

1 Overview

1.1 Location `$<APPSDKSamplesInstallPath>\samples\aparapi\examples`

1.2 How to Run See the *Getting Started* guide for how to build samples. You first must compile the sample.

Use the command line to change to the directory where the executable is located. The pre-compiled sample jar is at

`$<APPSDKSamplesInstallPath>\samples\aparapi\examples\Mandel\`

Under Windows, type the following command(s).

1. `mandel.bat`
This runs the program.
2. `mandel.bat -h`
This prints the help file.

Under Linux, type the following command(s).

1. `./mandel.sh`
This runs the program.
2. `./mandel.sh -h`
This prints the help file.

1.3 Command Line Options Table 1 lists, and briefly describes, the command line options.

Table 1 Command Line Options

Short Form	Long Form	Description
-h	--help	Shows all command options and their respective meaning.
-q	--quiet	Quiet mode. Suppresses all text output.
-e	--verify	Verify results against reference implementation.
-t	--timing	Print timing.
-v	--version	AMD APP SDK version string.
-x	--exec_plat	Execution platform [CPU GPU JAVAST JAVAMT]

2 Introduction

Mandelbrot-set images are generated by

1. taking a complex number
2. checking if it tends to infinity when the formula is iterated on that number
3. using the number as X and Y coordinates in the picture
4. coloring the pixel depending on whether it tends to infinity or not.

A Mandelbrot set is a set of values of c in the complex plane for which the orbit of 0 under iteration of the complex quadratic polynomial $z_{n+1} = z_n^2 + c$ remains bounded. That is, a complex number c is part of the Mandelbrot set if, when starting with $z_0 = 0$ and applying the iteration repeatedly, the absolute value of z_n remains bounded however large n gets.

The definition of the Mandelbrot set along with its basic properties can be used to draw a picture. The region of the complex plane under consideration is subdivided into a certain number of pixels. To color a pixel, let c be the midpoint of that pixel; then, iterate the critical point 0 under P_c , and check at each step if the orbit point has a modulus larger than 2.

- If it does, then c does not belong to the Mandelbrot set, and color the pixel according to the number of iterations that was used to find out.
- If it does not, iterate up to a fixed number of steps, then decide that the parameter is “probably” in the Mandelbrot set, or at least very close to it, and color the pixel black.

3 Implementation Details

This example starts with a Mandelbrot image of a specific scale (default-scale), pauses for several seconds, then zooms in for 128 frames; finally, it zooms out to the image it started with. It supports four modes of execution: GPU, CPU (using Aparapi), Java single thread, and Java multi-thread. The sample does not override `Kernel.run()`; instead, it uses an OpenCL kernel in the `Mandel.cl` file by creating a `MandelBrot` interface that extends `OpenCL<MandelBrot>`. The location of the OpenCL kernel is specified by `@OpenCL.Resource()`. `JavaMandelBrot.java` has Java single-thread implementation of the same kernel as in `Mandel.cl`, while `JavaMandelBrotMultiThread.java` has a multi-threaded implementation of the kernel.

In case the `--quiet` or `--verify` option is used, the zoom-in point is generated randomly; otherwise, it waits for users to click on the image, then zooms in at the clicked point.

4 Recommended Input Option Settings

For best performance, enter the following on the command line: `-x GPU -q -t`

5 References

1. http://en.wikipedia.org/wiki/Mandelbrot_set
2. <http://code.google.com/p/aparapi/>

Contact

Advanced Micro Devices, Inc.
One AMD Place
P.O. Box 3453
Sunnyvale, CA, 94088-3453
Phone: +1.408.749.4000

For AMD Accelerated Parallel Processing:

URL: developer.amd.com/appsdk
Developing: developer.amd.com/
Forum: developer.amd.com/opencvforum



The contents of this document are provided in connection with Advanced Micro Devices, Inc. ("AMD") products. AMD makes no representations or warranties with respect to the accuracy or completeness of the contents of this publication and reserves the right to make changes to specifications and product descriptions at any time without notice. The information contained herein may be of a preliminary or advance nature and is subject to change without notice. No license, whether express, implied, arising by estoppel or otherwise, to any intellectual property rights is granted by this publication. Except as set forth in AMD's Standard Terms and Conditions of Sale, AMD assumes no liability whatsoever, and disclaims any express or implied warranty, relating to its products including, but not limited to, the implied warranty of merchantability, fitness for a particular purpose, or infringement of any intellectual property right.

AMD's products are not designed, intended, authorized or warranted for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of AMD's product could create a situation where personal injury, death, or severe property or environmental damage may occur. AMD reserves the right to discontinue or make changes to its products at any time without notice.

Copyright and Trademarks

© 2014 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, ATI, the ATI logo, Radeon, FireStream, and combinations thereof are trademarks of Advanced Micro Devices, Inc. OpenCL and the OpenCL logo are trademarks of Apple Inc. used by permission by Khronos. Other names are for informational purposes only and may be trademarks of their respective owners.