Prime Numbers & Noise Generation

The thought behind using prime numbers came from a video by 3Blue1Brown on YouTube (source: https://www.youtube.com/watch?v=EK32jo7i5LQ). He discusses the distribution of prime numbers in the polar coordinate system such that the polar coordinates (p, p), where p is prime. This visualization can be viewed in *Figure 1*. Shown in *Figure 2*, we see our desired Fourier transform. Its evident these two are similar.

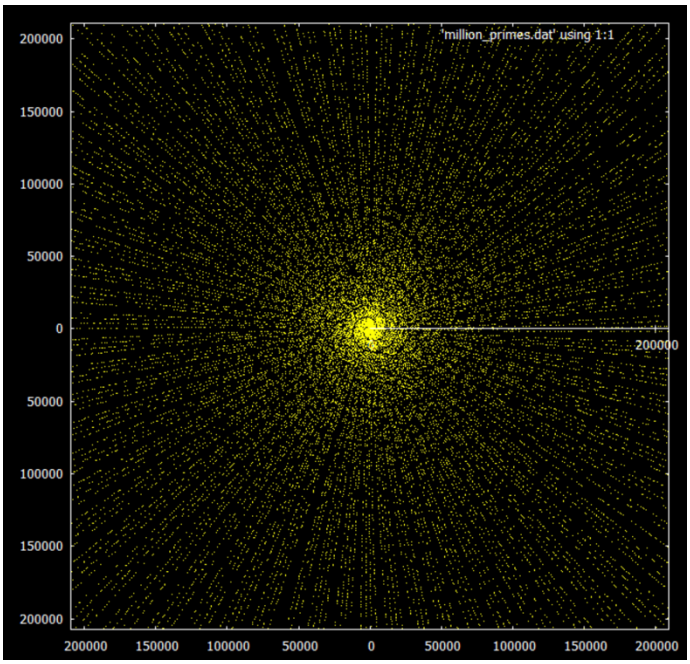


Figure 1

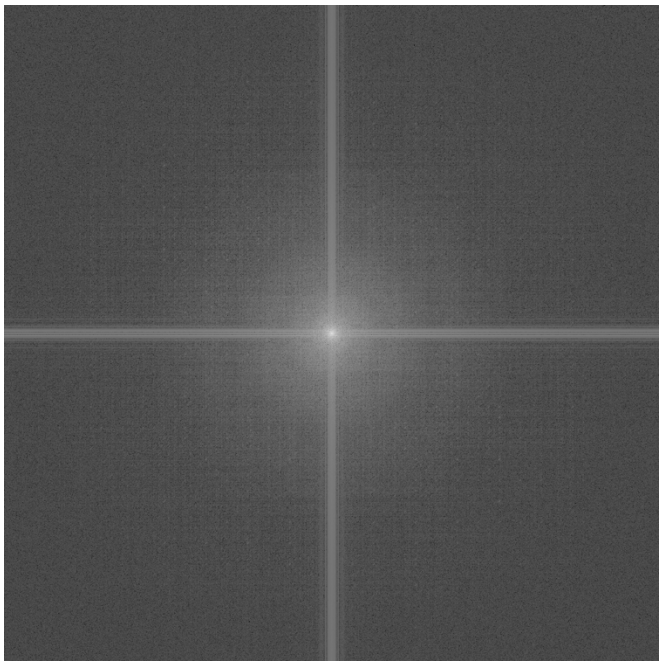
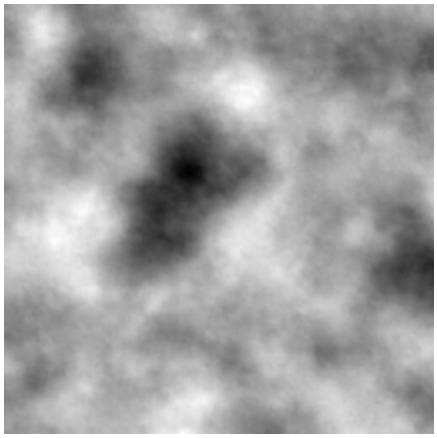
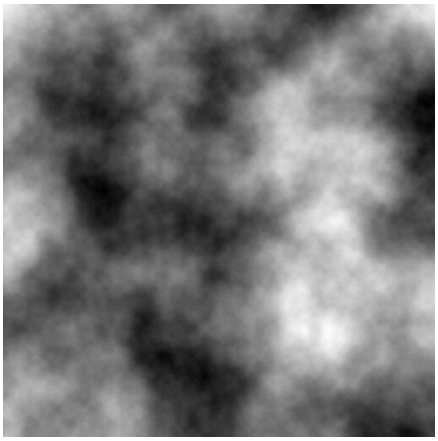
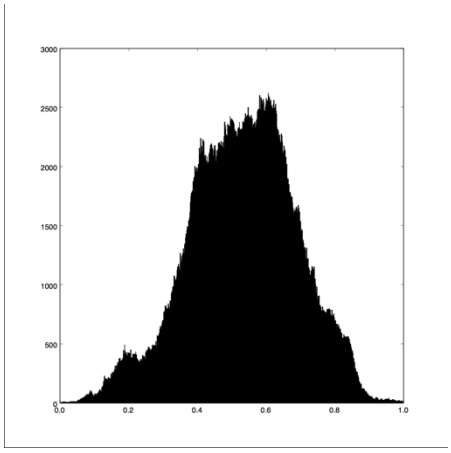
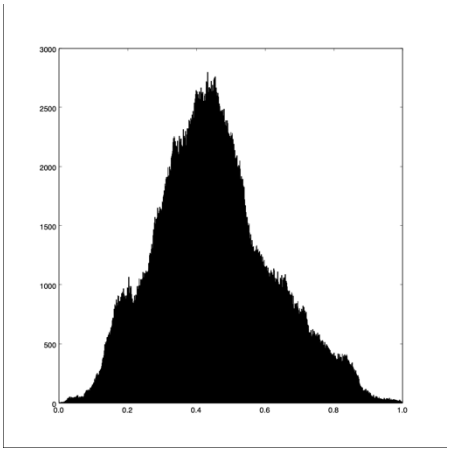
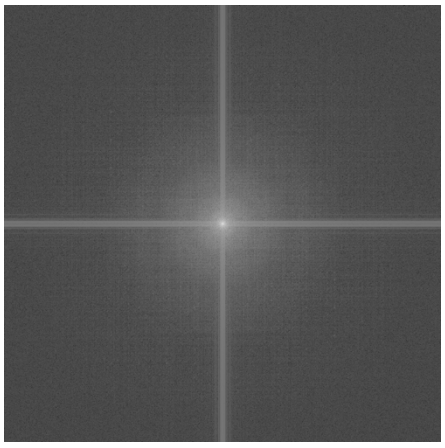
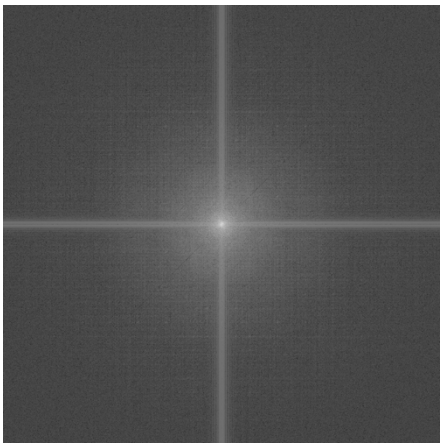


Figure 2

The idea was to investigate into how these two are related and if noise could somehow be generated from assembling a Fourier transform, in turn working backwards to generate a noise image. I'm still investigating into whether this idea is a possibility. Owen – you may be able to assist here.

In light of our analysis on the Szudzik hashing scheme and its benefit in removing the need for a permutation table, I also explored ways in the gradient tables could be removed or reduced. The way in which this was implemented was by generating one gradient table that was seeded with the 256 smallest prime numbers. Instead of hashing to separate gradients for each coordinate (I.E. 2 in 2D or 3 in 3D), one prime can be retrieved at which time the polar coordinate, (p, p) for 2D or (p, p, p) for 3D, where p is the prime retrieved, can be used to retrieve the Cartesian coordinates. Once the Cartesian coordinates are retrieved, normalize the resulting vector and use this as the gradient vector at a given corner in a lattice-based noise. This slightly reduces the storage needed in generating and storing gradients for each instantiation.

The results of procedurally generating lattice-based noise in such a manner, compared with that of traditional lattice-based noises such as Perlin noise, is as follows:

	Perlin (Szudzik)	*Prime Noise (Szudzik)*
Noise Generated		
Amplitude Histogram		
Fourier Transform		

References

Figure 1
https://math.stackexchange.com/questions/885879/meaning-of-rays-in-polar-plot-of-prime-numbers