

# UseLATEX.cmake: L<sup>A</sup>T<sub>E</sub>X Document Building Made Easy

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## Contents

<b>1</b>	<b>Description</b>	<b>2</b>
<b>2</b>	<b>Download</b>	<b>2</b>
<b>3</b>	<b>Usage</b>	<b>2</b>
3.1	Using a Bibliography . . . . .	3
3.2	Incorporating Images . . . . .	3
3.3	Create a PDF by Default . . . . .	5
3.4	Building Multiple L <sup>A</sup> T <sub>E</sub> X Documents . . . . .	5
3.5	Making an Index . . . . .	6
3.6	Making a Glossary . . . . .	6
3.7	Multipart L <sup>A</sup> T <sub>E</sub> X Files . . . . .	6
3.8	Configuring L <sup>A</sup> T <sub>E</sub> X Files . . . . .	7
3.9	Identifying Dependent Files . . . . .	8
<b>4</b>	<b>Frequently Asked Questions</b>	<b>8</b>
4.1	How do I process L <sup>A</sup> T <sub>E</sub> X files on Windows? . . . . .	8
4.2	How do I process L <sup>A</sup> T <sub>E</sub> X files on Mac OS X? . . . . .	9
4.3	Why does UseLATEX.cmake have to copy my tex files? . . . . .	9
4.4	Why is convert failing on Windows? . . . . .	10
4.5	How do I automate plot generation with command line programs? . . . . .	11
4.6	Why does make stop after each image conversion? . . . . .	12
4.7	How do I resolve \write 18 errors with pstricks or pdftricks? . . . . .	13
<b>5</b>	<b>Acknowledgments</b>	<b>13</b>
<b>A</b>	<b>Sample CMakeLists.txt</b>	<b>14</b>

## 1 Description

Compiling  $\LaTeX$  files into readable documents is actually a very involved process. Although CMake comes with `FindLATEX.cmake`, it does nothing for you other than find the commands associated with  $\LaTeX$ . I like using CMake to build my  $\LaTeX$  documents, but creating targets to do it is actually a pain. Thus, I've compiled a bunch of macros that help me create targets in CMake into a file I call "UseLATEX.cmake." Here are some of the things UseLATEX.cmake handles:

- Runs  $\LaTeX$  multiple times to resolve links.
- Can run `bibtex`, `makeindex`, and `makeglossaries` to make bibliographies, indexes, and/or glossaries.
- Optionally runs `configure` on your  $\LaTeX$  files to replace `@VARIABLE@` with the equivalent CMake variable.
- Automatically finds `png`, `jpeg`, `eps`, and `pdf` files and converts them to formats `latex` and `pdflatex` understand.

## 2 Download

UseLATEX.cmake is currently posted to the CMake Wiki at

<http://public.kitware.com/Wiki/CMakeUserUseLATEX>.

## 3 Usage

Using UseLATEX.cmake is easy. For a basic  $\LaTeX$  file, simply include the file in your `CMakeLists.txt` and use the `ADD_LATEX_DOCUMENT` command to make targets to build your document. For an example document in the file `MyDoc.tex`, you could establish a build with the following simple `CMakeLists.txt`.

```
PROJECT(MyDoc NONE)

INCLUDE(UseLATEX.cmake)
ADD_LATEX_DOCUMENT(MyDoc.tex)
```

The `ADD_LATEX_DOCUMENT` adds the following targets to create a readable document from `MyDoc.tex`:

**dvi** Creates `MyDoc.dvi`.

**pdf** Creates `MyDoc.pdf` using `pdflatex`. Requires the `PDFLATEX_COMPILER` CMake variable to be set.

**ps** Creates `MyDoc.ps`. Requires the `DVIPS_CONVERTER` CMake variable to be set.

**safepdf** Creates `MyDoc.pdf` from `MyDoc.ps` using `ps2pdf`. Many publishers prefer pdfs are created this way. Requires the `PS2PDF_CONVERTER` CMake variable to be set.

**html** Creates html pages. Requires the `LATEX2HTML_CONVERTER` CMake variable to be set.

One caveat about using `UseLATEX.cmake` is that you are required to do an out-of-source build. That is, CMake must be run in a directory other than the source directory. This is necessary as latex is very picky about file locations, and the relative locations of some generated or copied files can only be maintained if everything is copied to a separate directory structure. For more details and hints on workarounds, see the “Why does `UseLATEX.cmake` have to copy my tex files?” frequently asked question.

