Supplementary Materials

for *"Inconsistencies in TEX-produced PDF Documents"*

Contents

A MOTIVATING STUDY

A.1 Sampled Documents

Table A.1.1: Documents sampled in the motivating study

arXiv ID	Document class	Taxonomy
2306.00001	`IEEEtran`	cs.CV
2306.00002	`elsarticle`	physics.soc-ph
2306.00004	`llncs`	cs.SE
2306.00022	`mnras`	astro-ph.EP
2306.00036	`article`	cs.AI
2306.00057	`revtex4-1`	quant-ph
2306.00207	`amsart`	math.AG
2306.00417	`revtex4-2`	cond-mat.stat-mech
2306.01308	`revtex4`	nucl-th
2306.01691	`acmart`	cs.GR

A.2 Types of Inconsistencies

Table A.2.1: Number of inconsistencies found

	Comparing XeTeX with:	
Type of inconsistency	pdfTeX	LuaTeX
Text spacing	9	9
Line breaks	9	9
Images	3	4
Other formatting	3	2
Font formatting	2	0
Ligatures	2	0
Missing content	1	1
References	0	2
Number of pages	1	1

B CROSS-ENGINE COMPARISON

B.1 Inconsistencies in common document classes

Table B.1.1: Differences across common document classes (XeLaTeX vs pdfLaTeX)

	% of papers with difference (XeLaTeX versus pdfLaTeX)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled (342)	21.9	2.3	17.8	27.8	98.3	96.2	0.9
article (134)	17.2	3.7	37.3	41.0	97.0	97.7	1.5
amsart (65)	6.2	0.0	21.5	21.5	96.8	88.9	0.0
revtex4-2 (43)	7.0	0.0	25.6	37.2	95.3	95.3	2.3
IEEEtran (27)	63.0	0.0	63.0	70.4	100.0	88.9	0.0
elsarticle (26)	19.2	0.0	30.8	50.0	100.0	100.0	0.0
revtex4-1 (23)	0.0	0.0	30.4	52.2	100.0	100.0	0.0
acmart (21)	19.0	0.0	28.6	52.4	95.0	95.0	0.0
llncs (8)	12.5	0.0	12.5	0.0	100.0	100.0	0.0
mnras (8)	25.0	0.0	25.0	25.0	87.5	100.0	0.0
revtex4 (7)	0.0	14.3	28.6	57.1	100.0	100.0	0.0

Table B.1.2: Differences across common document classes (XeLaTeX vs LuaLaTeX)

	% of papers with difference (XeLaTeX versus LuaLaTeX)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled (340)	0.0	4.1	8.2	19.1	74.8	74.3	10.0
amsart (65)	0.0	12.3	30.8	21.5	50.8	44.4	21.5
revtex4-2 (43)	0.0	0.0	23.3	37.2	74.4	76.7	4.7
IEEEtran (27)	0.0	3.7	29.6	37.0	88.9	88.9	3.7
elsarticle (26)	0.0	0.0	23.1	38.5	80.0	80.0	0.0
revtex4-1 (23)	0.0	0.0	30.4	52.2	73.9	73.9	0.0
acmart (21)	0.0	0.0	23.8	47.6	90.0	95.0	0.0
llncs (8)	0.0	0.0	0.0	0.0	37.5	37.5	12.5
mnras (8)	0.0	0.0	0.0	12.5	100.0	87.5	0.0
revtex4 (7)	0.0	14.3	28.6	57.1	85.7	85.7	14.3

