a hybrid workflow combining manual, semi-automatic, and computational methods. Recent scholarship in DH and film studies has emphasised the need to bridge close, interpretive analysis with scalable, data-driven techniques.⁴³ While automated procedures – such as shot boundary detection, speech diarisation, or text-in-image recognition – facilitate large-scale exploration, they often lack the contextual sensitivity required to capture narrative, aesthetic, or translational nuance.⁴⁴ For subtitle analysis in particular, human annotation remains indispensable, not as a fallback solution but as a methodologically constitutive practice.

We therefore employ VIAN, an open-source video annotation tool developed at the University of Zurich in collaboration with the Visual Analytics group at TIB Hannover.⁴⁵ Designed as a lightweight, interoperable platform built on prior developments,⁴⁶ the latest VIAN release supports manual annotation, automated segmentation, and the integration of externally generated data

(e.g., from Python scripts, ELAN, or TIB AV-Analytics), enabling human-in-the-loop workflows. Our approach thus understands annotation as an epistemically productive act that is not merely preparatory work, but also constitutes a situated analytical process through which subtitling – as an audiovisual, temporal, and discursive layer – becomes systematically explorable and comparable.

In practical terms, VIAN enables flexible, time-based annotation through manually adjustable segments arranged across parallel timeline tracks (see figure 5). These segments form the basis for analysing subtitle spotting, dialogue distribution, and their relation to shot structure or narrative organisation. For hardcoded subtitles in particular, spotting must be manually reconstructed and aligned with the filmic timeline. Crucially, subtitle segments do not necessarily coincide with shots or other aesthetic units, making separate tracks for spotting and shot segmentation analytically necessary.

In the case of *Landesverräter*, additional segmentation tracks allow us to record where dialogue occurs and which spoken language is used. This is especially relevant in scenes where Swiss German