### 3.1 Using a Bibliography

For any technical document, you will probably want to maintain a `BIBTEX` database of papers you are referencing in the paper. You can incorporate your `.bib` files by adding them after the `BIBFILES` argument to the `ADD_LATEX_DOCUMENT` command.

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib)
```

This will automatically add targets to build your bib file and link it into your document. To use the `BIBTEX` file in your `LATEX` file, just do as you normally would with `\cite` commands and bibliography commands:

```
\bibliographystyle{plain}  
\bibliography{MyDoc}
```

You can list as many bibliography files as you like.

### 3.2 Incorporating Images

To be honest, incorporating images into `LATEX` documents can be a real pain. This is mostly because the format of the images needs to depend on the version of `LATEX` you are running (`latex` vs. `pdflatex`). With these CMake macros, you only need to convert your raster graphics to `png` or `jpeg` format and your vector graphics to `eps` or `pdf` format. Place them all in a common directory (e.g. `images`) and then use the `IMAGE_DIRS` option to the `ADD_LATEX_DOCUMENT` macro to point to them. `UseLATEX.cmake` will take care of the rest.

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                    IMAGE_DIRS images)
```

If you want to break up your image files in several different directories, you can do that, too. Simply provide multiple directories after the `IMAGE_DIRS` command.

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                    IMAGE_DIRS icons figures)
```

Alternatively, you could list all of your image files separately with the `IMAGES` option.

```
SET(MyDocImages
    logo.eps
    icons/next.png
    icons/previous.png
    figures/flowchart.eps
    figures/team.jpeg
)
ADD_LATEX_DOCUMENT(MyDoc.tex IMAGES ${MyDocImages})
```

Both the `IMAGE_DIRS` and `IMAGES` can be used together. The combined set of image files will be processed. If you wish to provide a separate eps file and pdf or png file, that is OK, too. `UseLATEX.cmake` will handle that by copying over the correct file instead of converting.

Once you establish the images directory, `CMake` will automatically find all files with known image extensions (currently eps, pdf, png, jpeg, and jpg) in it and add makefile targets to use `ImageMagick`'s `convert` to convert the file times to those appropriate for the build. If you do not have `ImageMagick`, you can get it for free from <http://www.imagemagick.org>. `CMake` will also give you a `LATEX_SMALL_IMAGES` option that, when on, will downsample raster images. This can help speed up building and viewing documents. It will also make the output image sizes smaller.

Depending on what program is launched to build your  $\LaTeX$  file (either `latex` or `pdflatex`, and `UseLATEX.cmake` supports both), a particular format for your image is required. As stated, `UseLATEX.cmake` handles the necessary conversions for you. However, you will not know in advance what file extension is used on the image. That is no problem. Simply leave out the file extension in the file name argument to `\includegraphics` and  $\LaTeX$  will find the file with the appropriate extension for you.

Note that in order to ensure that the resulting image files are placed in the appropriate directory, you are required to give *relative* paths for images

and image directories. For example, `IMAGE_DIRS ${CMAKE_CURRENT_SOURCE_DIR}/images` will fail. Use `IMAGE_DIRS images` instead.

### 3.3 Create a PDF by Default

By default, when you use `ADD_LATEX_DOCUMENT` and then run `make` with no arguments, the `dvi` file will be created. You have to specifically build the `pdf` target to use `pdflatex` to create a `pdf` file. However, oftentimes we want the `pdf` to be generated by default. To do that, simply use the `DEFAULT_PDF` option to `ADD_LATEX_DOCUMENT`:

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                   IMAGE_DIRS images
                   DEFAULT_PDF)
```

If you still want to use the `latex` program to compile your documents but by default want to create `pdf` files (that is, build the `safepdf` target by default), then use the `DEFAULT_SAFEPDF` option to `ADD_LATEX_DOCUMENT`:

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                   IMAGE_DIRS images
                   DEFAULT_SAFEPDF)
```

### 3.4 Building Multiple $\LaTeX$ Documents

The most common use for `UseLATEX.cmake` is to build a single document, such as a paper you are working on. However, some use cases involve building several documents at one time. To do this, you must call `ADD_LATEX_DOCUMENT` multiple times. However, if you do this, the `dvi`, `pdf`, etc. targets will be generated multiple times, and that is illegal in the current version of `CMake`.<sup>1</sup> To get around this, you need to mangle the names of the targets that `ADD_LATEX_DOCUMENT` creates. To do this, use the `MANGLE_TARGET_NAMES` option.