B.2 Distribution of inconsistencies observed

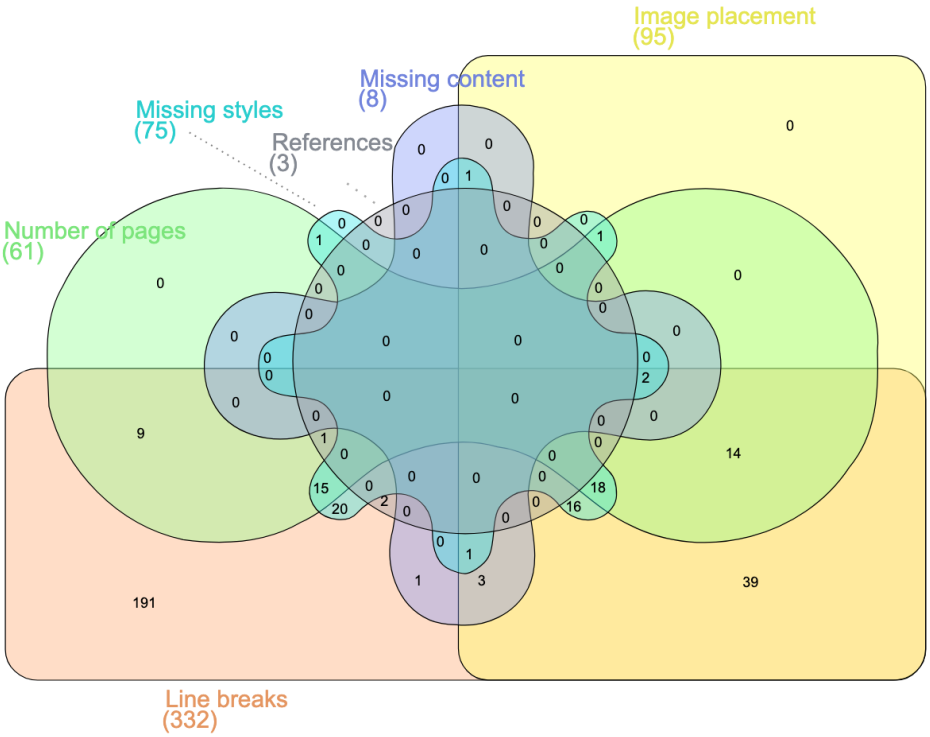

Figure B.2.1: Distribution of inconsistencies between pdfTEX and XETEX

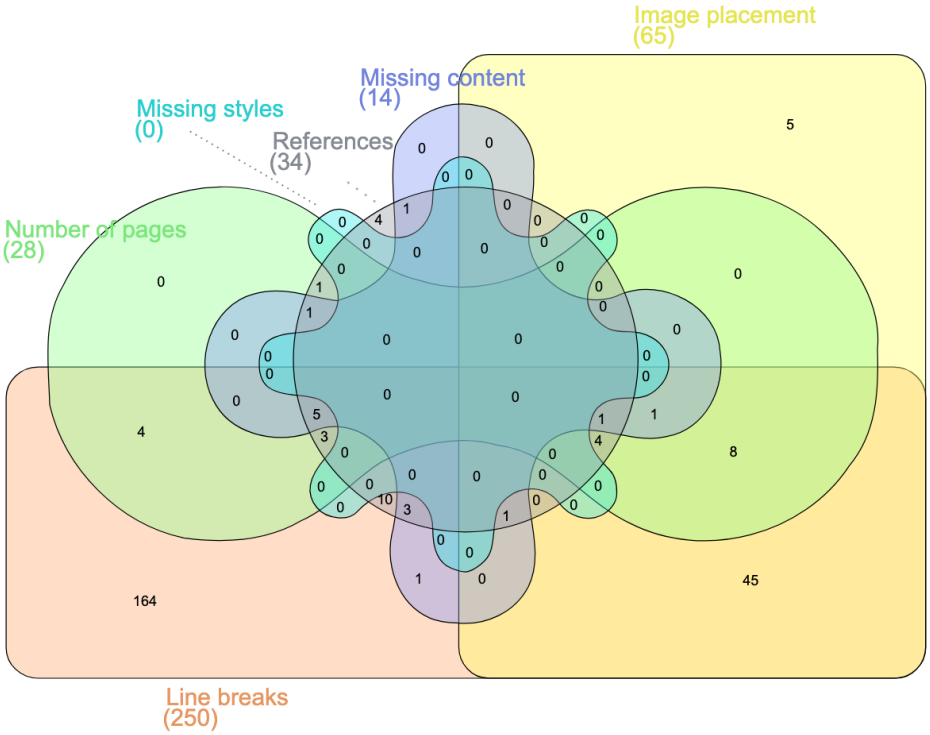

Figure B.2.2: Distribution of inconsistencies between LuaTEX and XETEX

C CROSS-VERSION COMPARISON

C.1 Inconsistencies in common document classes

Table C.1.1: Differences across common document classes (TeX Live 2020 vs 2023)

