Detecting the Presence of Anomalous Effects by Monitoring Timing in Random Walks

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Abstract: The present paper investigates the use of a Random Walk Bias Amplifier (RWBA) for measuring potential mental influence on random generators, specifically focusing on the MED100Kx8 generator. The RWBA method is described in detail, and an example of its application is provided. The empirical cumulative distribution function (CDF) of the number of steps to reach a bound (*N*) is obtained, and a weighting factor based on the surprisal value (SV) is derived from the CDF value. The paper demonstrates the utility of the RWBA method for detecting and measuring the effects of mental influence on random generators, paving the way for further research and development in the field of anomalous cognition and effects.

Keywords: Random Walk Bias Amplifier, anomalous cognition, MED100Kx8 generator, mental influence, empirical CDF, surprisal value

Introduction

The detection of anomalous effects or mind-matter interaction often involves observing the output of a true random number generator. In a basic experiment, a user mentally intends the generator to produce either more 1s or more 0s during a measurement period or trial, which typically lasts between 200ms and one second. The average measured bias reported from many studies is approximately 0.5001, compared to the expected 0.5 for random bits. This represents a small effect size (ES = 2 bias - 1) or 0.02%. To increase the effect size while maintaining the bias information from the input sequence, bias amplification methods have been devised that take a large number of random bits from high-speed generators and provide a small number of output bits.

Two fundamental methods exist for processing the large number of bits generated by a high-speed random generator during a trial: 1) Majority Voting, which counts the number of 1s in a fixed number of input bits (preferably odd to avoid ties), producing an output bit of 1 if the majority are 1s or 0 if the majority are 0s; and 2) The Random Walk Bias Amplifier (RWBA), a bidirectional counter that increments for each 1 input and decrements for each 0 input, generating an output of 1 if the positive bound is reached or 0 if the negative bound is reached. The average number of steps to reach a bound is $N = n^2$, where n represents the bound value. Although the RWBA is more efficient than Majority Voting in converting input bias to increased output bias, its variable bit consumption can be problematic when a regularly timed output is required.

In addition to increasing effect size, it is crucial to develop methods for detecting patterns indicating influence of mental intention on a sequence of bits, particularly in control applications where the user has no direct contact with the device being controlled. The absence of trial

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synchronization and user feedback present unique challenges in implementing a "free-running" control system. Addressing these challenges is essential for the successful integration of mind-matter interaction systems.

Enhancing Anomalous Effect Measurements using a Random Walk Bias Amplifier.

Historically, researchers used only the bias, that is, excess 1s or 0s, to determine the presence of mental influence on a random sequence of bits. Additional information can also be provided by monitoring timing in a RWBA. It's important to know that the average drift velocity, that is how fast the walker moves toward a bound, is equal to the effect size of the mental influence. Strong anomalous effects cause the bound to be reached more quickly, thus providing a way to estimate the probability that a bias-amplified sequence is strongly affected. In addition, multiple measurements within a trial when mental influence is present will tend to be correlated, both in their final outputs and in the time to reach a bound. Additional research is required to determine if there is useful information in the path of the walker, or if it takes longer than usual to reach a bound.

Algorithm for using the MED100Kx8 generator with external bias amplification.

The MED100Kx8 generator is available for testing, research, and development and is designed to respond to anomalous cognition and effects. It is based on an Intel Cyclone III FPGA and uses the transition jitter in ring oscillators to measure thermal and shot noise in its CMOS gates.

The generator provides high statistical quality without using any deterministic post processing stage. The total generation rate is 1.024Gbps, which is internally bias-amplified using RWBAs with the bound set at 101. That yields a bias amplification factor of 101 and reduces the bitrate by 101^2 (10,201), giving the device output rate of 100,382bps.

1. Selection of Bound Value (*n*): The first step is selecting the value for the bound, *n*. This involves balancing the generator rate and the desired output rate. In this example, *n* is chosen to be 31. As a result, the output rate is divided by a factor of *n*^2 (961), producing 104.45 outputs per second. This rate allows 200 ms trials with enough outputs to perform additional processing using weights and other noise-reducing approaches.
2. Running the RWBA Algorithm: The next step is running the RWBA algorithm using the generator output bits while monitoring the number of steps to complete each walk. A user program can directly count the number of bits required to reach either the positive or negative bound.
3. Important RWBA Details: a. Bounded random walk terminal values can only take on every other integer value. b. The minimum number of steps the random walk can take is *n*. c. Exact solutions for the probability mass function (PMF) and cumulative distribution function (CDF) exist, but an empirical distribution function will be used in this example.
4. Calculating Probability (*p*) After Each RWBA Output: After each RWBA output, calculate the probability, *p*, that the number of steps taken could have occurred by chance

