Global Illumination for Fun and Profit

Josiah S. Carberry, Ed Grimley, and Martha Stewart

Fig. 1: In the Clouds: Vancouver from Cypress Mountain. Note that the teaser may not be wider than the abstract block.

Abstract—Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. A free copy of this paper and all supplemental materials are available at https://OSF.IO/2NBSG.

Index Terms—Radiosity, global illumination, constant time

1 Introduction

This template is for papers of VGTC-sponsored conferences such as IEEE VIS, IEEE VR, and ISMAR which are published as special issues of TVCG. The template does not contain the respective dates of the conference/journal issue, these will be entered by IEEE as part of the publication production process. Therefore, **please leave the copyright statement at the bottom-left of this first page untouched**.

2 Author Details

Authors should specify ORCID IDs (see https://orcid.org/ to register) for author disambiguation and long-term contact preservation. Use `\authororcid{Author Name}{0000-0000-0000-0000}` for each author, replacing the "Author Name" and using the 16-digit (hyphenated) ORCID ID for the second parameter. The template shows an example without ORCID IDs for two of the authors. ORCID IDs should be provided in all cases.

Each author's affiliations have to be provided in the author footer on the bottom-left corner of the first page. It is permitted to merge two or more people from the same institution as long as they are shown in the same order as in the overall author sequence on the top of the first page. For example, if authors A, B, C, and D are from institutions 1, 2, 1, and 2, respectively, then it is ok to use 2 bullets as follows:

- A and C are with Institution 1. E-mail: {a | c}@i1.com .
- B and D are with Institution 2. E-mail: {b | d}@i2.org .

- *Josiah Carberry is with Brown University. E-mail: jcarberry@example.com*
- *Ed Grimley is with Grimley Widgets, Inc. E-mail: ed.grimley@example.com.*
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Manuscript received xx xxx. 201x; accepted xx xxx. 201x. Date of Publication xx xxx. 201x; date of current version xx xxx. 201x. For information on obtaining reprints of this article, please send e-mail to: reprints@ieee.org. Digital Object Identifier: xx.xxxx/TVCG.201x.xxxxxxx

3 Hyperlinks and Cross References

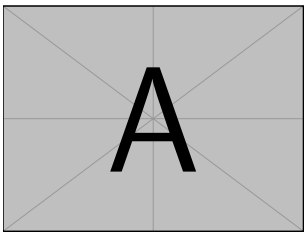
The style uses the `hyperref` package which can typeset clickable hyperlinks using `\href{...}{...}`, hyperlinked URLs using `\url{...}`, and turns references into internal links.

The style also uses `cleveref` to automatically and consistently format cross references. We recommend that you use the `\cref{label}` and `\Cref{label}` calls instead of `Figure~\ref{label}` or similar. `\Cref` should be used when starting a sentence to spell out the reference (e.g. "Section") while `\cref` should be used when referencing within a sentence to abbreviate (e.g. "Sec."). Here are examples for use within a sentence: Fig. 3, Tab. 1, Secs. 6 and 7, Eq. (1). The following sentences all start with a reference, so use `\Cref`. Figure 3 is a `figure` environment. Table 1 is a `table` environment. Sections 6 and 7 are `section` environments. Equation (1) is an `equation` environment.

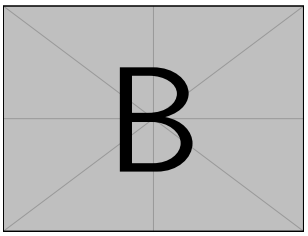
4 Figures

4.1 Loading figures

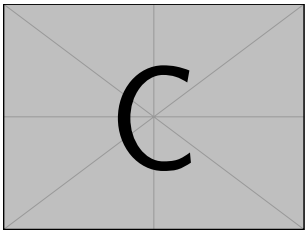
The style automatically looks for image files with the correct extension (eps for regular LaTeX; pdf, png, and jpg for pdfLaTeX), in a set of given subfolders defined above



(a) The letter A.



(b) The letter B.



(c) The letter C.

Fig. 2: Example of adding subfigures with the `subcaption` package.

using `\graphicspath`: figures/, pictures/, images/. It is thus sufficient to use `\includegraphics{CypressView}` (instead of `\includegraphics{pictures/CypressView.jpg}`). Figures should be in CMYK or Grey scale format, otherwise, colour shifting may occur during the printing process.

4.2 Vector figures

Vector graphics like svg, eps, pdf are best for charts and other figures with text or lines. They will look much nicer and crisper and any text in them will be more selectable, searchable, and accessible.