	% of papers with difference (TeX Live 2020 versus 2023)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled	5.6	6.5	7.9	1.6	51.2	14.8	11.6
article (133)	5.3	3.0	6.8	3.0	52.6	9.8	7.5
amsart (65)	0.0	1.5	0.0	1.5	52.3	3.1	3.1
revtex4-2 (43)	4.7	9.3	11.6	0.0	46.5	16.3	14.0
elsarticle (26)	7.7	11.5	11.5	0.0	38.5	19.2	11.5
IEEEtran (26)	0.0	15.4	7.7	0.0	34.6	19.2	15.4
revtex4-1 (23)	8.7	0.0	17.4	0.0	56.5	17.4	8.7
acmart (21)	9.5	19.0	19.0	4.8	90.5	47.6	61.9
mnras (8)	25.0	0.0	12.5	0.0	100.0	50.0	0.0
llncs (8)	0.0	12.5	0.0	0.0	25.0	0.0	25.0
revtex4 (7)	0.0	0.0	0.0	0.0	14.3	0.0	0.0

Table C.1.2: Differences across common document classes (TeX Live 2020 vs 2021)

	% of papers with difference (TeX Live 2020 versus 2021)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled	4.6	2.3	2.8	0.7	42.4	7.6	2.8
article (133)	5.3	0.8	3.0	1.5	43.6	4.5	1.5
amsart (65)	1.5	0.0	0.0	0.0	50.8	1.5	0.0
revtex4-2 (43)	4.7	0.0	0.0	0.0	44.2	4.7	0.0
elsarticle (26)	7.7	3.8	3.8	0.0	26.9	7.7	3.8
IEEEtran (26)	3.8	7.7	3.8	0.0	19.2	3.8	3.8
revtex4-1 (23)	0.0	0.0	8.7	0.0	34.8	13.0	4.3
acmart (21)	9.5	9.5	4.8	4.8	76.2	33.3	19.0
mnras (8)	0.0	0.0	12.5	0.0	87.5	37.5	0.0
llncs (8)	0.0	12.5	0.0	0.0	25.0	0.0	12.5
revtex4 (7)	0.0	0.0	0.0	0.0	14.3	0.0	0.0

Table C.1.3: Differences across common document classes (TeX Live 2021 vs 2022)

	% of papers with difference (TeX Live 2021 versus 2022)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled	1.4	6.5	5.3	0.0	15.5	8.8	10.0
article (133)	0.8	3.8	3.8	0.0	12.8	5.3	6.8
amsart (65)	0.0	3.1	0.0	0.0	4.6	3.1	3.1
revtex4-2 (43)	0.0	7.0	11.6	0.0	18.6	16.3	16.3
elsarticle (26)	0.0	7.7	7.7	0.0	11.5	7.7	7.7
IEEEtran (26)	0.0	7.7	7.7	0.0	23.1	19.2	15.4
revtex4-1 (23)	4.3	8.7	8.7	0.0	26.1	13.0	13.0
acmart (21)	0.0	14.3	9.5	0.0	38.1	19.0	23.8
mnras (8)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
llncs (8)	0.0	12.5	0.0	0.0	0.0	0.0	12.5
revtex4 (7)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C.1.4: Differences across common document classes (TEX Live 2022 vs 2023)

	% of papers with difference (TEX Live 2022 versus 2023)						
Class (count)	Missing styles	Missing content	Number of pages	Images	Text spacing	Line breaks	References
All compiled	1.6	0.7	0.5	0.0	13.0	3.2	2.3
article (133)	1.5	0.0	0.0	0.0	7.5	1.5	0.0
amsart (65)	0.0	0.0	0.0	0.0	1.5	0.0	0.0
revtex4-2 (43)	0.0	0.0	0.0	0.0	20.9	2.3	0.0
elsarticle (26)	0.0	0.0	0.0	0.0	7.7	0.0	0.0
IEEEtran (26)	3.8	0.0	0.0	0.0	11.5	3.8	0.0
revtex4-1 (23)	0.0	0.0	4.3	0.0	13.0	0.0	0.0
acmart (21)	0.0	14.3	4.8	0.0	61.9	47.6	47.6
mnras (8)	37.5	0.0	0.0	0.0	100.0	0.0	0.0
llncs (8)	0.0	0.0	0.0	0.0	12.5	0.0	0.0
revtex4 (7)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C.2 Compilation success rates across different TEX Live distributions

