

Mali™ Texture Compression Tool

Version: 3.0

User Guide



Mali Texture Compression Tool

User Guide

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Release Information

The following changes have been made to this book.

			Change history
Date	Issue	Confidentiality	Change
14 October 2009	A	Non-Confidential	First release for v2.1
28 October 2011	B	Non-Confidential	Updated for v3.0

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Preface

This preface introduces the *Mali Texture Compression Tool*. It contains the following sections:

- *About this book* on page v
- *Feedback* on page vii.

About this book

This is the *Mali Texture Compression Tool User Guide*. It provides guidelines for using the Mali Texture Compression Tool to assist in the development of applications for Mali *Graphics Processing Units* (GPU). This book is part of a suite belonging to the Mali Developer Tools.

Intended audience

This guide is written for software developers who are writing OpenGL ES or OpenVG applications for a Mali GPU.

Using this book

This book is organized into the following chapters:

Chapter 1 *Introduction*

Read this for an introduction to the Mali Texture Compression Tool and supported formats.

Chapter 2 *Installing the Mali Texture Compression Tool*

Read this chapter for information about how to install the Texture Compression Tool.

Chapter 3 *Using the Mali Texture Compression Tool*

Read this chapter for information about how to compress images so that they can be used more efficiently on Mali GPUs. The Mali Texture Compression Tool is intended to be used by developers of 2D and 3D content.

Glossary

The *ARM Glossary* is a list of terms used in ARM documentation, together with definitions for those terms. The *ARM Glossary* does not contain terms that are industry standard unless the ARM meaning differs from the generally accepted meaning.

The *ARM Glossary* is available on the ARM Infocenter at, <http://infocenter.arm.com/help/topic/com.arm.doc.aeg0014-/index.html>.

Typographical Conventions

The typographical conventions are:

<i>italic</i>	Highlights important notes, introduces special terminology, denotes internal cross-references, and citations.
bold	Highlights interface elements, such as menu names. Denotes signal names. Also used for terms in descriptive lists, where appropriate.
monospace	Denotes text that you can enter at the keyboard, such as commands, file and program names, and source code.
<u>monospace</u>	Denotes a permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.
<i>monospace italic</i>	Denotes arguments to monospace text where the argument is to be replaced by a specific value.
monospace bold	Denotes language keywords when used outside example code.

< **and** > Enclose replaceable terms for assembler syntax where they appear in code or code fragments. For example:
 MRC p15, 0 <Rd>, <CRn>, <CRm>, <Opcode_2>

Additional reading

This section lists publications by ARM and by third parties.

See Infocenter, <http://infocenter.arm.com>, for access to ARM documentation.

ARM publications

This guide contains information that is specific to the Mali Developer Tools. See the following documents for other relevant information:

- *Mali GPU Performance Analysis Tool User Guide* (ARM DUI 0502)
- *Mali GPU Shader Developer Studio User Guide* (ARM DUI 0504)
- *OpenGL ES Emulator User Guide* (ARM DUI 0511)
- *Mali GPU User Interface Engine User Guide* (ARM DUI 0505)
- *Mali GPU Mali Binary Asset Exporter User Guide* (ARM DUI 0507)
- *Mali OpenGL ES 2.0 Software Development Kit for Linux on ARM* (ARM DUI 0607)
- *Mali OpenGL ES 2.0 Software Development Kit for Android* (ARM DUI 0587)
- *Mali GPU Shader Library User Guide* (ARM DUI 0510)
- *Mali GPU Offline Shader Compiler User Guide* (ARM DUI 0513).

Other publications

This section lists relevant documents published by third parties:

- *OpenGL ES 1.1 Specification* at <http://www.khronos.org>.
- *OpenGL ES 2.0 Specification* at <http://www.khronos.org>.
- *OpenGL ES Shading Language Specification* at <http://www.khronos.org>.
- *OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 2* (5th Edition, 2005), Addison-Wesley Professional. ISBN 0-321-33573-2.
- *KTX File Format Specification* at <http://www.khronos.org>.
- *OpenGL Shading Language* (2nd Edition, 2006), Addison-Wesley Professional. ISBN 0-321-33489-2.

