Musical Flocks

Ruslan Kamolov[1], Penousal Machado[2] and Pedro Cruz[3]
CISUC, Department of Informatics Engineering, University of Coimbra

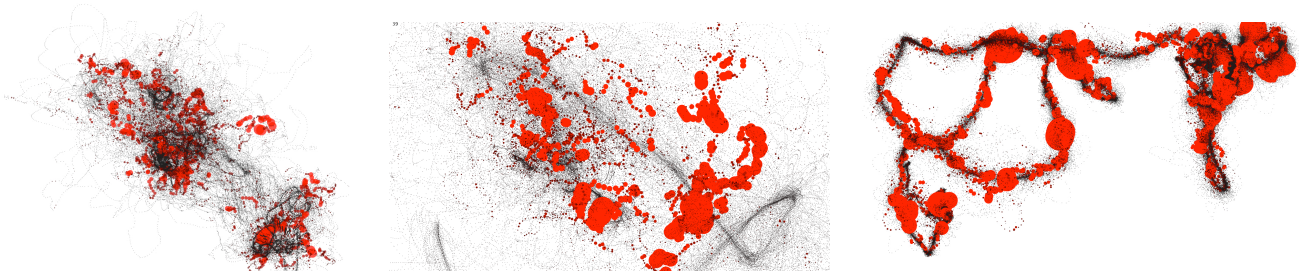

Figure 1 *Three artifacts resulting from the visualization of music pieces of three different genres.*

1 Introduction

Musical Flocks is a project in the field of music visualization. It produces animations by simulating the behavior of agents that react to the sound of music. Additionally, swarm-like behavior is attained by following the rules of separation, alignment and cohesion (Reynolds, 1987). This process produces reactive animations and static artifacts that constitute abstract representations of the pieces, with different genres resulting in artifacts with distinctive visual properties (see Figure 1).

2 Approach

Each agent, or boid, senses specific frequency intervals, reacting to the volume level of those frequencies and to the average volume level of all frequencies in the hearing range. The application reads the music file and performs a real-time analysis of the sound spectrum. The analysis of the spectrum's frequencies is performed using the external library 'beads' (Bown, 2008), with the implemented Fast Fourier Transform function. The processed spectrum consists of an array of 256 samples, each one having an associated volume value, being represented on screen by 256 boids. During playback, the flock moves inside the application's window and reacts to the volume of the sound, leaving movement tracks. The variation of the properties of each boid represents the volume frequencies of the music being played. In silence, the behavioral changes of the flock cease to exist and the group stops moving.

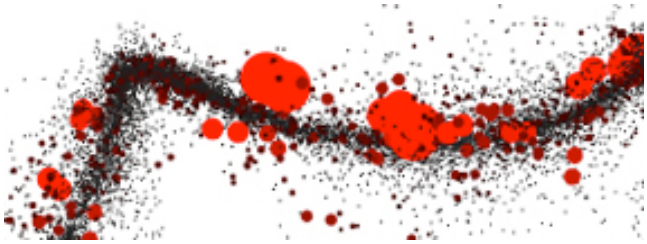

Figure 2 *Detail of one of the produced artifacts.*

The visual characteristics of each boid depend on the volume level of the corresponding frequency interval, with: *size*, *saturation*, *brightness* and *opacity* being proportional to volume. As such, low volumes result in small black circles with low opacity, while high volume results in large, red and opaque circles (see Figure 2). Likewise, the behavior of each agent is also influenced by volume, perturbing its movement's direction, with high volumes resulting in large perturbations. The average volume of all frequencies determines the activation of these behavioral modifiers, which only become active above a given threshold.

The global behavior of the flock depends on the following parameters: *the separation force* that prevents a boid from colliding with neighbors; *the alignment force* that makes a boid steer towards the same direction as its neighbors; *the cohesion force* that makes a boid steer to the center of its neighbors, staying within the group; and *the strength ratio* applied to each of the three forces. Different parameterizations of the flock's and boids' properties modify the overall dynamics of the flock and of its members, affecting the visual results.

3 Results

The visual results depend on various aspects, such as the genre and the tempo of the music, the intensity of the sound, and the instruments played. These aspects modify the temporal evolution of the music and its frequency spectrum at every frame, resulting in differentiated visual artifacts. Slow music makes the flock react gently and move slowly, while a fast music tempo results in fast movement and abrupt changes of direction. Sounds with high volume and rich frequency spectrum affect the majority of the boids, while low volume level and less quantity of active frequencies produce subtle visual variations and a slower graphic evolution. Music with a rich and uninterrupted sound patterns creates continuous black paths accompanied by large red blots. Music with pauses and frequent variations generates discontiguous and scattered black and red stains. The final artifacts generated by music of different genres vary in accordance with the changes in behavior of each agent and of the entire group, resulting in distinctive artifacts for each genre.

Acknowledgements

This research is partially funded by FEDER through POFC – COMPETE, project VisualyzARt with reference QREN 23201.

References

REYNOLDS, C., 1987. Flocks, herds and schools: A distributed behavioral model. *Computer graphics and interactive techniques (SIGGRAPH '87 Proceedings of the 14th annual conference)*, ACM, pp. 25-34.

BOWN, O., 2008. *Beads* [online]. Available at: <www.beadsproject.net> [Accessed 16 December 2012].

[1] ruslan@student.dei.uc.pt
[2] machado@dei.uc.pt
[3] pmcruz@dei.uc.pt