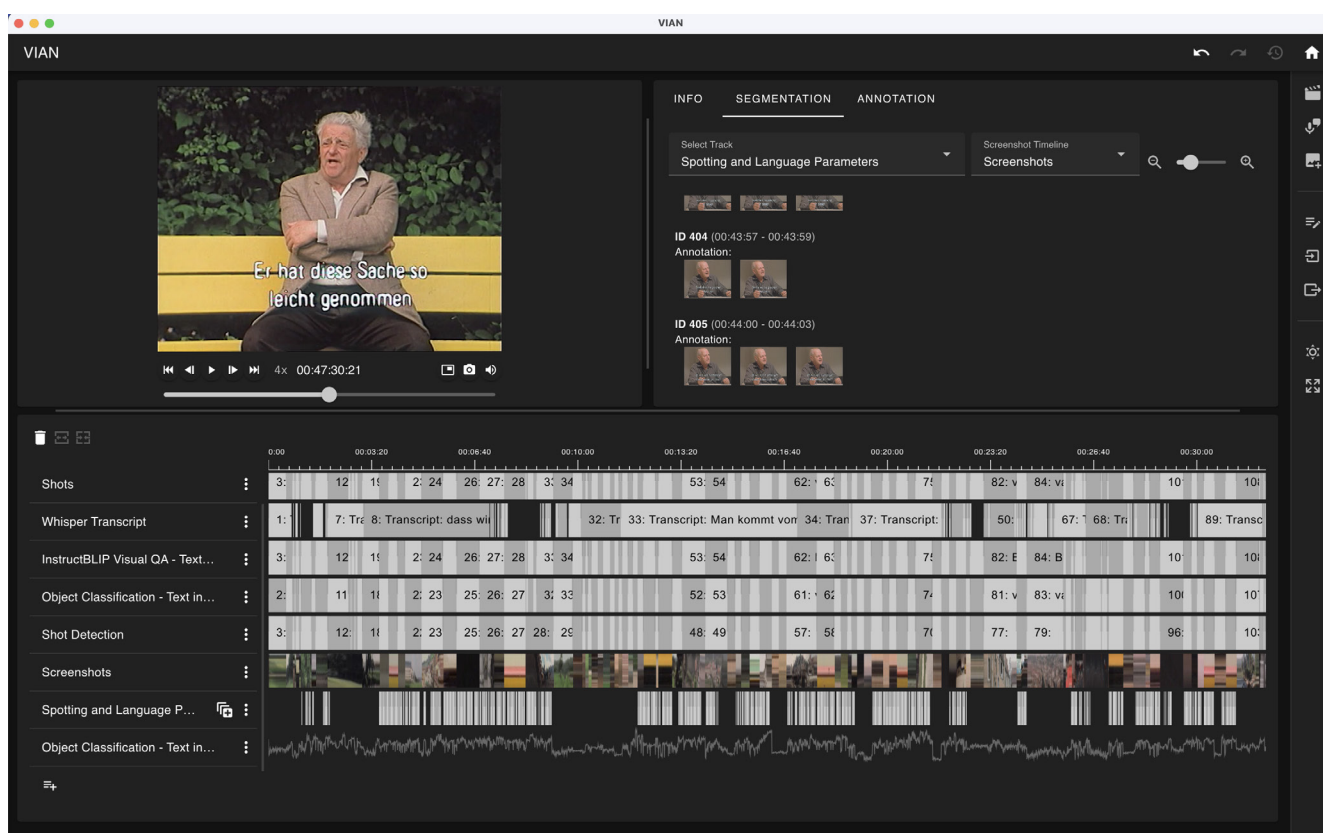


Figure 5. VIAN's interface while analysing the DVD version of *Landesverräter*.

dialect is spoken: annotation makes visible whether and when dialect is subtitled, and whether subtitling practices differ across manifestations. By linking subtitle segments to dialogue segments, we can analyse not only textual variation but also the distribution of subtitling in relation to speech patterns and narrative emphasis.

Temporal segmentation can be enriched through textual annotations. VIAN allows free-text comments, for example to document irregular spotting (such as subtitles extending beyond cuts), as well as controlled vocabularies for recording spoken language, subtitle type, or other recurring features. Screenshots generated at regular intervals or per segment enable visual cross-referencing between subtitle units and image composition, facilitating the analysis of how subtitling interacts with framing, shot scale, and visual emphasis. Moreover, supporting interoperable import and export via CSV and XML-compatible formats, VIAN functions as an analytical environment linking subtitle text, image, and sound.

Annotation Parameters and Vocabulary for VIAN

Effective video annotation requires explicit parameter definitions and controlled vocabularies. If annotation is understood as an epistemic act rather than a neutral technical procedure, then the chosen categories determine which aspects of subtitling become visible, comparable, and measurable. We therefore distinguish between repeatable, controlled categories applicable across the corpus and film-specific parameters that require contextual adaptation.

Because subtitles are not merely textual representations but operational artefacts, our annotation design foregrounds the technical conditions that structure their production and circulation. Micro-technical features such as spotting, subtitling length, reading speed, and segmentation are often treated as peripheral details in aesthetic or cultural analysis. Yet they constitute the material preconditions of subtitled cinema and therefore form the analytical starting point of our framework.

Our schema follows established AVT analytical levels: technical, linguistic, and translational. We begin with the technical level, as it provides the empirical foundation for cross-manifestation comparison. Drawing on Künzli's CIA Model of Subtitle Quality 2.0, we focus on legibility within the intelligibility dimension, limiting our scope to spotting as the measurable basis for comparison.⁴⁷

Time-based annotation forms the backbone of this analysis, capturing subtitle duration, display rate, gaps between subtitles, synchrony, and alignment with shot changes. Spatial parameters – characters per line, number of lines, and line segmentation – are included to account for layout conventions.

