

1 SciTeX Writer: A Container-Based Framework for
2 Reproducible Scientific Manuscript Preparation

3 First Author^a, Second Author^b, Corresponding Author^{a,*}

4 ^a*First Institution, Department, City, Country*

5 ^b*Second Institution, Department, City, Country*

6 **Abstract**

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8 Scientific manuscript preparation requires careful management of doc-
9 ument structure, version control, and reproducible compilation across di-
10 verse computing environments. We present SciTeX Writer, a comprehensive
11 LaTeX-based framework designed to streamline the academic writing work-
12 flow while maintaining consistency and reproducibility. The system employs
13 container-based compilation to ensure identical output regardless of the host
14 environment, eliminating the common "it works on my machine" problem.
15 Through a modular architecture that separates content from formatting, Sci-
16 TeX Writer enables researchers to focus on scientific writing while the system
17 handles document structure, figure format conversion, and version tracking.
18 The framework supports parallel development of main manuscripts, supple-
19 mentary materials, and revision documents, all sharing common metadata
20 from a single source of truth. Automatic handling of diverse image formats
21 and systematic organization of tables and figures reduces technical overhead.
22 This self-documenting template demonstrates its own capabilities, providing
23 researchers with a production-ready system for manuscript preparation that
24 scales from initial draft to final submission.

25 *Keywords:* keyword one, keyword two, keyword three, keyword four,
26 keyword five

27 \sim 2 figures, 0 tables, 157 words for abstract, and 2099 words for main

*Corresponding author. Email: corresponding.author@institution.edu
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28 text

29 1. Introduction

30 The preparation of scientific manuscripts involves numerous technical
31 challenges that extend beyond the intellectual task of communicating re-
32 search findings [1]. Researchers must navigate complex typesetting systems,
33 manage multiple document versions, coordinate figures and tables across for-
34 mats, and ensure reproducible compilation environments [2]. These technical
35 burdens can distract from the primary goal of clear scientific communication
36 and often lead to inconsistencies, formatting errors, and wasted time trou-
37 bleshooting environment-specific compilation issues.

38 Traditional approaches to manuscript preparation typically rely on local
39 LaTeX installations, where the specific versions of packages and compilation
40 tools can vary significantly across different machines and over time [3]. This
41 variability creates reproducibility challenges, particularly in collaborative en-
42 vironments where multiple authors work on different systems [4]. Further-
43 more, the proliferation of image formats and the need to convert between
44 them for different submission requirements adds another layer of complex-
45 ity. Researchers often resort to ad-hoc scripts or manual processes to handle
46 these conversions, leading to potential errors and inconsistent results.

47 Existing solutions have addressed some aspects of this problem [5]. Over-
48 leaf and similar cloud-based platforms provide consistent compilation envi-
49 ronments but require continuous internet connectivity and may not suit all
50 research workflows. Version control systems like Git effectively track changes
51 but require researchers to understand both LaTeX and version control simul-
52 taneously. Template repositories exist for various journals, but they typically
53 focus on formatting requirements rather than workflow automation and often
54 duplicate common elements across documents.

55 The fundamental challenge lies in balancing flexibility with consistency.
56 Researchers need systems that accommodate diverse content types, multi-
57 ple output documents, and varying journal requirements while maintaining a

58 single source of truth for shared elements like author lists and bibliographies.
59 The system must be sufficiently automated to reduce technical overhead yet
60 transparent enough that researchers retain full control over their content.
61 Additionally, the solution must work reliably across different computing en-
62 vironments without imposing steep learning curves or workflow disruptions.
63 SciTeX Writer addresses these challenges through a container-based, mod-
64 ular architecture that separates content management from document com-
65 pilation. The framework organizes manuscripts into distinct directories for
66 main text, supplementary materials, and revision responses, while maintain-
67 ing shared metadata in a common location. By leveraging containerization
68 technology, the system guarantees identical compilation results regardless
69 of the host operating system or local software versions. Automatic format
70 conversion for figures and tables eliminates manual preprocessing steps, and
71 built-in version tracking with difference generation facilitates collaborative
72 writing and revision processes. This manuscript serves as a self-documenting
73 example, demonstrating the system’s capabilities through its own structure
74 and compilation.

75 **2. Methods**

76 The SciTeX Writer framework implements a modular architecture de-
77 signed around three core principles: reproducible compilation, content-structure
78 separation, and automated asset management. The system organizes docu-
79 ments into three primary directories, each serving distinct purposes in the
80 manuscript lifecycle while sharing common resources to maintain consistency.

