

# Uniform Random Noise Generator

## 1 Overview

**1.1 Location** \$(AMDAPPSDKSAMPLESROOT)\samples\opencl\cl\app

**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 executable is at \$(AMDAPPSDKSAMPLESROOT)\samples\opencl\bin\x86\ for 32-bit builds, and \$(AMDAPPSDKSAMPLESROOT)\samples\opencl\bin\x86\_64\ for 64-bit builds.

Type the following command(s).

1. URNG  
This generates uniform noise in the input image.
2. URNG -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.
	--device	Devices on which the program is to be run. Acceptable values are <code>cpu</code> or <code>gpu</code> .
-q	--quiet	Quiet mode. Suppresses all text output.
-e	--verify	Verify results against reference implementation.
-t	--timing	Print timing.
	--dump	Dump binary image for all devices.
	--load	Load binary image and execute on device.
	--flags	Specify compiler flags to build the kernel.
-p	--platformId	Select platformId to be used (0 to N-1, where N is the number of available platforms).
-d	--deviceId	Select deviceId to be used (0 to N-1, where N is the number of available devices).
-f	--factor	Noise factor.
-i	--iterations	Number of iterations for kernel execution.

## 2 Implementation Details

This sample generates noise in an image by using a *linear congruential generator* which generates a uniform deviation in the range (0, 1) and which is multiplied by a *noise factor* to produce the final noise.

A minimal standard linear congruential generator proposed by Park and Miller (see reference [1]) is:

$$l_{j+1} = a l_j \bmod m$$

where  $a = 16807 (7^5)$  and  $m = 2^{31} - 1$

We use Schrage's method (see [2] ), which is based on an approximate factorization of  $m$ , to implement this.

$$m = aq + r, \text{ that is: } q = \lfloor m/a \rfloor, r = m \bmod a.$$

We then apply a shuffling algorithm by Bays and Durham, as described in Knuth (see reference [3]), to remove low-order serial correlations.

We calculate the uniform deviation from the seed, which is generated by averaging four components of a pixel, and apply that deviation (multiplied by the noise factor) to all the components of the pixel. Thus, each global thread computes a uniform deviation and applies it to a pixel.

## 3 References

1. Park, S.K., and Miller, K.W 1988, *Communications of the ACM*, vol 31, pp, 1192-1201.
2. Schrage, L. 1979, *ACM transactions on Mathematical Software*, vol. 5, pp. 132-138.
3. Knuth, D.E, 1981, *Seminumerical Algorithms*, 2<sup>nd</sup> ed., vol. 2 of *The art of computer programming*, 3.2-3.3.

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### 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](http://developer.amd.com/appsdk)  
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