These temporal and spatial annotations enable quantitative calculations across manifestations. While digital subtitles allow automated extraction of timestamps and textual data, hardcoded subtitles require manual spotting in VIAN. The workflow, therefore, combines manual and (semi-) automated procedures. Other CIA dimensions, such as readability, correspondence between spoken dialogues and subtitles, and authenticity, are addressed at the linguistic and translational levels rather than within the technical layer. The technical annotations thus lay the groundwork for subsequent linguistic, stylistic, and translation-oriented analyses.

Beyond the technical layer, we annotate categories that capture the relationship between spoken dialogue and subtitled text at either the manifestation or segment level. These include: spoken language(s) (in both monolingual and multilingual films), types of subtitles (intralingual and interlingual), and linguistic composition of subtitles (monolingual and bilingual). These categories make it possible to analyse not only textual variation but also distributional strategies: which speech segments are subtitled, and which are omitted across manifestations. By linking spotting data to linguistic and translational parameters, the framework shifts from measurable variation to interpretive questions about reduction, emphasis, accessibility, and narrative structuring. The annotation design thus balances corpus scalability with close reading, enabling subtitle variants to be examined both as quantitative patterns and as historically situated translation practices.

Time-coded Features: Analysing and Comparing Data from Subtitle Variants

The extraction and annotation workflows described above generate a structured dataset that enables comparative analysis at multiple levels. The central analytical question guiding this stage is: How and why do subtitle variants diverge across manifestations of the same film? Addressing this question requires both textual collation and quantitative evaluation of temporal parameters, followed by contextualisation through archival sources.

Our first level of investigation focuses on computer-assisted textual comparison between subtitle variants. For this purpose, we employ LERA (Locate, Explore, Retrace, Apprehend), an interactive environment originally developed for the collation of historical text witnesses.⁴⁸

Unlike many collation tools that require a single base text, LERA allows different textual witnesses to be examined as equal variants – an approach particularly suitable for subtitle comparison, where no version can be presupposed as authoritative. Because each subtitle insertion constitutes a discrete textual segment, LERA aligns corresponding passages and highlights identical, similar, or divergent formulations within a critical apparatus. The output can be exported for further analysis and forms the basis for developing a lexical and semantic annotation vocabulary.

The comparison between the two German subtitle variants of *Landesverräter* reveals several types of divergence (see figure 6). First, the hardcoded version is substantially shorter – approximately 1,000 lines fewer than the Play Suisse subtitles – primarily because German speech is not subtitled in that version. Second, lexical and stylistic differences emerge. As the text example illustrates, information such as location details ('Bahnhofsplatz', line 51) and descriptions of actions ('und dass man ihn erschossen will?', line 53) are rendered more precisely in the Play Suisse version.

	hardcoded_sub	PlaySuisse_sub
48	Ich war damals arbeitslos	Ich war damals arbeitslos und musste in die Stadt zum Stempeln. [49]
49	musste in die Stadt stempeln gehn	Ich war damals arbeitslos und musste in die Stadt zum Stempeln.
50	Dort traf ich einen Kollegen, der sagte mir:	
51		Dort begegnete ich einem Freund, auf dem Bahnhofplatz.
52	Du, weisst du schon, dass dein Bruder verhaftet ist?	Der sagte: "Weisst du, dass dein Bruder verhaftet wurde
53	und dass wir uns nicht dazu hergeben, ihn zu erschossen [1191]	und dass man ihn erschossen will?"
54	Ja, warum und wieso? - Wegen Landesverrat [79]	Ich sagte: "Warum, wieso? Ich weiss nichts."
55	in seiner Lust nach einem Bohemienleben [479]	Ich habe es von einem seiner Freunde erfahren,
56	Ich wusste von nichts	
57	Ich erfuhr es von einem Kollegen	
58	der mit ihm in der Musikgesellschaft war	der mit ihm zusammen in der Musikgesellschaft Abtwil war.
59	Sie haben scheint's den Ernst in St. Gallen verhaftet	Ernst sei in St. Gallen verhaftet worden. [1182]
60	Das gibt eine schöne Geschichte	Eine schöne Nacht, aber eine dunkle Nacht. [1252]
61	Salü Ernst, sagte ich, wie geht's? [134]	Er sagte: "Weisst du, was mit Ernst passiert ist?"
62		Man hat ihn verhaftet.
63	und St. Gallen war schon immer eine [455]	In St. Gallen. Der wird ganz schön Ärger kriegen."