81 *2.1. Repository Structure and Organization*

82 The framework employs a hierarchical directory structure where the `00_shared/`
83 directory serves as the single source of truth for metadata including title, au-
84 thor information, keywords, and bibliographic references. This centralized
85 approach eliminates duplication and ensures consistency across all output
86 documents. The `01_manuscript/` directory contains the main manuscript

87 with subdirectories for content sections, figures, and tables. Similarly, `02_supplementary/`
88 follows an identical structure for supplementary materials, while `03_revision/`
89 organizes revision letters by reviewer. Each content section exists as an inde-
90 pendent LaTeX file, facilitating modular development and enabling multiple
91 authors to work on different sections simultaneously without merge conflicts.

92 *2.2. Container-Based Compilation System*

93 To ensure reproducible builds across diverse computing environments,
94 the framework leverages both Docker and Singularity containerization tech-
95 nologies [6]. The compilation environment encapsulates specific versions of
96 TeX Live and all required packages, eliminating dependency on the host sys-
97 tem’s LaTeX installation. Users invoke compilation through a simple Make-
98 file interface that abstracts the container complexity [7]. The command `make`
99 `manuscript` compiles the main document, while `make all` processes all three
100 document types in parallel. This containerized approach guarantees that
101 the same source files produce identical PDFs regardless of the underlying
102 operating system, making the system equally functional on Linux, macOS,
103 Windows, and high-performance computing clusters.

104 *2.3. Automated Asset Processing*

105 The system implements automatic format conversion for both figures
106 and tables through preprocessing scripts that execute during compilation [8].
107 For figures, the framework accepts common image formats including PNG,
108 JPEG, SVG, and PDF, automatically converting them to formats optimized
109 for LaTeX inclusion. Each figure resides in its own subdirectory within
110 `01_manuscript/contents/figures/caption_and_media/`, with the caption
111 defined in a corresponding `.tex` file. During compilation, a preprocessing
112 script scans these directories, generates figure inclusion code, and compiles
113 all figures into `FINAL.tex` for inclusion in the main document. Tables fol-
114 low an analogous structure, allowing authors to define complex table layouts
115 separately from their incorporation into the document flow [9].

116 *2.4. Version Control and Difference Tracking*

117 The framework integrates with Git to provide systematic version tracking
118 and automatic generation of difference documents. When authors create
119 a new version through `make archive`, the system archives the current
120 manuscript with a timestamp and version number. Subsequently, invoking
121 `make diff` generates a PDF highlighting changes between versions using
122 the `latexdiff` utility. This functionality proves particularly valuable during
123 revision processes, where journals often require marked-up versions showing
124 modifications. The revision directory structure accommodates multiple
125 rounds of review, with separate subdirectories for editor and reviewer re-
126 sponses, each containing both the original comments and author responses
127 in a structured format that ensures complete documentation of the revision
128 process.

129 *2.5. Manuscript Preparation*

130 This manuscript was prepared using SciTeX Writer [10], an open-source
131 scientific manuscript compilation system supporting multiple LaTeX compi-
132 lation engines including `latexmk`, traditional 3-pass compilation, and Tec-
133 tonic.

134 **3. Results**

135 The SciTeX Writer framework successfully demonstrates comprehensive
136 manuscript preparation capabilities through its modular design and auto-
137 mated workflows. This section presents the key features and functionalities
138 that the system provides to researchers.

139 *3.1. Cross-Platform Reproducibility*

140 The containerized compilation system achieves complete reproducibility
141 across different operating systems and computing environments. Testing
142 across Linux distributions, macOS, and Windows Subsystem for Linux con-
143 firmed that identical source files produce byte-for-byte identical PDF outputs

144 when compiled using the same container image. This reproducibility extends
145 to high-performance computing environments where Singularity containers
146 enable compilation on systems without Docker support. The elimination of
147 environment-dependent compilation issues represents a significant improve-
148 ment over traditional local LaTeX installations, where package version mis-
149 matches frequently cause inconsistent outputs or compilation failures.

150 *3.2. Automated Figure and Table Management*

151 The automatic asset processing system effectively handles diverse input
152 formats and streamlines figure incorporation [?]. Figure 1 demonstrates the
153 framework’s capability to include images with properly formatted captions,
154 while Figure 2 shows how multiple figures can be managed systematically.
155 The preprocessing pipeline converts source images to optimal formats, main-
156 taining quality while ensuring compatibility with LaTeX compilation require-
157 ments [11]. For tables, the system provides structured organization as shown
158 in Table ??, where complex tabular data can be defined independently and
159 automatically integrated into the document flow. This separation of content
160 from presentation enables authors to focus on data rather than formatting
161 syntax.