Feedback

ARM welcomes feedback on this product and its documentation.

Feedback on this product

If you have any comments or suggestions about this product, contact your supplier and give:

- The product name.
- The product revision or version.
- An explanation with as much information as you can provide. Include symptoms and diagnostic procedures if appropriate.

Feedback on content

If you have comments on content then send an e-mail to errata@arm.com. Give:

- the title
- the number, DUI 0503B
- the page numbers to which your comments apply
- a concise explanation of your comments.

ARM also welcomes general suggestions for additions and improvements.

Chapter 1

Introduction

This chapter describes the Mali Texture Compression Tool. It contains the following section:

- [About the Mali Texture Compression Tool](#) on page 1-2.

1.1 About the Mali Texture Compression Tool

This section gives an overview of the Mali Texture Compression Tool.

Texture compression enables you to reduce the bandwidth usage required to load textures in graphics applications.

This can give your application superior performance and reduce the power consumption of your platform.

Your graphics application that is running on your platform, reads and displays the compressed texture data produced by the Texture Compression Tool.

You can compress individual textures or multiple textures. You can view the original texture and the compressed texture together for comparison

The Texture Compression Tool is compatible with Windows XP and Linux, See [Chapter 2 Installing the Mali Texture Compression Tool](#).

The Texture Compression Tool can read and convert many common graphic formats including bmp, jpg, and png. See the documentation supplied with the ImageMagick tool for a full list.

The Texture Compression Tool compresses textures using the *Ericsson Texture Compression* (ETC) algorithm. ETC is a 4bpp texture compression algorithm. ETC is the Khronos recommended texture compression algorithm.

The Texture Compression Tool can be used from a *Graphical User Interface* (GUI) or from a command line.

Chapter 2

Installing the Mali Texture Compression Tool

This section describes how to install the Mali Texture Compression Tool. It contains the following sections.

- [Installing the Mali Texture Compression Tool on Microsoft Windows on page 2-2](#)
- [Installing the Mali Texture Compression Tool on Linux on page 2-3.](#)

2.1 Installing the Mali Texture Compression Tool on Microsoft Windows

This section describes how to install the Texture Compression Tool on Microsoft Windows. It contains the following sections:

- [Installation requirements](#)
- [Installing the Mali Texture Compression Tool on Microsoft Windows.](#)

2.1.1 Installation requirements

To install the Texture Compression Tool on Microsoft Windows, you require:

- Microsoft Windows XP, service pack2
- 50 MB free hard disk space.

———— **Note** —————

The Texture Compression Tool has been tested successfully on a 32-bit computer.

2.1.2 Installing the Mali Texture Compression Tool on Microsoft Windows

To install the Texture Compression Tool on Microsoft Windows:

1. Go to the Mali Developer Center web site at:
<http://www.malideveloper.com>
2. Download the Mali Texture Compression Tool package.
3. Run the file `Mali_Texture_Compression_Tool_m_n_o_p_Win32.msi`.
where:
m identifies the major version
n.o.p identifies the minor version.
4. Select the required installation options and then click **Finish** to complete the installation.

By default, the Texture Compression Tool is installed in:

`C:\Program Files\ARM\Mali Developer Tools\Mali Texture Compression Tool vm.n.o`

The Texture Compression Tool examples are installed in:

`C:\Program Files\ARM\Mali Developer Tools\Mali Texture Compression Tool vm.n.o\examples`

2.2 Installing the Mali Texture Compression Tool on Linux

This section describes how to install the Texture Compression Tool on Linux. It contains the following sections:

- [Installation requirements](#)
- [Procedure for installing the Texture Compression Tool on Linux.](#)

2.2.1 Installation requirements

To install the Texture Compression Tool on Linux, you require:

- Ubuntu Linux version 10.4
- 50 MB free hard disk space.

———— **Note** —————

The Texture Compression Tool has been tested successfully on a 32-bit computer.