Figure 6. Excerpt from a collation result generated in LERA, showing the DVD hardcoded subtitles on the left and the Play Suisse SRT subtitles on the right.

The comparison also reveals lexical shifts in terminology (‘Kollege’, line 50 vs. ‘Freund’, line 51), different verb tenses and idiomatic expressions formulated either literally (‘Das gibt eine schöne Geschichte’, line 60) or figuratively (‘Der wird ganz schön Ärger kriegen’, line 63). All of these examples indicate different translational strategies.

Such divergences are not merely stylistic variations. They point to distinct reduction strategies, audience assumptions, and possibly distribution contexts. Establishing a systematic vocabulary in line with AVT literature for categorising these differences – lexical shifts, omissions, expansions, reformulations – enables the identification of patterns beyond isolated examples. In future stages, these comparisons will be enriched by aligning them with automatically generated transcripts of the spoken dialogue (e.g., via TIB-AV-A or trained language models), enabling systematic measurement of reduction rates and condensation strategies.

The second level of investigation focuses on quantitative comparison based on temporal annotation data. By combining spotting information with subtitle text, we can calculate measurable parameters such as subtitle duration, characters per subtitle, characters per second (reading speed), number of lines, and characters per line (see figure 7).

Whereas digital subtitle files allow automatic extraction of timecodes, hardcoded subtitles require manual reconstruction through VIAN. Once normalised, however, both variants can be analysed within a shared metric framework. For example, the mean characters-per-second (CPS) value of the Play Suisse subtitle is 14.56. While this value is meaningful primarily in comparative

Number	Start	End	Text	Duration	Number of characters	CPS	Number of lines
1	00:00:22,360	00:00:25,680	In der Nacht vom 9. auf den 10. November 1942	3.32	[23, 21]	13.25	2
2	00:00:25,840	00:00:29,040	wurde der Soldat Ernst S. in seinem 23. Lebensjahr	3.2	[25, 24]	15.31	2
3	00:00:29,240	00:00:32,880	hier bei Jonschwil, Kanton St. Gallen, in einem Wald erschossen,	3.64	[30, 33]	17.31	2
4	00:00:33,040	00:00:35,880	etwas unterhalb der Häusergruppe namens Bisacht.	2.84	[19, 28]	16.55	2
5	00:00:36,040	00:00:41,080	17 Landessverräter wurden zwischen 1942 und 1944 exekutiert,	5.04	[34, 25]	11.71	2
6	00:00:41,240	00:00:43,160	und Ernst S. war der erste davon.	1.92	[33]	17.19	1
7	00:00:47,480	00:00:50,880	Über die Landesverräter ist im Allgemeinen wenig durchgesickert.	3.4	[30, 33]	18.53	2
8	00:00:51,560	00:00:53,600	Die Geheimnisteurei hatte angefangen,	2.04	[19, 17]	17.65	2

Figure 7. Excerpt from a table containing processed data of the Play Suisse subtitles.

terms, it establishes a baseline for identifying deviations across manifestations within the research corpus and, ultimately, discerning trends over time and across languages. Differences in CPS, subtitle length, or segmentation patterns indicate varying degrees of condensation and pacing, which may correlate with distribution media conventions, assumed audience reading speeds, or institutional guidelines.

Temporal annotation also enables relational analysis between subtitle and speech segments. By aligning subtitle spotting with dialogue annotation, we can examine: (1) which speech segments are subtitled and which are omitted, (2) how much subtitling density diverges from narrative emphasis, (3) how subtitles interact with shot structure and editing rhythm, and (4) whether conventions remain stable across manifestations or shift over time. Quantitative visualisations of subtitle occurrences across the timeline further reveal clustering patterns, for example in sequences dominated by talking head interviews, where extended speech segments produce concentrated subtitle density.