in the absence of any mental influence. This probability is the value of the CDF evaluated at *N*, the number of steps (bits) used to reach the bound. The same CDF is used when either the positive or negative bound is reached. This probability is assumed to be one-tailed, meaning that only probabilities less than 0.5 suggest increased mental influence. If an increased number of bits to reach a bound is also shown to be of interest, a two-tailed analysis may be considered.

Finding the Value of the Cumulative Distribution Function at *N*

A simulation using pseudorandom bits in a Mathematica program provided the terminal counts from four million random walks with $n = 31$. These were used to produce the probability mass function (PMF). The following plot shows the empirical CDF, which is the integral of the PMF.

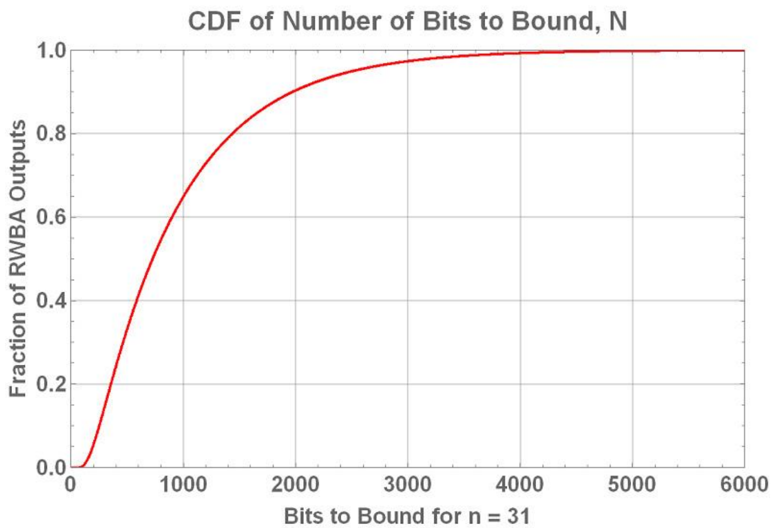

Figure 1

Since this is an empirical plot, we will obtain the specific value of the CDF using a second-order interpolation function (e.g., quadratic interpolation) with the nearest three data points. The selected data points from this curve are presented as comma-separated pairs of points (*N*, CDF value):

29, 0.,31, 4.6566*10^-10,43, 2.5*10^-7,55, 0.0000125,65, 0.000099,79, 0.00058575,93, 0.00190025,105, 0.0039455,107, 0.0043945,121, 0.008407,141, 0.01659625,149, 0.02066175,165, 0.030027,181, 0.04097325,193, 0.050018,205, 0.0596295,217, 0.06968525,229, 0.08007275,241, 0.0908285,251, 0.1000605,263, 0.11127425,273, 0.12071075,283, 0.13028675,293, 0.13996,303, 0.14965975,313, 0.159455,323, 0.169184,335, 0.1807995,345, 0.19049125,355, 0.20016375,365, 0.2098285,377, 0.2213085,387, 0.230712,397, 0.240088,407, 0.2494425,419, 0.26057975,429, 0.26976425,441, 0.280628,451, 0.28950875,463, 0.30000425,475, 0.31068675,487, 0.32107725,497, 0.3295655,509, 0.339624,521, 0.34972,533, 0.35958,545, 0.36930075,547, 0.37091775,559, 0.38047775,571, 0.38994775,585, 0.40080525,597, 0.4099845,611, 0.4205175,625, 0.43086725,637, 0.43958075,653, 0.45089025,667, 0.46073875,681, 0.470314,695, 0.47976625,711, 0.490367,727, 0.50069425,741, 0.50964775,759, 0.52087975,775, 0.53063475,791, 0.54031025,809, 0.55084375,825, 0.55995425,843, 0.57005225,861, 0.57994375,881, 0.59072425,899, 0.6000415,919, 0.61021475,939, 0.620246,959, 0.62984475,981, 0.64021725,1003, 0.6502895,1025, 0.66007175,1049, 0.670426,1073, 0.68044825,1097, 0.690253,1123, 0.700487,1149, 0.710324,1175, 0.7198345,1205, 0.73038025,1233, 0.73999,1263, 0.74984525,1295, 0.7599175,1329, 0.770246,1363, 0.78015725,1399, 0.79014875,1437, 0.80026,1475, 0.80978925,1517, 0.8198905,1563, 0.830206,1609, 0.83999175,1659, 0.85001525,1713, 0.8600645,1771, 0.870173,1831, 0.87985925,1899, 0.8899505,1973, 0.89991075,2055, 0.9100075,2147, 0.92004975,2251, 0.93005225,2371, 0.9400265,2513, 0.95003225,2685, 0.95996375,2909, 0.97001825,3221, 0.9800235,3757, 0.99000575,4293, 0.99499475,4691, 0.99700025`,5005, 0.998001,5543, 0.99900225,6081, 0.99950225,6463, 0.9997005,6789, 0.99980025,7341, 0.9999,7861, 0.99995,8247, 0.99997,9141, 0.99999,9647, 0.999995,10057, 0.999997,10995, 0.999999,11807, 0.9999995