4.3 Raster figures

Of the raster graphics formats, screenshots of user interfaces and text, as well as line art, are better shown with png. jpg is better for photographs. Make sure all raster graphics are captured in high enough resolution so they look crisp and scale well.

4.4 Figures on the first page

The teaser figure should only have the width of the abstract as the template enforces it. The use of figures other than the optional teaser is not permitted on the first page. Other figures should begin on the second page. Papers submitted with figures other than the optional teaser on the first page will be refused.

4.5 Subfigures

You can add subfigures using the `subcaption` package that is automatically loaded. Inside a `figure` environment, create a `subfigure` environment. See Fig. 2 for an example. We can reference individual figures, either fully using `\cref` (Figs. 2a and 2b) or by letter using `\subref`. E.g., (b), (c). Note that `\subref` only works for one label at a time.

4.6 Figure Credits

In the Figure Credits section at the end of the paper, authors should credit the original sources of any figures that were reproduced or modified. Include any license details necessary, as well as links to the original materials whenever possible. For credits to figures from academic papers, include a citation that is listed in the **References** section. An example is provided below.

For IEEE VIS, this section is included in the **2-page allotment for References, Figure Credits, and Acknowledgments**.

Table 1: VIS/VisWeek accepted/presented papers: 1990–2016.

year	Vis/SciVis	SciVis conf	InfoVis	VAST	VAST conf	TVCG @ VIS	CG&A @ VIS	VIS/VisWeek incl. TVCG/CG&A	VIS/VisWeek w/o TVCG/CG&A
2016	30		37	33	15	23	10	148	115
2015	33	9	38	33	14	17	15	159	127
2014	34		45	33	21	20		153	133
2013	31		38	32		20		121	101
2012	42		44	30		23		139	116
2011	49		44	26		20		139	119
2010	48		35	26				109	109
2009	54		37	26				117	117
2008	50		28	21				99	99
2007	56		27	24				107	107
2006	63		24	26				113	113
2005	88		31					119	119
2004	70		27					97	97
2003	74		29					103	103
2002	78		23					101	101
2001	74		22					96	96
2000	73		20					93	93
1999	69		19					88	88
1998	72		18					90	90
1997	72		16					88	88
1996	65		12					77	77
1995	56		18					74	74
1994	53							53	53
1993	55							55	55
1992	53							53	53
1991	50							50	50
1990	53							53	53
sum	**1545**	**9**	**632**	**310**	**50**	**123**	**25**	**2694**	**2546**

5 Equations and Tables

Equations can be added like so:

$$\sum_{j=1}^{z} j = \frac{z(z+1)}{2} \tag{1}$$

Tables, such as Tab. 1 can also be included.

6 Supplemental Material Instructions

6.1 Long-term Open Science goals

Research should be accessible to everyone. Financial means and privileged access should not limit anyone's ability to participate in and learn from research. As such, research articles and their accompanying supplemental materials should be freely accessible to researchers from all backgrounds, discoverable, and uniquely and persistently identifiable in perpetuity.

Research should be transparent, reproducible, and trustworthy. Authors should be as transparent as possible about their research process. Increased transparency can help reviewers and readers judge for themselves whether the research conducted was plausible and whether the results are reliable. In particular, research should be:

- *Transparent*—enough description and supplemental material should be provided so that reviewers and readers can follow all important details of any processes or analyses.
- *Reproducible*—a reviewer or reader should, to the extent possible, be able to use the process, software, data, and operating conditions provided by the authors to obtain the same result

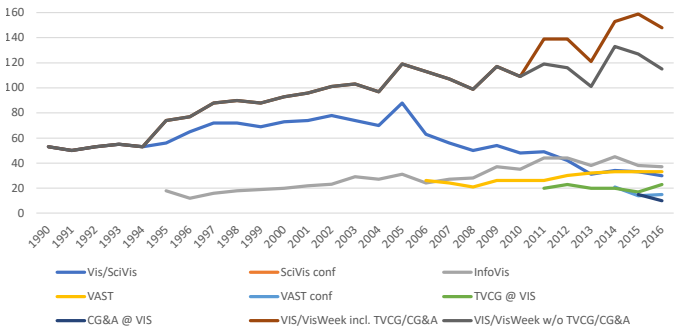


Fig. 3: A visualization of the 1990–2016 data from Tab. 1, recreated based on Fig. 1 from [1].

- *Trustworthy*—This combination of transparency and reproducibility will help readers to gain trust in the research process and results.