Conclusion

As this article has shown, the research field of film subtitling encompasses a complex web of products, processes, and actors whose in-depth examination demands an interdisciplinary approach – particularly in an era shaped by digital platform logics and the widespread application of technologies commonly subsumed under the term ‘artificial intelligence’. In the current subtitling industry, the shift toward automation driven by ASR, NMT, and platform-based infrastructures is often associated by professionals with reduced agency, loss of status, and ultimately deprofessionalisation. In research, however, such automation can prove highly useful for retracing historical products and practices. From a media-archaeological perspective, in particular, it can assist in revealing structural (dis-)continuities.

Aware of these tensions, our research on film subtitling combines historical, archival, and computational perspectives, rooted in critically informed, data-driven, and cross-disciplinary practices that continually reflect on the potentials, affordances, and effects of applying digital methods to film research. This also means that we are not exclusively interested in automating processes or adopting the latest technologies – for instance from so-called artificial intelligence – but rather aim to develop and adjust appropriate workflows guided by our research objects, interests, and

questions. In this sense, we use processes of automation not as ends in themselves but as means to reconfigure the socio-technical conditions under which translation is produced, circulated, and interpreted.

Our study therefore proposes a variant-oriented and media-archaeologically grounded framework for analysing subtitling as a historically situated, audiovisual, and operational practice. Drawing on Zielinski's variantology and Descriptive AVT Studies, and combining archival research with digital annotation, we have demonstrated how subtitle variants emerge from specific material conditions, institutional decisions, and distribution contexts. The case of *Landesverräter* illustrates that even within the same subtitle language, manifestations can diverge significantly in technical, linguistic, and translational choices, such as omission and reduction strategies, spotting conventions, etc. Such differences become visible only when textual collation, temporal metrics, and archival documentation are brought into systematic relation.

The triad 'time-coded, hardcoded, decoded,' articulated in reversed order in this article, summarises both the historical operations of subtitling and the methodological steps required to study it. Subtitles are time-coded artefacts, synchronised with speech and image; they may be hardcoded into the visual field or embedded within digital infrastructures, and they must be decoded analytically, through comparison, annotation, and contextualisation. This layered approach bridges close and distant reading, human and computational analysis, and archival recovery with corpus-based measurement.

Our contribution is threefold. First, we establish subtitling as a central yet understudied node in the media history of Swiss cinema, foregrounding its infrastructures, multiple manifestations, and production practices across analogue and digital contexts. Second, we construct a version- and variant-sensitive theoretical framework and interdisciplinary methodology. Third, we apply the proposed methodology that integrates film studies, AVT, and DH to our corpus and case study, demonstrating how variant-based analysis can be operationalised through integrated archival and computational workflows.

Importantly, computational comparison does not replace historical inquiry but redirects it. Divergences detected through textual and temporal analysis serve as indicators that prompt renewed consultation of archival sources. By integrating film artefacts, multiple manifestations, and non-filmic archival records, our approach provides an empirical and conceptual foundation for studying subtitling as both an audiovisual practice and a cultural negotiation. Subtitles do not simply translate

dialogue; they are products of institutional choices and aesthetic decisions, not neutral supplements to cinematic form.

From this perspective, media archaeology does not offer a nostalgic return to obsolete formats. It equips us to read subtitling's analogue pasts and digital futures as overlapping operational strata. What we extract, annotate, and compare today not only reconstructs historical translation practices but also informs how subtitled cinema will be preserved, standardised, and experienced in increasingly automated environments. Attending to variants, infrastructures, and micro-histories thus becomes more than a scholarly exercise: it is a critical intervention into the conditions shaping the evolution of audiovisual translation.

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