```
ADD_LATEX_DOCUMENT(MyDoc1.tex MANGLE_TARGET_NAMES)
ADD_LATEX_DOCUMENT(MyDoc2.tex MANGLE_TARGET_NAMES)
```

In the example above, the first call to `ADD_LATEX_DOCUMENT` will create targets named `MyDoc1.dvi`, `MyDoc1.pdf`, `MyDoc1.ps`, etc. whereas the second call will create targets named `MyDoc2.*`.

If you still want the simple, short targets to build all of the documents, you can add them yourself with custom targets that depend on the targets created by `ADD_LATEX_DOCUMENT`

---

<sup>1</sup>`CMake` version 2.4 as of this writing.

```
ADD_CUSTOM_TARGET(dvi)
ADD_DEPENDENCIES(MyDoc1_dvi MyDoc2_dvi)
ADD_CUSTOM_TARGET(pdf)
ADD_DEPENDENCIES(MyDoc1_pdf MyDoc2_pdf)
ADD_CUSTOM_TARGET(ps)
ADD_DEPENDENCIES(MyDoc1_ps MyDoc2_ps)
```

### 3.5 Making an Index

You can make an index in a  $\LaTeX$  document by using the `makeidx` package. However, this package requires you to run the `makeindex` command. Simply add the `USE_INDEX` option anywhere in the `ADD_LATEX_DOCUMENT` arguments, and `makeindex` will automatically be added to the build.

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                   IMAGE_DIRS images
                   USE_INDEX)
```

### 3.6 Making a Glossary

There are multiple ways to make a glossary in a  $\LaTeX$  document, but the `glossaries` package provides one of the most convenient ways of doing so. Like the `makeidx` package, `glossaries` requires running `makeindex` for building auxiliary files. However, building the glossary files can be more complicated as there can be different sets of glossary files with different extensions. `UseLATEX.cmake` will handle that for you. Simply add the `USE_GLOSSARY` option anywhere in the `ADD_LATEX_DOCUMENT` arguments, and the glossary creating will be handled for you.

```
ADD_LATEX_DOCUMENT(MyDoc.tex BIBFILES MyDoc.bib
                   IMAGE_DIRS images
                   USE_GLOSSARY)
```

### 3.7 Multipart $\LaTeX$ Files

Often, it is convenient to split a  $\LaTeX$  document into multiple files and use the  $\LaTeX$  `\input` or `\include` command to put them back together. To do this, all the files have to be located together. `UseLATEX.cmake` can take care of that, too. Simply add the `INPUTS` argument to `ADD_LATEX_DOCUMENT` to copy these files along with the target tex file. Build dependencies to these files is also established.

```

ADD_LATEX_DOCUMENT(MyDoc.tex
  INPUTS Chapter1.tex Chapter2.tex Chapter3.tex Chapter4.tex
  BIBFILES MyDoc.bib
  IMAGE_DIRS images
  USE_INDEX
)

```

As far as UseLATEX.cmake is concerned, input files do not necessarily have to be tex files. For example, you might be including the contents of a text file into your document with the `\VerbatimInput` command of the `fancyvrb` package. In fact, you could also add graphic files as inputs, but you would not get the extra conversion features described in Section 3.2.

### 3.8 Configuring L<sup>A</sup>T<sub>E</sub>X Files

Sometimes it is convenient to control the build options of your tex file with CMake variables. You can achieve this by using the `CONFIGURE` argument to `ADD_LATEX_DOCUMENT`.

```

ADD_LATEX_DOCUMENT(MyDoc.tex
  INPUTS Chapter1.tex Chapter2.tex Chapter3.tex Chapter4.tex
  CONFIGURE MyDoc.tex
  BIBFILES MyDoc.bib
  IMAGE_DIRS images
  USE_INDEX
)

```

In the above example, in addition to copying `MyDoc.tex` to the binary directory, `UseLATEX.cmake` will configure `MyDoc.tex`. That is, it will find all occurrences of `@VARIABLE@` and replace that string with the current CMake variable `VARIABLE`.

