# Autarkeia Aggregatum: Autonomous Points, Emergent Textures

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## 1. Introduction

*Autarkeia Aggregatum*, an integrated sound and video artwork I created in 2005, appears in the SIGGRAPH2006 Art Gallery. The visual component of the work emphasizes continuous flow and transformation. There are no cuts or splices in the piece; it unfolds as a constantly transforming, massed animation of nearly 12,000 individual points in a high-definition (720p) visual field. I sought a particular resonance between the visual and sonic materials, a resonance that would suggest a way of being in which a deep inner fullness is expressed outwardly — audibly and visibly — in elegant, self-sufficient restraint.

A common algorithmic process is applied to all of the points comprising the image, but each point has its own instance of the process. Thus, each point is autonomous, acting under control of its own process without regard to the other points. A complexly textured gestalt arises from the combined behaviors of the autonomous points. So when seeking a title for the piece, I turned to the *Monadology* — the philosopher Leibniz's theory of fundamental particles of reality (*monads*). I appropriated two words from that work: *autarkeia* (Greek) for self-sufficiency, and *aggregatum* (Latin) meaning joined, aggregated. The terms together appropriately suggest an aggregation of the activities of autonomous entities. More subtly, a poetic resonance with an idealized Classicism draws me to the words, suggesting to me a kinship with the "inner fullness" proposed above.

## 2. The Visual Algorithm

The animation algorithm for *Autarkeia Aggregatum* is a filtering process that disperses the points of an input image. At its simplest level, this "Brownian Dispersal Filter" (BDF) simply draws the input image row by row, column by column, recreating the image. By telling the BDF to skip a desired number of rows or columns in the process, a simple visual matrix of points predictably results. Each point has two independent Brownian noise functions associated with it: one to control polar magnitude and the other to control polar angle. In end-user terms, these are referred to as "displacement" and "spin". The displacement's Brownian function is bounded between zero and a user-defined value. The user can specify the maximum Brownian random jump per frame and a minimum displacement to which the Brownian value is added. In other words, the point can be made to move a minimum distance away from its original location and will engage in a bounded random walk between that distance and an outer limit. The spin-parameter's Brownian function is continuous, wrapping around a $2\pi$ radians range. The user can control the maximum random angle jump per frame and a constant angle increment to be accumulated with the Brownian value on each frame. That is, one can control the rate to spin and the amount of Brownian jitter applied to that spin. Point size is directly controllable. But it can also be made a function of displacement: the further the point is from its original location, the smaller it will be, with the scaling range user-defined. In other words, the more we are shifting the original point by displacement, the more the point will be deemphasized. The reverse formula is also available. An alpha specification for point drawing allows blending of point colors as they are drawn. Finally, an alpha level control impacts the redrawing of the previous frame, the first step in creating a new frame.

## 3. Implementation

I implemented BDF as an Objective-C plugin filter for Apple's *Motion 2* compositing and effects software. This allowed for detailed time-control of the algorithm parameters using the *Motion 2* GUI. In theory, one should be able to render any composition frame in isolation in such a tool. *Autarkeia Aggregatum*, however, ultimately had to be rendered in one run from beginning to end due to the feedback elements in the filter design.

## 4. Sound and Image Relationship

I compose both the sound and the image for my works, seeking a deep structural and gestural unity in which both mediums play an equal role in expressing a greater whole. I encourage viewers in the Art Gallery to consider the ways in which the continuous nature of the image is reflected in the sound — not directly, but in the general avoidance of sharp attack events in the unrolling of the musical form. The music is *strongly* delineated, dramatically, but perhaps not *sharply* delineated, if I might make that distinction. I created continuous pitch-curve melodies, which begin to appear about halfway through the piece, with custom software inspired by the continuous-pitch nature of Indian classical music [Battey 2004].

## 5. Conclusion

Establishing simple means for creating malleable and engaging complexity is a core interest in my artistic practice. BDF is a clear example. The basic approach and controls used in the filter are relatively simple. The visual results, however, can be rich, complex, dynamic, and expressive.

## 6. References

BATTEY, B. 2004. Bézier Spline Modeling of Pitch-continuous Melodic Expression and Ornamentation, *Computer Music Journal*, 28, 4, 25-39.