Research should be replicable and transferable. We believe that our community should support knowledge transfer between teams and that research results should stand up to scrutiny by future researchers. An independent team should be able to replicate or transfer the research results in other contexts, locations, domains, and in multiple trials. By making research more transparent and reproducible, we make it easier for future researchers to adopt and adapt the research methodologies to new situations as well as larger or otherwise more convincing studies.

6.2 Where to upload supplementary material

We recommend using `https://osf.io` as the primary repository for supplemental materials and that authors justify using an alternative repository. In some cases, `https://databrary.org` or `https://dataverse.org` may be more appropriate. We caution authors against using solely IEEE Xplore and IEEE Dataport, GitHub & GitLab, or institutional repositories / homepages / lab pages, but do encourage hosting multiple mirrors of material.

Using OSF, you can create anonymous view-only links for blind peer review. For example: `https://osf.io/2nbsg/?view_only=bb2c55b2d13e42e39172d27d443273f5`. This link was created following OSF's instructions. You can use a custom short hyperlink text for peer review, e.g., "see our supplemental material at osf.io (anonymous link)". However, ensure that you make the OSF project public and spell out the URL in text for the camera-ready publication.

6.3 What to include in the Supplemental Material section

In the Supplemental Materials section at the end of the paper, authors should try to be as descriptive and complete as possible about (1) what supplemental materials are available, (2) where they are hosted, and (3) justifications for why materials were omitted (if any). An example is provided below.

For IEEE VIS, this section is included in the **2-page allotment for References, Figure Credits, and Acknowledgments**.

7 References

An example of the reference formatting is provided in the **References** section at the end.

For IEEE VIS, the References section is included in the **2-page allotment for References, Figure Credits, and Acknowledgments**.

7.1 Include DOIs

All references which have a DOI should have it included in the bibTeX for the style to display. The DOI can be entered with or without the `https://doi.org/` prefix.

7.2 Narrow DOI option

The `-narrow` versions of the bibliography style use the font `PTSansNarrow-TLF` for typesetting the DOIs in a compact way. This font needs to be available on your LaTeX system. It is part of the `paratype` package, and many distributions (such as MikTeX) have it automatically installed. If you do not have this package yet and want to use a `-narrow` bibliography style then use your LaTeX system's package installer to add it. If this is not possible you can also revert to the respective bibliography styles without the `-narrow` in the file name. DVI-based processes to compile the template apparently cannot handle the different font so, by default, the template file uses the `abbrv-doi` bibliography style.

7.3 Disabling hyperlinks

To avoid adding hyperlinks to the references (the default) you can use `\bibliographystyle{abbrv-doi}` instead of `\bibliographystyle{abbrv-doi-hyperref}`. By default, the DOI field in a bibTeX entry is turned into a hyperlink.

See the examples in the bibTeX file and the bibliography at the end of this template.

7.4 Guidelines for bibTeX

- All bibliographic entries should be sorted alphabetically by the last name of the first author. This LaTeX/bibTeX template takes care of this sorting automatically.
- Merge multiple references into one; e. g., use [2, 4] (not [2] [4]). Within each set of multiple references, the references should be sorted in ascending order. This LaTeX/bibTeX template takes care of both the merging and the sorting automatically.
- Verify all data obtained from digital libraries, even ACM's DL and IEEE Xplore etc. are sometimes wrong or incomplete.
- Do not trust bibliographic data from other services such as Mendeley.com, Google Scholar, or similar; these are even more likely to be incorrect or incomplete.
- Articles in journal—items to include:
  - author names
  - title
  - journal name
  - year
  - volume
  - number
  - month of publication as variable name (i.e., {jan} for January, etc.; month ranges using {jan #{/}# feb} or {jan #{--}# feb})
- Use journal names in proper style: correct: "IEEE Transactions on Visualization and Computer Graphics", incorrect: "Visualization and Computer Graphics, IEEE Transactions on"
- Papers in proceedings—items to include:
  - author names
  - title
  - abbreviated proceedings name: e.g., "Proc.\ CONF_ACRONYNM" without the year; example: "Proc.\ CHI", "Proc.\ 3DUI", "Proc.\ Eurographics", "Proc.\ EuroVis"
  - year
  - publisher
  - town with country of publisher (the town can be abbreviated for well-known towns such as New York or Berlin)
- Article/paper title convention: refrain from using curly brackets, except for acronyms/proper names/words following dashes/question marks etc.; example:

  The paper "Marching Cubes: A High Resolution 3D Surface Construction Algorithm" should be entered as "{M}arching {C}ubes: A High Resolution {3D} Surface Construction

Algorithm" or "{M}arching {C}ubes: A high resolution {3D} surface construction algorithm". It will then be typeset as "Marching Cubes: A high resolution 3D surface construction algorithm"

- For all entries:
  - DOI can be entered in the DOI field as plain DOI number or as DOI url.
  - Provide full page ranges AA--BB
- When citing references, do not use the reference as a sentence object; e.g., wrong: "In [3] the authors describe ...", correct: "Lorensen and Cline [3] describe ..."