2.2.2 Procedure for installing the Texture Compression Tool on Linux

To install the Texture Compression Tool on Linux:

1. Locate the Mali Developer Center web site at:
<http://www.malideveloper.com>
2. Download the following package:
`Mali_Texture_Compression_Tool_m_n_o_p_Linux.tar.gz`
where:
m identifies the major version
n.o.p identifies the minor version.
3. To decompress the file:
 - open a command terminal and navigate to the directory where you have downloaded the package
 - type the following command:
`tar -zxvf Mali_Texture_Compression_Tool_m_n_o_p_Linux.msi.tar.gz`

By default, the Texture Compression Tool is installed in:

`Mali_Texture_Compression_Tool_m.n.o`

The Texture Compression Tool examples are installed in:

`Mali_Texture_Compression_Tool_m.n.o/examples/`

Chapter 3

Using the Mali Texture Compression Tool

This chapter describes how to use the Mali Texture Compression Tool. It contains the following sections:

- *Using the Mali Texture Compression Tool Graphical User Interface on page 3-2*
- *Using the Mali Texture Compression Tool from the command line on page 3-10.*

3.1 Using the Mali Texture Compression Tool Graphical User Interface

This section describes how to use the Texture Compression Tool from the provided GUI. It contains the following sections:

- [Starting the GUI Version of the Texture Compression Tool](#)
- [The Texture Compression Tool main window](#)
- [Compressing textures on page 3-4](#)
- [Using the Preferences dialog on page 3-8.](#)

3.1.1 Starting the GUI Version of the Texture Compression Tool

This section describes the basic operation of the Texture Compression Tool. It contains the following sections:

- [Starting the Texture Compression Tool from Microsoft Windows](#)
- [Starting the Texture Compression Tool from Linux.](#)

Starting the Texture Compression Tool from Microsoft Windows

To start the Texture Compression Tool from Microsoft Windows, select:

Start → **All Programs** → **ARM** → **Mali Developer Tools** → **Mali Texture Compression Tool**

Starting the Texture Compression Tool from Linux

To start the Texture Compression Tool from Linux:

1. Open a command terminal
2. Navigate to:
`Mali_Texture_Compression_Tool_m.n.o`
 where:
m identifies the major version
n identifies the minor version.
3. Type the following command to run the executable:
`./tct`

3.1.2 The Texture Compression Tool main window

[Figure 3-1 on page 3-3](#) shows the Texture Compression Tool with textures loaded.

