BALLISTIC DEPOSITION

Introduction:

‘Ballistic’ Derived from the word ‘Ballista’ defined as a large crossbow used in ancient warfare for firing a spear is used to describe projectile motion or motion of objects that follow a specific trajectory. Hence, the deposition of particles that follow a specific trajectory in a single direction is defined using the term ‘Ballistic Deposition’.

The requirement for the Ballistic Deposition Model was due to Scientists needing to understand the process of ‘Sedimentation’ and ‘Aggregation in Colloids’ on the most rudimentary levels, with the least number of variables required to describe the process. This model and its variants give rise to complex porous structures useful for studying formation of sedimentary rock structures and dust agglomerates.

Ballistic Deposition is a 3-Dimensional Process, though for Simplicity and Observational understanding of the properties we consider BD in 2-Dimensional Plane i.e. Length of 2D Box (x-axis), and Height of the Box (y-axis)

Algorithm:

1. First, we Define the Length of the Box as ‘L’. Now, we do not have a measure for ‘time’ in the simulation and for the system to be invariant regardless of the number of particles that are deposited, we consider 1 unit of time = L number of Particles deposited. Hence, we also define the maximum time to run our simulation as ‘nmc’ (Anagram for No. of Monte Carlo Cycles)
2. We Create an Array ‘H [:]’ that stores Maximum Height at every point on x-axis of the system after each particle is deposited. It is trivial to see that the no. of elements in H is equal to L.

We initialize H to be equal to 0.0

1. Now we select a random point between 1 to L (say r) and check the maximum height between H[r] and its closest neighbours i.e., H[r-1] and H[r+1] lets call this

maximum height y.

* 1. If H[r] = y then we update H[r] with H[r] = y + 1
  2. Else we update H[r] = y

Later, we store our results as coordinates of particles deposited (x, y) = (r, H(r))

1. We repeat this process nmc\*Length number of times and plot our results for further study.

OBSERVATIONS:

1. We start observing that a lot of spaces between are empty giving us a nicely branched compact structure that has its surface roughness increasing w.r.t. time.
2. The deviation of points from the mean surface Height tends to increase as well w.r.t. time.
3. For lower values of time i.e. 0 < t < 10 this deviation increases a lot rapidly after which it slows down and later starts saturating differently for different