With the `CONFIGURE` argument you can list the target tex file (as shown above) as well as any other tex file listed in the `INPUTS` argument.

```

ADD_LATEX_DOCUMENT(MyDoc.tex
  INPUTS Ch1Config.tex Ch1.tex Ch2Config.tex
        Ch2.tex Ch3Config Ch3.tex
  CONFIGURE Ch1Config.tex Ch2Config.tex Ch3Config.tex
  BIBFILES MyDoc.bib
  IMAGE_DIRS images
  USE_INDEX
)

```

Be careful when using the `CONFIGURE` option. Unfortunately, the `@` symbol is used by  $\LaTeX$  in some places. For example, when establishing a tabular environment, an `@` is used to define the space between columns. If you use it more than once, then `UseLATEX.cmake` will erroneously replace part of the definition of your columns for a macro (which is probably an empty string). This can be particularly troublesome to debug as  $\LaTeX$  will give an error in a place that, in the original document, is legal. Hence, it is best to only configure tex files that contain very little text of the actual document and instead are mostly setup and options.

### 3.9 Identifying Dependent Files

In some circumstances, CMake's configure mechanism is not sufficient for creating input files. Input  $\LaTeX$  files might be auto-generated by any number of other mechanisms.

If this is the case, simply add the appropriate CMake commands to generate the input files, and then add that file to the `DEPENDS` option of `ADD_LATEX_DOCUMENT`. To help you build the CMake commands to place the generated files in the correct place, you can use the `LATEX_GET_OUTPUT_PATH` convenience function to get the output path.

```
LATEX_GET_OUTPUT_PATH(output_dir)

ADD_CUSTOM_COMMAND(OUTPUT ${output_dir}/generated_file.tex
  COMMAND tex_file_generate_exe
  ARGS ${output_dir}/generated_file.tex
  )

ADD_LATEX_DOCUMENT(MyDoc.tex DEPENDS generated_file.tex)
```

## 4 Frequently Asked Questions

This section includes resolutions to common questions and issues concerning use of `UseLATEX.cmake` and with  $\LaTeX$  in general.

### 4.1 How do I process $\LaTeX$ files on Windows?

I have successfully used two different ports of LaTeX for windows: the cygwin port (<http://www.cygwin.com/>) and the MikTeX port (<http://www.miktex.org/>).

If you use the cygwin port of  $\LaTeX$ , you must also use the cygwin port of CMake, make, and ImageMagick. If you use the MikTeX port of  $\LaTeX$ , you must use the CMake from <http://www.cmake.org/HTML/Download.html>, the ImageMagick port from <http://www.imagemagick.org/script/index.php>,



and a native build tool like MSVC or the GNU make port at <http://unxutils.sourceforge.net/>. *Do not use the “native” CMake program with any cygwin programs or the cygwin CMake program with any non-cygwin programs.* This issue at hand is that the cygwin ports create and treat filenames differently than other windows programs.<sup>2</sup>

Also be aware that if you have images in your document, there are numerous problems that can occur on Windows with the ImageMagick convert program. See Section 4.4 for more information.

## 4.2 How do I process $\LaTeX$ files on Mac OS X?

Using  $\LaTeX$  on Mac OS X is fairly straightforward because this OS is built on top of Unix. By using the Terminal program or X11 host, you can run  $\LaTeX$  much like any other Unix variant. The only real issue is that  $\LaTeX$  and some of the supporting programs like CMake and ImageMagick are not typically installed (whereas on Linux they often are).

Most applications port fairly easily to Mac OS so long as you are willing to use them as typical Unix or X11 programs. To make things even easier, I recommend taking advantage of a Mac porting project to make this process even easier. MacPorts (<http://www.macports.org>) is a good tool providing a comprehensive set of tool ports including  $\LaTeX$ , CMake, and ImageMagick. The fink project and FinkCommander (<http://finkcommander.sourceforge.net/>) is a similar although less active project.

## 4.3 Why does UseLATEX.cmake have to copy my tex files?

UseLATEX.cmake cannot process your tex file without copying it. As explained in Section 3,  $\LaTeX$  is very picky about file locations. The relative locations of files that your input files point to, and all but the most simple  $\LaTeX$  files point to other files, must remain consistent.