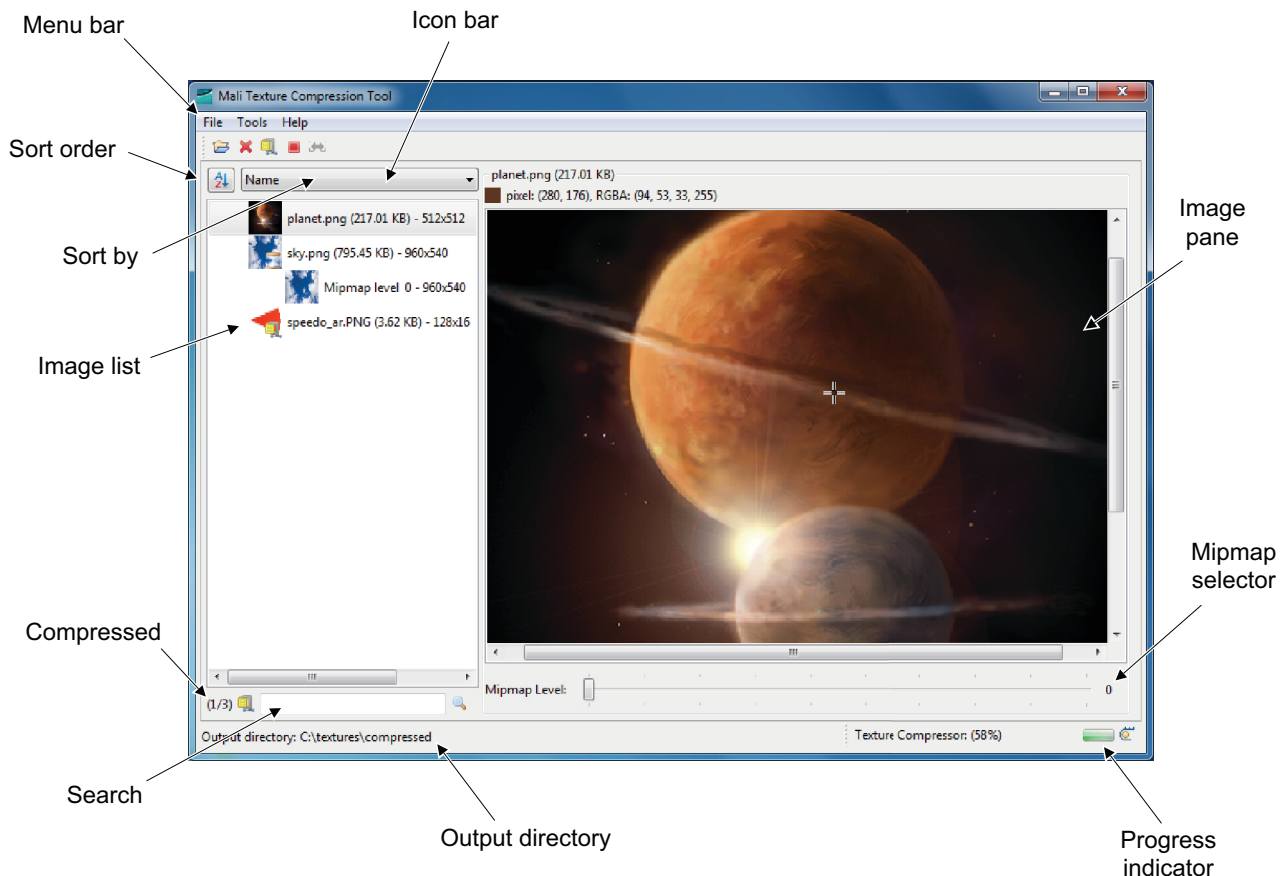


Figure 3-1 Texture Compression Tool window

———— **Note** ————



- All graphics in this section are from the Microsoft Windows version of the Texture Compression Tool.
- The Linux version of the tool has minor differences in appearance.

You can control the Texture Compression Tool using menu options or buttons on the Icon bar. [Table 3-1](#) shows the Texture Compression Tool buttons, their equivalent menu items and their action.

Table 3-1 Texture Compression Tool GUI buttons and menu items

Button	Equivalent menu entry	Action
	Open Images	Open a texture for compression.
	Remove Selected Images	Remove all selected textures from the GUI tool window. You can also press the Del key to delete the selected images.
	Compress Selected Images	Compress a texture. Clicking this button displays the Compression Options window. The number of compressed images is displayed in the small Compressed count pane.
	Cancel All Compression Jobs	Stop compression.

Table 3-1 Texture Compression Tool GUI buttons and menu items (continued)

Button	Equivalent menu entry	Action
	Compare Two Images	Compare two images. Exactly two images must be selected in the Image list.
	About	Display the About box.
-	Preferences	Display the Preferences dialog.

In addition to the control icons, you can use the following controls to display images:

Sort by drop-down list

If you have multiple images open in the image list, select an entry from the list to select the sort criteria. To reverse the sort order, click the Sort order button next to the control.

Filter image text box

If you have multiple images open in the image list, enter all or part of the name in the search box and click the search icon.

Image list This lists all images you have opened. Select one or more items in the list for compression.

Image pane The image pane displays the selected image. If the image has been compressed, both the original and compress images are displayed.

If the cursor is over an image, you can use the mouse scroll wheel or the + and - keys on your keyboard to zoom in or out on the image.

To display the texture at its original size, right click on a zoomed texture at any time and select **Original size**.

Mipmap Level slider

Use the Mipmap Level slider to show how the image appears at different Mipmap levels.

If **Enable mipmaps** is checked in the Compression Options dialog, multiple Mipmaps are produced and the Mipmap slider displays the original and compressed version of the Mipmap.