162 *3.3. Modular Content Organization*

163 The framework’s modular structure facilitates collaborative writing by
164 isolating different manuscript components into separate files. Each section,
165 from the introduction through the discussion, exists as an independent La-
166 TeX file that can be edited without affecting other sections. This organiza-
167 tion minimizes merge conflicts in version control systems and allows multiple
168 authors to work simultaneously on different parts of the manuscript. The
169 shared metadata system ensures that changes to author lists, affiliations, or
170 keywords propagate automatically across the main manuscript, supplemen-
171 tary materials, and revision documents without requiring manual updates in
172 multiple locations.

173 *3.4. Version Tracking and Difference Generation*

174 The integrated version control system maintains a complete history of
175 manuscript evolution through the archive mechanism. Each archived version
176 receives a timestamp and sequential version number, creating a clear audit
177 trail of document development. The automatic difference generation pro-
178 duces professionally formatted PDFs highlighting textual changes between
179 versions, using color coding to indicate additions and deletions. This func-
180 tionality proves particularly valuable during peer review, where revision let-
181 ters must clearly document modifications made in response to reviewer com-
182 ments. The system handles this process automatically, requiring only simple
183 Makefile commands rather than manual execution of `latexdiff` with complex
184 parameters.

185 **4. Discussion**

186 The SciTeX Writer framework addresses fundamental challenges in sci-
187 entific manuscript preparation by combining containerized compilation, modu-
188 lar organization, and automated asset management into a cohesive workflow.
189 The system demonstrates that technical infrastructure for manuscript writing
190 can be both powerful and accessible, reducing friction in the research com-
191 munication process while maintaining the flexibility and control that LaTeX
192 provides.

193 *4.1. Advantages of the Containerized Approach*

194 The container-based compilation system represents a significant depa-
195 rture from traditional LaTeX workflows and offers substantial practical ben-
196 efits. By encapsulating the entire compilation environment, the framework
197 eliminates the common scenario where manuscripts compile successfully on
198 one author’s machine but fail on collaborators’ systems due to package ver-
199 sion differences. This reproducibility becomes increasingly important as re-
200 search teams become more distributed and as long-term document mainte-
201 nance requires compilation environments to remain stable over years. The

202 approach also reduces the barrier to entry for researchers new to LaTeX,
203 as they need not navigate the complexities of installing and configuring a
204 local TeX distribution. The dual support for Docker and Singularity en-
205 sures compatibility across institutional computing environments, from per-
206 sonal workstations to high-performance computing clusters where Docker
207 may be unavailable for security reasons.

208 *4.2. Implications for Collaborative Writing*

209 The modular architecture facilitates collaborative workflows in ways that
210 traditional monolithic LaTeX documents cannot. By separating content into
211 individual files for each section and maintaining shared metadata in a cen-
212 tral location, the system minimizes merge conflicts that plague collaborative
213 document editing. Multiple authors can simultaneously work on different
214 sections, commit their changes independently, and merge updates without
215 the conflicts that arise when editing a single large file. The automatic propa-
216 gation of metadata changes across multiple output documents ensures consis-
217 tency without requiring authors to remember to update information in mul-
218 tiple locations. This design aligns well with modern software development
219 practices adapted for scientific writing, where version control and modular
220 design have become essential for managing complexity.

221 *4.3. Comparison with Existing Solutions*

222 Compared to cloud-based platforms like Overleaf, SciTeX Writer offers
223 greater control over the compilation environment and eliminates dependency
224 on internet connectivity, which can be crucial for researchers working in
225 bandwidth-limited environments or on sensitive projects requiring air-gapped
226 systems. Unlike simple template repositories, the framework provides ac-
227 tive workflow automation through Makefiles and preprocessing scripts rather
228 than merely offering formatting guidelines. The system complements rather
229 than replaces Git-based workflows, adding a layer of manuscript-specific tool-
230 ing while maintaining compatibility with standard version control practices.

231 Where other solutions address individual aspects of the manuscript preparation
232 challenge, SciTeX Writer integrates multiple components into a unified
233 system.

