Camera Musica

Compositions in music and space

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Abstract. The relationship between music and architecture in the European context, the similarities, interdependencies and differences of both disciplines, served as starting point for the academic project ‘Camera Musica’. In this project interior design students composed animated spatial interpretations based on the characteristics of pieces of music – video clips – by using visualization- and compositing-software. The goal was to convey specific knowledge in animation techniques as digital design tool and to discover experimental design concepts which arise between the disciplines of music and space.

Keywords. Music; architectural space; animation; compositing.

INTRODUCTION

Music and architectural space

Since antique times exists a strong connection between music and architecture. Already the Pythagoreans developed in the 6th century BC a common foundation by empiric experiments, based on harmonic ratios as aesthetic principle for the composition of music – in terms of harmonics – and the design of architectural space – in terms of proportion theory.

During the Renaissance the correspondence between balanced proportions of architectural space and musical harmony has been elaborated, as to be read in Leon Battista Alberti’s treatises ‘De re aedificatoria’ (1485) in which he describes the ideal spatial proportions based on Pythagorean ratios.

At the beginning of the 20th century this objective number theory gave way in favour of a more subjective/metaphoric connection between music and space: like for example the chapel of Notre Dame du Haut in Ronchamp which Le Corbusier himself describes as an „acoustic sculpture“ or the urban planning project ‘Bloch City’ by Peter Cook (1983) who transferred the notational system of Ernest Bloch’s concerto for violin and orchestra – notes, bar lines and staves – into a city’s tower buildings, bridges and lanes.

There’s certainly no absolute guideline to design architecture or space in the same way music is composed, but at least for the present time it is to adhere, that the design process – of architects as well as of composers – can originally be based on a personal artistic/associative intention, which is then elaborated into a concept.

Visual and emotional impacts of buildings are often inspired and/or described by musical parameters like rhythm, melody, chords and so on. On the
other hand a piece of music is composed out of ‘material’ (notes, tone pitch and duration, volume etc.), ‘structure’ and gets a ‘form’, definitions that resemble parameters known from the architectural context.

Transformation of music into architectural space can be based on different layers – like the already mentioned association – and beyond that the acoustic and the compositional layer (Dermietzel, 2005). The associative layer stands for the spontaneous, subjective, emotional interpretation of a designer or an architect in respect to a composition – for example while or after listening intensively to a piece of music. When music and space are functionally related – either if the music is composed for the performance at a special place or if the place is built for a special kind of music – the acoustic layer comes into focus, which is mostly related on building physics.

The compositional layer at last contains characteristics of music or sound which synergize with spatial characteristics based on equal mathematical structures:

- The tone pitch involves the vertical dimension: stepwise change of tone pitch can be equalised with human movements like walking or dancing, on the contrary the gliding change can be associated with levitation;
- Elapsed time in a composition represents the horizontal dimension, divided into sections by for example by rhythm;
- The change of dynamics can be interpreted as spatial depth, if it happens abruptly: loud = nearby, quite = distant. Gradual change of dynamics implement a more omnidirectional sensation;
- Timbre can also represent spatial depth: sounds seem to be distant for example, when the high pitched frequencies are strongly muted;
- The conciseness of a composition means – according to the reification – that a concise form (regardless of whether 3D-object or melody) always appears to be spatially in the foreground. It also deals with spatial depths (Behne, 1989).

**Representing architectural space via animation**

In architectural animation, the three-dimensional representation of an architectural design is enhanced by the fourth dimension of time. Animation techniques are employed by architects either to create cinematic walkthroughs or as generative design tool (Burry, 2001).

Walkthroughs expand the perspective with the inclusion of the representation of movement around and through buildings, a relatively extreme process compared to traditional architectural exposé such as physical models that place absolute reliance on the viewer’s cognitive and interpretative skills. This way, the visual experience of a three-dimensional space can be simulated realistically, because in most cases the user visually perceives the surrounding space.
from a moving viewpoint – either because the body is moved or just the head. Visualisation software translates this into the animation options of a virtual camera or objects move in the field of view.

Animation can also be used as a device of the representation of morphological shifts in architectural form through movement in reaction to external forces. Often time is taken as the fourth dimension and is the device by which such shifts are explored.

**Classes of visual perception of motion**

All objects and object attributes animated in a virtual scene are managed by a timeline. To achieve realistic visual perception, one can differentiate between the following classes and subclasses of motion that can be simulated with the animation tools within a visualisation program:

Movement of the entire field of view:
- locomotion and head movement

Local movement within the field of view:
- object movement and the movement of surfaces
- movement of people and other living creature
- movement of one's own limbs

**CASE STUDY: CAMERA MUSICA**

**Starting point, methodology and goal**

Similarities, interdependencies and differences of both disciplines, music and architecture in the European context, served as starting point for the academic project ‘Camera Musica’. In this project students composed video clips – animated spatial interpretations based on the characteristics of pieces of music by using visualisation- and compositing-software.

After introducing the aspects of the first part of this paper to the students, the academic project began with the students’ own choice of a piece of music. The only requirements were that it should be instrumentally, not longer than 3 minutes and with distinct sequences. The students were asked to analyse the music and to translate the compositional aspects – like tone pitch, rhythm, dynamics etc. – into spatial parameters, locomotion and camera/object movements. They also should work on the associative layer to clarify the emotional facets of the music and to work out keywords and references for further atmospheric interpretations of geometry, light, material and so on.

The main goal was to convey specific knowledge on one hand in animation techniques as representation possibility for architectural space and on the other hand in the experimental use of the computer as digital design tools while generating spaces, which focus on perception in motion rather than on functional or programmatic parameters. In this respect the case study was meant to trigger the generation of virtual animated spaces as a creative output of an experimental design-process.