Progress indicator

This indicates that images are being loaded or compressed. You can click on this to open a more descriptive view.

3.1.3 Compressing textures

To compress one or more textures:

1. Open a texture for compression:
 - a. From the menu, select **Open Images** from the **File** menu or click the **Open** icon. The **Select images to compress** window opens.
 - b. Navigate to the required texture and click **Open**. The texture appears in the left pane of the Texture Compression Tool.
 - c. Click on the texture in the left pane of the Texture Compression Tool to display it in the main pane.

2. Click a texture in the left pane of the Texture Compression Tool to select it.

———— **Note** ————

You can select multiple textures for compression by holding down the **CTRL** key while selecting images with the mouse.

3. Compress the selected texture:
 - a. Click the **Compress** button on the toolbar or select **Compress** from the **Mali TCT** menu.

The **Compression options** dialog box shown in [Figure 3-2](#) displays:

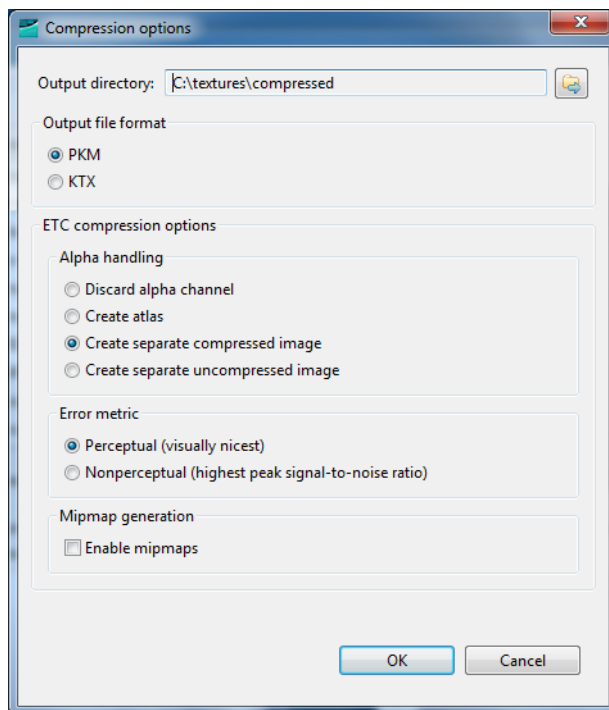


Figure 3-2 Compression options

———— **Note** ————

If you have images selected you can right-click in the left pane and select **Compress selection** as an alternative to steps 3.

- b. Select the compression options described in [Table 3-2](#).

Table 3-2 Options for ETC compression

Option	Description
Output directory	The current output directory is shown. You can click the Select Output Directory icon to open a dialog and select a new output directory.
Output file format	The options are: <ul style="list-style-type: none"> • PKM is a simple file format for single compressed images. If you generate Mipmaps, multiple PKM files are created. • KTX is a Khronos Group standard compression format that provides a container for images. If you generate Mipmaps, a single KTX file is generated.
Alpha handling	The options are: <ul style="list-style-type: none"> • Discard Alpha channel does not process the alpha information in the original image. • Create Atlas is a single image that places the color and alpha parts of the original in separate areas of a combined image. If you generate Mipmaps and have selected PKM format, multiple images are created. • Create a separate compressed image from the alpha image. If you select this option, a separate image file is created for each Mipmap image: <ul style="list-style-type: none"> — If you are using KTX format, two KTX files are generated. One file is generated for color and one is generated for the compressed alpha. If Mipmaps are generated, they are inside the color and alpha files. — If you are using PKM format, one file is created for color and one for the compressed alpha for each Mipmap. For example, if you have ten Mipmaps, twenty images are created. • Create a separate uncompressed image from the alpha image: <ul style="list-style-type: none"> — If you are using KTX format, two KTX files are generated. One file is generated for color and one is generated for the uncompressed alpha. If Mipmaps are generated, they are inside the color and alpha files. — If you are using PKM format, one file is created for color and one for the uncompressed alpha for each Mipmap. For example, if you have ten Mipmaps, twenty images are created.
Error metric	The options are: <ul style="list-style-type: none"> • Perceptual provides the best visual results. Using Perceptual, the compression algorithm sets green closer to its required value, at the expense of an inferior representation of red and blue. This decreases the <i>Peak Signal-to-Noise Ratio</i> (PSNR), but provides a superior visual result because the eye is more sensitive to green than to blue and red. • Nonperceptual is optimized to provide the highest PSNR. This is the default. Although technically superior, this setting does not account for the fact that the eye is more sensitive to green than to blue and red, and images might appear to be visually inferior.
Mipmap generation	Check this option to generate mipmaps.