Table C.2.1: Comparison results (%) from TEX Live 2020 to 2023

	TEX Live versions compared			
Comparison result /%	’20/’21	’21/’22	’22/’23	’20/’23
Identical PDFs	20.4	80.1	85.2	30.3
Different PDFs	69.4	19.2	13.9	68.1
Compile failure	1.2	0.7	0.9	1.6

C.3 Pairwise comparison results over time

Table C.3.1: Comparison results over time (2020 to 2023)

○ identical output; ● different output

Comparison results				Count
’20/’21	’21/’22	’22/’23	’20/’23	
○	○	○	○	42.1%
●	○	○	●	27.1%
●	●	○	●	8.1%
○	●	○	●	7.9%
●	○	●	●	6.7%
○	○	●	●	3.0%
●	●	●	●	2.8%
●	○	●	○	1.2%
○	●	●	●	0.7%
○	●	●	○	0.5%

Table C.3.2: Comparison results (%) from TEX Live 2020 to 2023

	TEX Live versions compared			
Comparison result /%	’20/’21	’21/’22	’22/’23	’20/’23
Identical PDFs	20.4	80.1	85.2	30.3
Different PDFs	69.4	19.2	13.9	68.1
Compile failure	1.2	0.7	0.9	1.6

D ROOT CAUSE ANALYSIS

D.1 Sampled Documents

In **RQ3**, we studied 26 documents:

- 7 compile failures (4 root causes)
- 6 reversions (3 root causes)
- 13 changes from TeX Live 2022 to TeX Live 2023 (3 root causes)

Table D.1.1: Root causes of compile failures

arXiv ID	Years with compilation failures	Triage	Root cause
2306.00003	2023	Reported bug	`jmlr` package
2306.05750	2020	Fixed bug	Adding a linebreak in footnotes
2306.03822	2020	Expected behaviour	Imported (`tabularray.sty`) which did not exist yet
2306.00275	2020	Expected behaviour	Imported (`tabularray.sty`) which did not exist yet
2306.00490	2020, 2021, 2022, 2023	Expected behaviour	Syntax error by author
2306.00055	2020, 2021, 2022, 2023	Expected behaviour	Syntax error by author
2306.00030	2020, 2021, 2022, 2023	Expected behaviour	Syntax error by author

Table D.1.2: Root causes of reversions

arXiv ID	Change introduced	Change reverted	Triage	Root cause
2306.00001	2021	2023	Fixed bug	`siunitx` package applied font styles inconsistently
2306.01403	2021	2023	Fixed bug	`revtex4-2` package did not detect the `eqnarray` environment
2306.03237	2021	2023	Fixed bug	`revtex4-2` package did not detect the `eqnarray` environment
2306.00365	2021	2023	Fixed bug	`revtex4-2` package did not detect the `eqnarray` environment
2306.00746	2022	2023	Fixed bug	Handling of newlines after the `\eqno` macro
2306.01235	2022	2023	Fixed bug	Handling of newlines after the `\eqno` macro

Table D.1.3: Root causes of changes only in TeX Live 2022 to 2023

arXiv ID	Inconsistency	Triage	Root cause
2306.00285	Vertical spacing	Fixed bug	Importing `hyperref` package changes line spacing
2306.00052	Importing `colortbl` changes horizontal spacing	Confirmed bug	Inconsistent behaviour in LaTeX `array` package
2306.00329	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00415	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.01017	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00372	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00060	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.01838	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00269	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00510	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00537	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.00469	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package
2306.01515	Spacing with alignment characters	Expected behaviour	Redefining tilde character in core LaTeX package

E COMPARISON METHODS

The full source code of our tool, including the implementation of all comparison methods, is available at https://zenodo.org/records/10778054, or https://github.com/[redacted]. The following is a summary of the tools used in performing comparisons:

- `diff-pdf` for pixel-wise comparisons of PDFs. Available at: https://github.com/vslavik/diff-pdf
- `PyMuPDF` for extracting text and fonts from PDFs. Available at: https://pypi.org/project/PyMuPDF/
- `opencv` for feature extraction. Available at: https://opencv.org/get-started/. Specifically, we used the:
  - Structural Similarity (SSIM) Index
  - Complex Wavelet Structural Similarity (CW-SSIM) Index
  - Scale-Invariant Feature Transform (SIFT) algorithm
  - Oriented FAST and Rotated BRIEF (ORB) algorithm