**Process**

The design-process was pre-determined by the following definition of specific steps for the translation of music into virtual animated spaces.

- select a piece of music – instrumentally, 3 minutes long, with distinct sequences – and describe it subjectively-emotionally by words and images;
- define keywords and reference-images;
- analyse it objectively-rationally by naming the sequences and by extracting patterns, structures, repetitions and so on out of the composition;
- create a matrix containing the worked out emotional and rational aspects observing the timeline;
- develop a storyboard;
- translate everything into a computer-generated animation, containing the aspects of geometry, light, material, camera and especially movement and sound;
- compose the animation together with the chosen piece of music.

The students choice of music ranged from classical Pachelbel’s canon in D Major over guitar music...
of the band ‘Explosions In The Sky’ to ‘Apocalytpica’, a so called ‘Cello Rock Band’. The first three preparative steps were accompanied by an introduction into the basics of computer-generated animation techniques:

• the method of keyframe animation
• the principles of frame rate and duration
• animation of camera and (target) objects
• the interdependencies of perspective, image section and framing

For key frame animation, object properties such as size, colour, and camera angle a. o. are determined at specific points in time, in the so-called key frames. The animation software calculates the changes in the individual frames between the two key frames by mathematic interpolation.

The frame rate for the individual images determines the quality of an animation. It is set in images per second or frames per second (fps). The optimum calculated frame rate relates to the 50 milliseconds that the retina needs to process a light impetus and receive a new one: a playback of 20 frames gives the viewer the illusion of a fluid motion. The frame rate varies depending on the platform: 25 fps is regarded as a mean default value for the frame rate of a computer animation.

The duration of a computer animation is typically noted by the total number of frames necessary for the intended length of the animation. To do this, the mean value of 25 fps is multiplied with the number of seconds that an animation should run for – in this case the duration of the chosen piece of music.

The animation of a virtual camera corresponds to the movement of the field of view when the observer moves about or moves his or her head. Like a static camera, the animated camera can be moved...
around a room arbitrarily or focus on a target object. The following camera animations are conceivable:
- Animated camera, static target object
- Static camera, animated target object
- Animated camera and target object

The options for camera animation correspond to the settings of a static camera in a visualisation software. These settings – like perspective, image and framing – become visible when the factor time is added to an animation.

The perspective is determined by the viewing angle of the camera, panning around the three spatial axes. Rotating the camera around the vertical axis corresponds to the viewer turning his or her head to pan a room.

The image section is defined by the size of the display detail – the distance between the camera and the scene and the focal length. In animation it is differentiated between three categories: long shot or full shot, intermediate shot and close up.

Framing separates the visible portion of the animation from the area beyond the camera, the off. This, in combination with perspective and image section creates a filmic composition. The composition can be limited to the image format making it appear closed, conveying order and careful arrangement. The contrary, namely spontaneity is conveyed if the objects in a scene are truncated and reach beyond the border of the image format. In addition to framing, experienced directors use spatial parameters such as vertical elements that divide the image into two parts, or window or door openings to frame the plot.

An animation requires thorough preparation. Before aspects such as duration and camera or object motion are determined, a concept must be created that illustrates the chronology as well as the

Figure 5
Image sections: close up and full shot; framing (from left to right)

Figure 6
intended statement and a detailed design. To clarify these aspects, the students were asked firstly to translate the result of their preparation into a matrix that represents time elapsed (in seconds), sound level, tone pitch and different timbres and secondly to combine the matrix with a storyboard that visually illustrates the chronology of the plot.

The last two steps were first to translate matrix and storyboard into a computer-generated animation, containing the aspects of geometry, light, material, camera and especially movement and sound and second to compose the animation together with the chosen piece of music.

Discussion of the results
Within the project the students produced 3-minute video clips, which corresponded analytically and emotionally to the chosen compositions. Thus the results were as different as the pieces of music taken from various music genres – from classical music to heavy metal.

The result of Janine Bläß – for the guitar song ‘A Song For Our Fathers’ by the band ‘Explosions In The Sky’ – has its origins in the monitoring of weather phenomenons in the reference images she found. The geometry exists of two helical surfaces/umbilical cords – which symbolize the two lead guitars and move...
vibrantly while producing hairy bulges due to the tone pitch. Both helixes are textured with different, colour-changing materials. The initially ambient light becomes visible and volumetric. The camera perspective changes from the outside, the observers point of view to the intimate inner space built by the helixes, dependent on the densification of the piece of music.

Viktor Schiller chose ‘Somewhere Around Nothing’, a fast and furious piece of music by the cello rock band ‘Apocalyptica’. His video clip mirrors a panic-stricken escape, driven by the fast rhythm of the music. Gloomy atmosphere – symbolized by the dark, shimmering material he created – alternates with glimmers of light. A ghost light leads the camera’s way through maze-like spaces which seem to emerge just in time to catch the steps of a desperate refugee.

**CONCLUSION**

Right from the beginning the students were highly motivated to transform their chosen piece of music into digital animated videos. The threshold to learn and use a quite complex animation software was accordingly low. In the context of this project, the use of the computer as an experimental, digital design tool worked well. All in all the process proved to be a good way to achieve animated spaces and to sensitise students for perception in motion in architectural visualisation.

**OUTLOOK**

The following steps are …

- to analyse the generated animated spaces regarding their components (like movement/locomotion, geometry, light, material, …) and their interdependencies;
- to compare the animations with the results of an earlier project, where the description of human characters served as starting point for the students to design ‘anthropological’ spaces and to visualise them in stills;
- to compare the perception of dynamic and static spaces or rather perception in motion and motionless perception of spaces;
- to extend the design methodology to other starting points, i.e. fine arts;
- to extend the research by using stereoscopic projections.

**REFERENCES**


[1] www.see-this-sound.at/kompendium/text/75