UseLATEX.cmake will often have to modify at least one file either through configurations or image format and size conversions. When creating new files, UseLATEX.cmake will have to copy either all of the files or none of the files. Since configuring and writing over an original file is unacceptable, UseLATEX.cmake forces you to configure it such that  $\LaTeX$  builds in a different directory than where you have placed the original. If you do not specify a separate directory, you get an error like the following.

```
CMake Error at UseLATEX.cmake:377 (MESSAGE):
  LaTeX files must be built out of source or you must set
  LATEX_OUTPUT_PATH.
```

---

<sup>2</sup>If you are careful, you can use the cygwin version of make with the windows ports of CMake,  $\LaTeX$ , and ImageMagick. It is an easy way around the problems described in Section 4.4.

The best way around this problem is to do an “out of source” build, which is really the preferred method of using CMake in general. To do an out of source build, create a new build directory, go to that directory, and run `cmake` from there, pointing to the source directory.

If for some reason an out of source build is not feasible or desirable, you can set the `LATEX_OUTPUT_PATH` variable to a directory other than `.` (the local directory). If you are building a `LATEX` document in the context of a larger project for which you wish to support in source builds, consider pragmatically setting the `LATEX_OUTPUT_PATH` CMake cache variable from within your `CMakeLists.txt`.

#### 4.4 Why is convert failing on Windows?

Assuming that you have correctly downloaded and installed an appropriate version of ImageMagick (as specified in Section 4.1), there are several other problems that users can run into the created build files attempt to run the `convert` program.

A common error seen is

```
Invalid Parameter - filename
```

This is probably because CMake has found the wrong `convert` program. Windows is installed with a program named `convert` in `%SYSTEMROOT%\system32`. This `convert` program is used to change the filesystem type on a hard drive. Since the windows `convert` is in a system binary directory, it is usually found in the path before the installed ImageMagick `convert` program. (Don’t get me started about the logic behind this.) Make sure that the `IMAGEMAGICK_CONVERT` CMake variable is pointing to the correct `convert` program.

Another common error is that `convert` not finding a file that is clearly there.

```
convert: unable to open image 'filename'
```

If you notice that the drive letter is stripped off of the filename (i.e. `C:`), then you are probably mixing the Cygwin version of `convert` with the non-cygwin CMake. The cygwin version of `convert` uses the colon (`:`), as a directory separator for inputs. Thus, it assumes the output file name is really two input files separated by the colon. Switch to the non-cygwin port of ImageMagick to fix this.

If you are using `nmake`, you may also see the following error:

```
convert.exe: unable to open image 'C:': Permission denied.
```

I don’t know what causes this error, but it appears to have something to do with some strange behavior of `nmake` when quoting the `convert` executable. The easiest solution is to use a different build program (such as `make` or MSVC’s IDE or a unix port of `make`). If anyone finds away around this problem, please contribute back.

## 4.5 How do I automate plot generation with command line programs?

L<sup>A</sup>T<sub>E</sub>X is often used in conjunction with plotting programs that run on the command line like `gri` or `gnuplot`. Although there is no direct support for these programs in `UseLATEX.cmake`, it is straightforward to use these programs.

One way to use a plotting program is simply to run it yourself to generate the plot and then incorporate the image file into your L<sup>A</sup>T<sub>E</sub>X document as you would any other image file (see Section 3.2). This the easiest way to incorporate these plots since it does not require additional CMake code. It also ensures consistency of how the plot looks (often the plots will look different if created on different platforms), and it provides the opportunity to edit the image to make it look better for publication.

Another way to use these plotting programs is to automatically run them when building the L<sup>A</sup>T<sub>E</sub>X document. This is convenient if you frequently change the data you are plotting or if you are creating many plots. To automate running the plotting program build one or more targets to generate these files and then add these targets as L<sup>A</sup>T<sub>E</sub>X dependencies (see Section 3.9 for information on adding dependencies). Here is an example of creating the targets for converting a directory of `gri` files and incorporating the resulting files in a L<sup>A</sup>T<sub>E</sub>X document.

```
# Set GRI executable
SET(GRI_COMPILE "/usr/bin/gri")
# Set the location of data files
SET(DATA_DIR data)
# Set the location of the directory for image files
SET(IMAGE_DIR graphics)

# Get a list of gri files
FILE(GLOB_RECURSE GRI_FILES "*.gri")

FOREACH(file ${GRI_FILES})
  GET_FILENAME_COMPONENT(basename "${file}" NAME_WE)
  # Replace stings in gri file so data files can be found
  FILE(READ
    ${CMAKE_CURRENT_SOURCE_DIR}/${IMAGE_DIR}/${basename}.gri
    file_contents
  )
  STRING(REPLACE "${DATA_DIR}" "${IMAGE_DIR}/${DATA_DIR}"
    changed_file_contents ${file_contents}
  )
  FILE(WRITE
    ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.gri
    ${changed_file_contents}
  )