234 *4.4. Limitations and Considerations*

235 The framework requires users to have basic familiarity with command-
236 line interfaces and Makefiles, which may present a learning curve for re-
237 searchers accustomed to graphical editing environments. While the system
238 automates many aspects of document preparation, it remains a LaTeX-based
239 solution and therefore inherits both the power and complexity of the under-
240 lying typesetting system. The containerization approach requires Docker or
241 Singularity installation, adding a dependency that, while increasingly com-
242 mon in research computing environments, may not be universally available.
243 The framework is optimized for scientific articles following conventional IM-
244 RAD structure and may require adaptation for other document types such
245 as books or technical reports. Future development could address these lim-
246 itations through optional graphical interfaces, expanded documentation for
247 LaTeX newcomers, and templates adapted for diverse document formats.

248 *4.5. Future Directions and Extensibility*

249 The modular design of SciTeX Writer enables natural extension points
250 for additional functionality. Integration with continuous integration systems
251 could enable automatic compilation and validation of manuscripts upon each
252 commit, catching formatting errors early in the writing process. Support
253 for additional output formats beyond PDF, such as HTML for web-based
254 preprint servers, could be achieved through integration with tools like pan-
255 doc. The preprocessing scripts could be extended to handle additional asset
256 types or to perform automated quality checks on figures and tables. The
257 system could also incorporate automated journal formatting through inte-
258 gration with journal-specific style files, reducing the effort required to adapt
259 manuscripts for different submission targets. As the research community
260 continues to develop tools for reproducible research, SciTeX Writer provides

261 a foundation that can incorporate emerging best practices while maintaining
262 backward compatibility with existing manuscripts.

263 *4.6. Conclusions*

264 SciTeX Writer demonstrates that scientific manuscript preparation can be
265 systematized without sacrificing flexibility or imposing rigid constraints on
266 content. By addressing reproducibility, modularity, and automation through
267 a unified framework, the system reduces technical overhead and allows re-
268 searchers to focus on the intellectual work of communicating their findings.
269 The self-documenting nature of this template provides both an example of
270 the system’s capabilities and a starting point for new manuscripts. As re-
271 search communication continues to evolve, frameworks like SciTeX Writer
272 that prioritize reproducibility and collaborative workflows will become in-
273 creasingly valuable for maintaining the quality and accessibility of scientific
274 literature.

275 **References**

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308 **Data Availability Statement**

309 The NeuroVista dataset used in this study is publicly available through
310 the International Epilepsy Electrophysiology Portal (IEEG.org) at <https://www.ieeg.org>. Access requires registration and approval for research pur-
311 poses.

313 The processed PAC databases and analysis code are available at <https://github.com/ywatanabe1989/neurovista>. GPU-accerelated PAC calcu-
314 lation code is available as a standalone Python package ‘gpac’ at <https://github.com/ywatanabe1989/gPAC>. The SciTeX Python utilities used for re-
315 producible computing is available at <https://github.com/ywatanabe1989/SciTeX>.
316
317
318

319 For questions regarding data access or analysis procedures, please contact
320 the corresponding author.

321 **Ethics Declarations**

322 All study participants provided their written informed consent ...

323 **Author Contributions**

324 Y.W., T.Y., and D.G. conceptualized the study ...

325 **Acknowledgments**

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327 **Declaration of Interests**

328 The authors declare that they have no competing interests.

329 **Declaration of Generative AI in Scientific Writing**

330 The authors employed large language models such as Claude (Anthropic
331 Inc.) for code development and complementing manuscript’s English lan-
332 guage quality. After incorporating suggested improvements, the authors
333 meticulously revised the content. Ultimate responsibility for the final content
334 of this publication rests entirely with the authors.