- c. Click **OK**. The texture is compressed and the Texture Compression Tool displays the results. [Figure 3-3 on page 3-8](#) shows an example window after compression.

The window contains the following sections:

Compression Options

A summary of the compression options used in the compression.

If you selected **Enable Mipmap**, a slider is displayed to enable you to vary the displayed mipmap level. The lowest mipmap level is zero, and uses the original texture size. Setting successive higher levels enables you to use the next available mipmap in the series, which is half the size.

Difference

This view shows the difference between the RGB values of the original and compressed textures.

With good quality compression, there is little difference between the uncompressed and compressed versions, resulting in a low RGBA difference. In such cases, you can use the **Difference** slider located below the Compressions Options view to amplify the difference and improve the view.

Place the cursor over any part of an texture to view RGBA values for the original and compressed versions.

If the image is too large to fit into the available space, part of the image is displayed and you must use the horizontal and vertical sliders to display other parts of the image.

Original image

The name of the input file, its size, and resolution is displayed above the uncompressed image.

Compressed image

The name of the input file, its size, and resolution is displayed above the compressed image.

Image list

The image list displays both compressed and uncompressed textures. A compression icon indicates if a texture has been compressed.

You can expand compressed textures in the list to show individual mipmap levels. You can also expand the mipmap levels to show the corresponding color and alpha components.

