Universidade de Aveiro

Mestrado em Engenharia Informática

Simulação e Otimização

Lesson 3: Random Value Generators

Academic year 2021/2022 Nuno Lau/Amaro Sousa

1. Implement the Midsquare Method for random number generation. Test it and verify its tendency to converge to 0. Build a histogram of the distribution of the generated values.

2. Linear Congruential Generator (LCG) are often used to generate pseudo-random numbers in a simple way. The equation that is used to generate the non-normalized random numbers is:

   $$Z_i = (a . Z_{i-1} + c) \bmod m$$

   2.1. Choose values for *a*, *c* and *m* that may be used to generate numbers in the interval *[0, 1[*, that have a minimum distance between them that is lower than *0.01* but close to this value. Explain how is the LCG used to generate numbers in this interval.

   2.2. Verify if the previous *a*, *c* and *m* values provide a full period LCG.

3. Implement a general Linear Congruential Generator.

   $$Z_i = (a . Z_{i-1} + c) \bmod m$$

   Verify that the generator has a full period *m* iff *m* and *c* are mutually prime and 1; if *q* is a prime number that divides *m*, then *q* divides *a*-1; if 4 divides *m*, then 4 divides *a*-1. Build a histogram of the distribution of the generated values.

4. Implement a Linear Shift Register Generator with r=3 and q=5. Build a histogram of the distribution of the generated values.

5. Implement a Generalized Shift Register Generator with r=3, q=5, l=4 and d=6.