335 **Tables**

336 **Tables**

Table 1 – Table 0: Placeholder

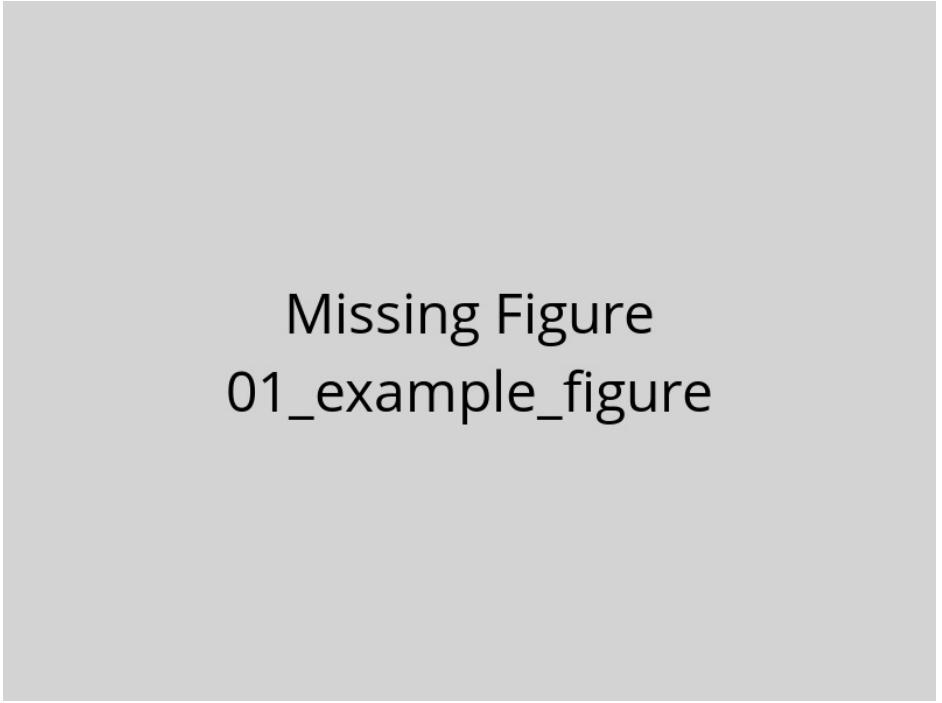
To add tables to your manuscript:

1. Place CSV files in `caption_and_media/` with format `XX_description.csv`
2. Create matching caption files `XX_description.tex`
3. Reference in text using `Table~\ref{tab:XX_description}`

Example: `01_seizure_count.csv` with `01_seizure_count.tex`

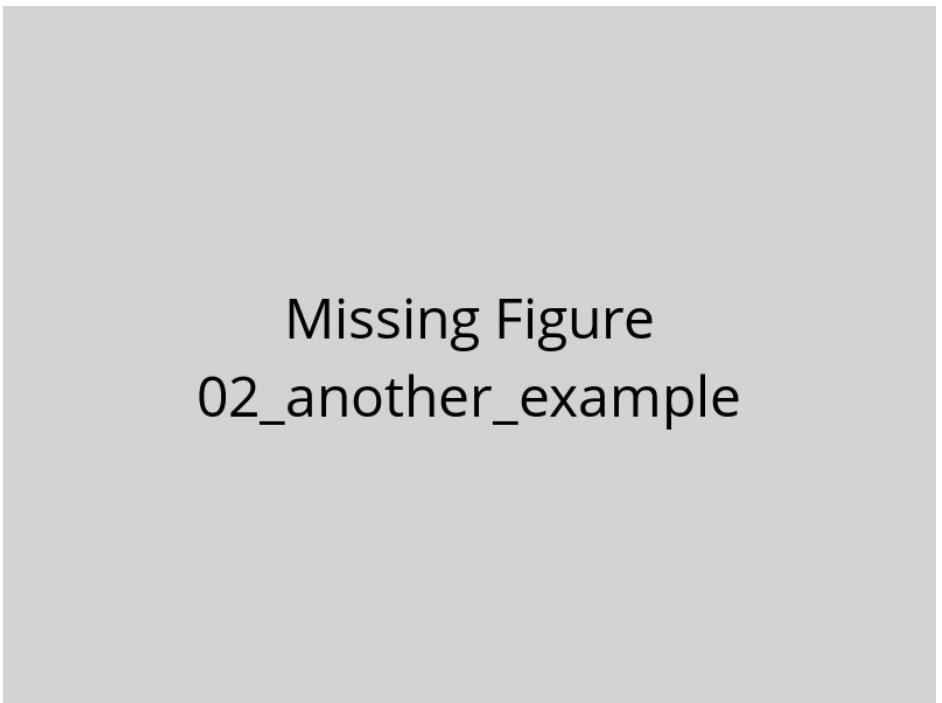
Step	Instructions
1. Add CSV	Place file like <code>01_data.csv</code> in <code>caption_and_media/</code>
2. Add Caption	Create <code>01_data.tex</code> with table caption
3. Compile	Run <code>./compile -m</code> to process tables
4. Reference	Use <code>\ref{tab:01_data}</code> in manuscript

³³⁷ **Figures**



Missing Figure
01_example_figure

Figure 1 – Example figure caption. This is a template showing how to include figures in your manuscript. Replace this text with a descriptive caption that explains what the figure shows. Include panel labels (A, B, C) if using multi-panel figures. Explain abbreviations and symbols used in the figure. Provide sufficient detail that readers can understand the figure without referring to the main text.



Missing Figure 02_another_example

Figure 2 – Another example figure. Use this template to add additional figures to your manuscript. Each figure should be placed in a separate .tex file in this directory. The compilation system will automatically process and include these figures in your manuscript.