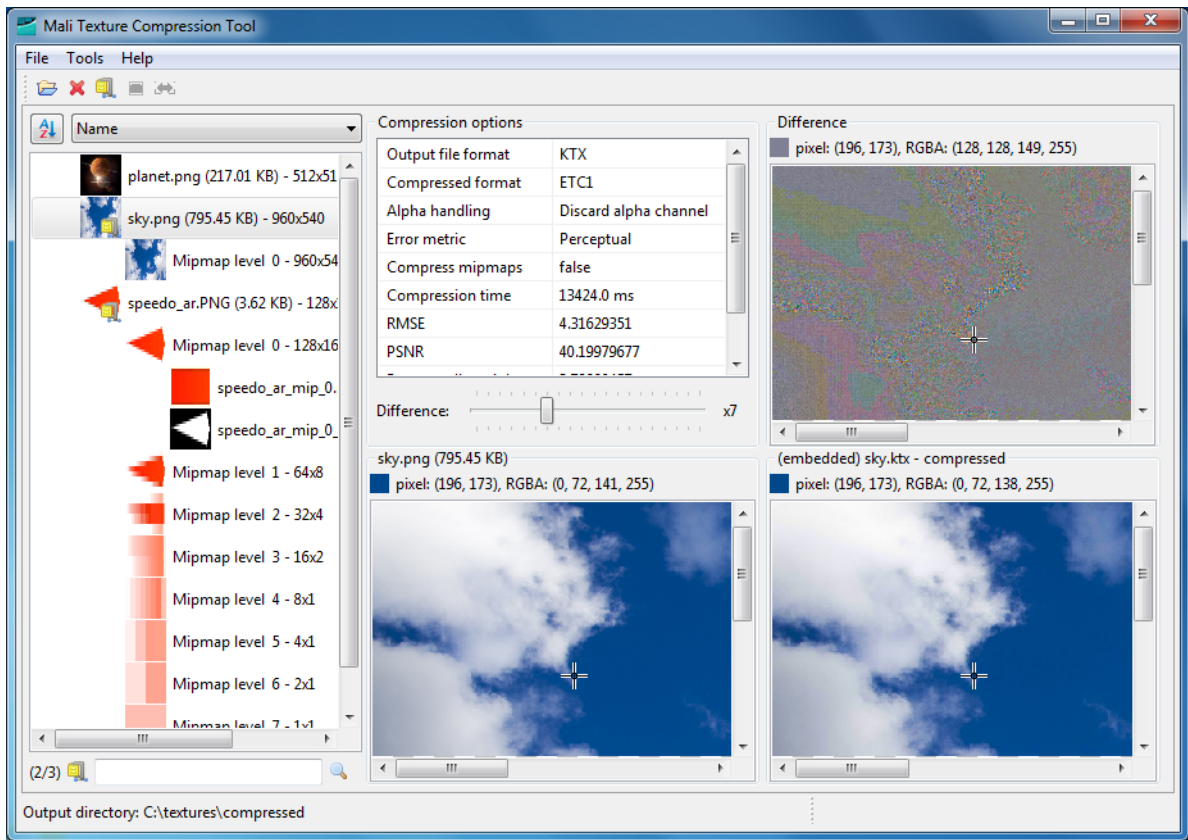


Figure 3-3 Compression results

- d. To use the compressed textures in your application, copy the files from the output directory to your application development environment.

3.1.4 Using the Preferences dialog

You can modify application options from the Preferences dialog shown in Figure 3-4:

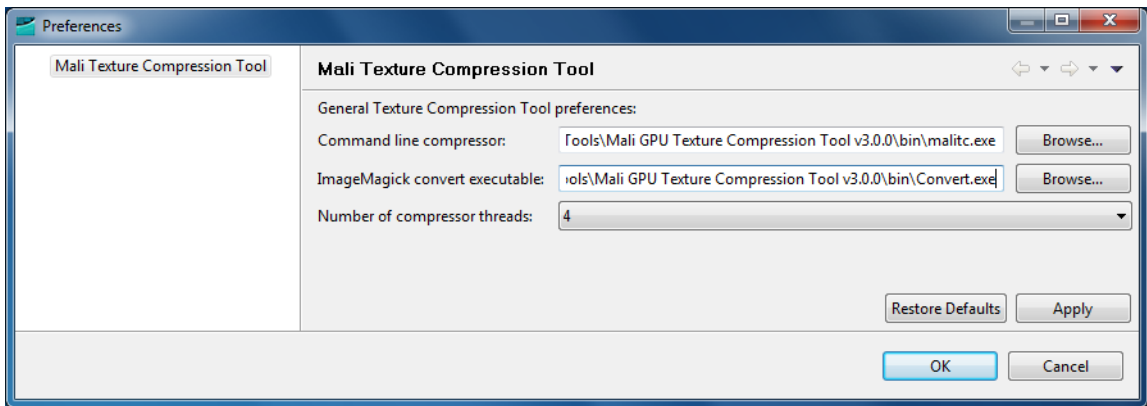


Figure 3-4 Preferences dialog

To open the dialog, select **Preferences** from the **Mali TCT** menu.

The dialog has the following controls:

Command line compressor

Displays the location of the mali tc executable. To change this entry, click **Browse** and navigate to the new location.

ImageMagick convert executable

Displays the location of the imagemagick executable. To change this entry, click **Browse** and navigate to the new location.

Number of compressor threads

This selects the number of threads that will be used by the compressor. The default is four. For maximum speed, the value for the number of threads should match or exceed the number of available hardware threads.

Restore Defaults

Click this button to restore all entries to their default values.

Apply Click this button to apply the changes you made.

Cancel Click this button to cancel the changes you made and close the dialog.

OK Click this button to apply the changes you made and close the dialog.

3.2 Using the Mali Texture Compression Tool from the command line

This section describes how to use the Texture Compression Tool from the command line. It contains the following sections:

- [About the command-line version of the Texture Compression Tool](#)
- [Starting the Texture Compression Tool from the command line on Microsoft Windows](#)
- [Starting the Texture Compression Tool from the command line on Linux](#)
- [Compressing files from the command line on page 3-11.](#)

3.2.1 About the command-line version of the Texture Compression Tool

You can use the Texture Compression Tool from the command line, this enables you to compress textures using a single command. You can use arguments and options to specify:

- texture compression algorithm to use
- name of the file to compress
- output directory to store compressed file
- texture compression options specific to the compression algorithm used.