8 Appendices

Appendices can be specified using `\appendix`. For example, our Troubleshooting instructions in Appendix B.

Note, however, that appendices do count against the page limit and that reviewers are not required to review appendices in the supplemental material. Regardless, we suggest creating a complete version of the paper with all appendices that you then upload in your supplemental material and to arXiv, OSF, or another preprint server.

We provide the `\iflabelexists` macro to help you cross reference an appendix from the main text, but only if that label (i.e. the appendix) actually exists. For example, above we use

```
\iflabelexists{appendix:troubleshooting}
  {\cref{appendix:troubleshooting}}
  {the appendix of the full paper at
   \url{https://osf.io/XXXXX}}.
```

in order to cross-reference to the appendix with `\cref` if it exists, but if the appendix is commented out then we will simply create a hyperlinked URL to it.

9 Filler Text to Flush Out the Paper

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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Supplemental Materials

Refer to the instructions for this section (Sec. 6). Below is an example you can follow that includes the actual supplemental material for this template:

All supplemental materials are available on OSF at https://doi.org/10.17605/OSF.IO/2NBSG, released under a CC BY 4.0 license. In particular, they include (1) Excel files containing the data for and analyses for creating Tab. 1 and Fig. 3, (2) figure images in multiple formats, and (3) a full version of this paper with all appendices. Our other code is intellectual property of a corporation—Starbucks Research—and there is no feasible way to share it publicly.

Figure Credits

Refer to the instructions for this section (Sec. 4.6). Here are the actual figure credits for this template:

Figure 1 image credit: Scott Miller / Special to the Vancouver Sun, January 22, 2009, page A6.

Figure 3 is a partial recreation of Fig. 1 from [1], which is in the public domain.

Acknowledgments

For IEEE VIS, this section is included in the **2-page allotment for References, Figure Credits, and Acknowledgments**.

The authors wish to thank A, B, and C. This work was supported in part by a grant from XYZ (# 12345-67890).

References

[1] P. Isenberg, F. Heimerl, S. Koch, T. Isenberg, P. Xu, C. Stolper, M. Sedlmair, J. Chen, T. Möller, and J. Stasko. vispubdata.org: A Metadata Collection about IEEE Visualization (VIS) Publications. *IEEE Transactions on Visualization and Computer Graphics*, 23, 2017. doi: 10.1109/TVCG.2016.2615308 3, 4

[2] Kitware, Inc. *The Visualization Toolkit User's Guide*, January 2003. 3

[3] W. E. Lorensen and H. E. Cline. Marching cubes: A high resolution 3D surface construction algorithm. *SIGGRAPH Computer Graphics*, 21(4):163–169, Aug. 1987. doi: 10.1145/37402.37422 4

[4] N. Max. Optical models for direct volume rendering. *IEEE Transactions on Visualization and Computer Graphics*, 1(2):99–108, June 1995. doi: 10.1109/2945.468400 3

A About Appendices

Refer to Sec. 8 for instructions regarding appendices.

B Troubleshooting

B.1 ifpdf error

If you receive compilation errors along the lines of `Package ifpdf Error: Name clash, \ifpdf is already defined` then please add a new line `\let\ifpdf\relax` right after the `\documentclass[journal]{vgtc}` call. Note that your error is due to packages you use that define `\ifpdf` which is obsolete (the result is that `\ifpdf` is defined twice); these packages should be changed to use `ifpdf` package instead.

B.2 pdfendlink error

Occasionally (for some LaTeX distributions) this hyper-linked bibTeX style may lead to **compilation errors** (`pdfendlink ended up in different nesting level ...`) if a reference entry is broken across two pages (due to a bug in `hyperref`). In this case, make sure you have the latest version of the `hyperref` package (i.e. update your LaTeX installation/packages) or, alternatively, revert back to `\bibliographystyle{abbrv-doi}` (at the expense of removing hyperlinks from the bibliography) and try `\bibliographystyle{abbrv-doi-hyperref}` again after some more editing.