Manual

Poisson Noise - An ImageJ Plugin

Janick Cardinale, `janick@inf.ethz.ch`
MOSAIC Group, www.mosaic.inf.ethz.ch

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1 Introduction

Due to the descrete character of light, images acquired using photon counting devices such as CCD cameras suffer from *photon counting noise*: During the exposure time of a given time T, a photon might or might not hit the sensor (since it is a non-continuous event). Such a process can be modeled using a Poisson distribution. This ImageJ plugin inserts Poisson distributed noise into an image or an imagestack to simulate the acquisition of an image. The noise realization is independent for each pixel. The distribution parameter λ is set to the original intensity value.

2 Installation

Copy the `mosaic_plugins.jar` file to the ImageJs `plugins` directory. Restart ImageJ. The plugin can be launched from the `Mosaic` submenu in ImageJs plugin menu.

The plugin handles 8-bit, 16-bit and 32-bit grayscale images or stacks.

Prerequisits: At least Java 5.0 and ImageJ 1.36.

3 How to use the plugin

Open an image or an image stack in ImageJ. In the `Plugin` menu, selecting the `Poisson Noise` entry in the `Mosaic` submenue starts the plugin. You might process only one slice or even the whole stack.

Please note that there is no undo for this operation.

4 Description

At each pixel, a Poisson distributed random variable is sampled and replaced with the original intensity value. The distribution parameter λ is set to the intensity of the original pixel value (before noise was inserted). If $\lambda > 30$, the distribution is approximated with a Gaussian distribution $\mathcal{N}(\lambda + 0.5, \lambda)$.

The sampling algorithm of the random variable is implemented as followed [1]:

```
double p = 1;
int k = 0;
double vL = Math.exp(-aLambda);
do{
   k++;
   p *= mRandomGenerator.nextDouble();
}while(p >= vL);
return k - 1;
```

5 Disclaimer

References

[1] D. E. Knuth. *Art of Computer Programming, Volume 2: Seminumerical Algorithms (3rd Edition)*. Addison-Wesley Professional, November 1997.