3.2.2 Starting the Texture Compression Tool from the command line on Microsoft Windows

To start the Texture Compression Tool on Microsoft Windows:

1. Select **Run...** from the **Start** menu.
2. Type `cmd` and click **OK** to open a command line.
3. Navigate to the following directory:

Program Files\ARM\Mali Developer Tools\Mali Texture Compression Tool *vm.n.o*\bin

where:

- m*** identifies the major version
- n.o*** identifies the minor version.

4. Type the following command

```
malitc
```

The `malitc` command without arguments or options displays help information about the command.

3.2.3 Starting the Texture Compression Tool from the command line on Linux

To start the Texture Compression Tool Linux:

1. Open a command line.
2. Navigate to the following directory:

Mali_Texture_Compression_Tool_*m.n.o*/bin

where:

- m*** identifies the major version
- n.o*** identifies the minor version.

3. Type the following command

```
./malitc
```

The `malitc` command without arguments or options displays help information about the command.

3.2.4 Compressing files from the command line

Use the following command to compress a texture:

```
malitc input_filename output_directory <options>
```

The arguments are:

input_filename

The input file to be compressed.

output_directory

The directory to place the compressed file into.

You must specify an output directory. If an output directory is not specified, the Texture Compression Tool requests one.

The options are:

-e [perceptual|nonperceptual]

Set the error measure parameter. See [Options for ETC compression on page 3-6](#).

-threads *count*

This selects the number of threads that will be used by the compressor. The default is four. For maximum speed, the value for the number of threads should match or exceed the number of available hardware threads.

-mipmaps

Generate mipmaps. A mipmap is a collection of scaled-down bitmap images that accompanies a main texture. Using mipmaps can increase rendering speed and reduce artifacts.

-aa

Use the alpha channel and create a texture atlas.

-as

Use the alpha channel and create a separate image.

-ar

Use the alpha channel and create a raw image.

-ktx

Output ktx files instead of pkm files.

-progress

Report the percentage progress of each compression.

-quiet

Do not display any information messages. Error messages, if any, will still be displayed.

-help

Print usage information and exit.

3.2.5 Log and error messages

During operation, the Texture Compression Tool can print status and error messages to the standard error output.

Error messages

If an error occurs the Texture Compression Tool outputs a message of the form:

```
Error:<error_message>
```

If there are errors in the command line arguments, the error message is followed by the standard help message.

Informational messages

Normal informational messages are in the following form:

```
malitc-<number><message_text>: <message_data>
```

where the fields are as described in [Table 3-3](#):

Table 3-3 Information messages

Number	Message text	Message data	Description
1	Compressing. Output file	file name	Output before the RGB component of an image or mipmap is compressed.
2	Compressing alpha component. Output file	file name	Output before the alpha component of an image or mipmap is compressed.
3	Writing uncompressed alpha. Output file	file name	Output when saving uncompressed alpha data.
4	Compression time	time in ms	Output when each compression completes. The time value is an integer and is followed by the string "ms" for readability.
5	RMSE	RMSE value in floating point format	Output for each compression.
6	PSNR	PSNR value in floating point format	Output for each compression.
7	Perceptually weighted RMSE	Perceptually weighted RMSE value in floating point format	Output for each compression.
8	Perceptual PSNR	Perceptually weighted PSNR value in floating point format	Output for each compression.
9	PSNR	"infinite"	Used for infinite PSNR (perfect compression) in place of message 6.
10	Perceptual PSNR	"infinite"	Used for infinite perceptual PSNR (perfect compression) in place of message 8.
11	Mipmap level	mipmap level	Output before each compression or pair of compressions of a mipmap level.
12	Compression progress	percent progress	Percent of current compression, not of the whole job, followed by percent symbol "%" for readability

Tools that analyzing the output should ignore everything except the number and data. The data always follows the only colon in the message.