```

```

# Command to run gri
IF(GRI_COMPILE)
  ADD_CUSTOM_COMMAND(
    OUTPUT
      ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.eps
    DEPENDS
      ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.gri
      ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${DATA_DIR}
    COMMAND
      ${GRI_COMPILE}
    ARGS
      -output
      ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.eps
      ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.gri
  )
ENDIF(GRI_COMPILE)
# Make a list of all gri files (for ADD_LATEX_DOCUMENT depend)
SET(ALL_GRI_FILES
  ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${basename}.eps
)
ENDFOREACH(file)

# Copy over all data files needed to generate gri graphs
ADD_CUSTOM_COMMAND(
  OUTPUT  ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${DATA_DIR}
  DEPENDS ${CMAKE_CURRENT_SOURCE_DIR}/${IMAGE_DIR}/${DATA_DIR}
  COMMAND ${CMAKE_COMMAND} -E copy_directory
          ${CMAKE_CURRENT_SOURCE_DIR}/${IMAGE_DIR}/${DATA_DIR}
          ${CMAKE_CURRENT_BINARY_DIR}/${IMAGE_DIR}/${DATA_DIR}
)

ADD_LATEX_DOCUMENT(MyDoc.tex
  IMAGE_DIRS ${IMAGE_DIR}
  DEPENDS ${ALL_GRI_FILES}
)

```

## 4.6 Why does make stop after each image conversion?

There is a bug in the ImageMagick convert version 6.1.8 that inappropriately returns a failure condition even when the image convert was successful. The problem might also occur in other ImageMagick versions. Try updating your installation of ImageMagick.

## 4.7 How do I resolve `\write 18` errors with `pstricks` or `pdftricks`?

A `\write18` command is  $\text{\LaTeX}$ 's obtuse syntax for running a command on your system. Commands in the `pstricks` and `pdftricks` packages may need to run commands on your system to, for example, convert graphics from one format to another.

Unfortunately, allowing  $\text{\LaTeX}$  to run commands on your system can be considered a security issue. Some versions of  $\text{\LaTeX}$  such as  $\text{\MikTeX}$  disable the feature by default. Thus, in order to use packages that rely on `\write18`, you may have to enable the feature, typically with a command line option. For  $\text{\MikTeX}$ , this command line option is `--enable-write18`.

You can instruct `UseLATEX.cmake` to pass any flag to  $\text{\LaTeX}$  by adding it to the `LATEX_COMPILER_FLAGS` CMake variable. One way to do this is through the CMake GUI. Simply go to the advanced variables, find `LATEX_COMPILER_FLAGS`, and add `--enable-write18` (or equivalent flag) to the list of arguments.

You can also automatically add this flag by setting the flag in your `CMakeLists.txt` file. For example:

```
SET(LATEX_COMPILER_FLAGS
  "-interaction=nonstopmode --enable-write18"
  CACHE STRING "Flags passed to latex."
)
INCLUDE(UseLATEX.cmake)
```

The disadvantage of this latter approach is the reduction of portability. This addition could cause a failure for any  $\text{\LaTeX}$  implementation that does not support the `--enable-write18` flag (for which there are many).

## 5 Acknowledgments

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## A Sample `CMakeLists.txt`

Following is a sample listing of `CMakeLists.txt`. In fact, it is the `CMakeLists.txt` that is used to build this document.

```
PROJECT(UseLATEX_DOC NONE)

CMAKE_MINIMUM_REQUIRED(VERSION 2.4)

INCLUDE(UseLATEX.cmake)

# Note that normally CMakeLists.txt would not be considered an
# input to the document, but in this special case of documenting
# UseLATEX.cmake the contents of this file is actually included
# in the document.
ADD_LATEX_DOCUMENT(UseLATEX.tex
  INPUTS CMakeLists.txt
)
```