Table 1

To find the CDF for the measured *N*, take the two points just below and one above to input into the interpolation function. For example, if the measured *N* is 101, the three points from the table are: 79, 0.00058575 = (x1, y1); 93, 0.00190025 = (x2, y2); 105, 0.0039455 = (x3, y3)
A second-order interpolation function, y = *a* + *b*x + *c*x^2, is used to interpolate between the values in the table, where *a*, *b*, and *c* are found by substituting the three points into the general simultaneous solution:
a = (x2 (x2 - x3) x3 y1 + x1 x3 (x3 - x1) y2 + x1 (x1 - x2) x2 y3)/((x1 - x2) (x1 - x3) (x2 - x3))
b = (x3^2 (y1 - y2) + x1^2 (y2 - y3) + x2^2 (y3 - y1))/((x1 - x2) (x1 - x3) (x2 - x3))
c = (x3 (y2 - y1) + x2 (y1 - y3) + x1 (y3 - y2))/((x1 - x2) (x1 - x3) (x2 - x3))
For the three selected points this gives, *a* = 0.014798, *b* = -0.000412479 and *c* = 2.94402*10^-6

Substituting these values for *a*, *b* and *c* into the interpolation function and 101 for x, gives the desired CDF of y = 0.0031695 at *N* = 101. These *a*, *b* and *c* values can be used for any x from 79 to 105, but the best accuracy will be obtained when the interpolated value is near the center of the range of x values.

While this may appear a little awkward, it is not overly complex to code. It also illustrates a general method of producing and using an empirical distribution function when the underlying distribution is not known.

Producing a Weighting Factor from the CDF Value

The CDF value can be used in several ways to produce a weighting factor for the RWBA results. One common approach is to convert the CDF to a surprisal value (SV). The SV is defined as SV = $\log_2(1/p)$, where the log function is base 2, giving the results in bits.

For the example above, $\log_2(1/0.0031695) = 8.30153$. This is a fairly high weight since p in the example is relatively small, meaning that reaching a random walk bound of 31 in 101 steps is significantly improbable. When $N = 725$, $p = 0.499409$, which is the closest to 0.5 given that only odd integers are valid for $n = 31$. The surprisal value is 1.00171, meaning a weighting factor of about 1 for a 50/50 chance of occurring. For $p > 0.5$, the surprisal factors and the corresponding weights become less than 1. For $N = 1973$, $p = 0.89991075$, and SV = 0.152146. In this context, this means that if the random walker takes so many steps to reach a bound, the sequence of random bits is unlikely to have been strongly affected by mental influence. However, as noted earlier, real-world testing could show that such a result may contain useful information, and the assumption of one-tailed results would have to be reconsidered.

Conclusion

The present paper demonstrates the utility of the Random Walk Bias Amplifier (RWBA) method for detecting and measuring the presence of anomalous effects or mental influence on random generators, specifically focusing on the MED100Kx8 generator. The paper describes the method in detail, providing an example of its application and the process of obtaining the empirical cumulative distribution function (CDF) for the number of steps required to reach a bound. A weighting factor based on the surprisal value (SV) is derived from the CDF value, offering a means of assessing the strength of mental influence on the random sequence of bits.

Valuable information regarding the presence and strength of anomalous cognition and effects on random generators can be extracted by monitoring the timing and steps taken in a RWBA. This approach can contribute to the advancement of research and development in the field of anomalous cognition and effects, as well as the successful integration of mind-matter interaction systems.