Mutations by Jean-Claude Risset

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I. Introduction

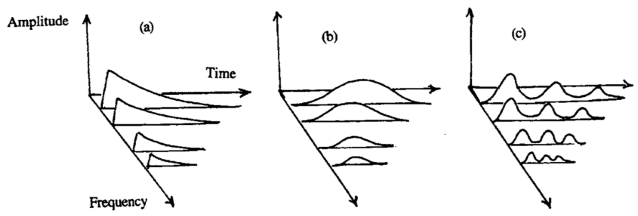
Jean-Claude Risset was a computer music composer and innovator from France. He was a trained mathematician, physicist and pianist. Risset makes multiple references to his own work, saying that he composes "the sound itself, instead of composing with sounds" [1], [2]. Risset is most well known for his work on trumpet timbre synthesis and on the generation of the auditory illusion, the Shepard-Risset glissando.

Mutations is a computer music piece written in 1969 by Jean-Claude Risset. It was commissioned by *Groupe de Recherches Musicales* (GRM). Mutations is often cited as a important piece in the annals of computer music. Much of the sounds for this piece were synthesized with the computers at Bell Labs, under the guidance of Max Mathews [3], [1], [4], then recorded on tape. Max Mathews is popularly known as the "Father of computer music" [5] for his pioneering contributions to computer music, such as the Radio baton and the Music N family of languages.

Risset created a catalog of timbral sounds in Music V. These timbres are made up of wind-like sounds, percussive sounds, spectrum and, pitch glissandi among others [6]. These were meant to act as points of departure upon which a composer can tune the instrument towards the desired output. Risset recalls creating this catalog hastily and without the intention that they may be used as models [1]. Risset was able to meet with and learn from John Chowning at Bell Labs. He was able to utilize Chowning's work on FM synthesis in his own work. Being able to work with Mathews, Chowning, and others at Bell Labs gave Risset the inspiration and materials he needed to succeed.

II. Composition Methodology

A majority of the sounds that make up the piece were composed during the time that Risset spent at Bell Labs on a Honeywell DDP-224. Risset uses all the sounds from a repository of patches written in the MUSIC V language. In addition to the patches, he uses "analog mixing, analog reverberation and frequent resampling" [1].



Perspective plots of inharmonic tones. Source: [7]

Bell and gong sounds were synthesized using nested structures of fixed frequency ratios. Risset used linear predictive coding or a phase vocoder to modify some aspects of a recorded sound. The original bell sounds, Figure 1a, have "a short attack followed by an exponential decay. [Figure 1b] is deduced from [Figure 1a] by changing the envelope to a smooth belllike shape. ... They yield textures in which the components are disperesed like white light through a prism" [1]. Risset used an "arrpegioed chord followed by a gong-like sound, composed like a chord, with the same implicit harmony" [1] to imitate the overtone structure of bells without the same attack. To achieve realism in the modified sounds, "slow amplitude modulations" [7] are added to Figure 1c.

Risset, in [8], talks about using scores as "Musical texts". He talks about using serial techniques, where he uses a cyclical motif of 12 pitches and 11 durations to get a "serial note mill", similar to Oliver Messian's work *Mode de valeurs et d'intensité*. He uses transformations on this serial note mill extensively to generate the synthesized sounds of Mutations. The transformations allow the pitches to gradually shift into harmonic relations and fade out the serialistic structures.

To evaluate the structure of the composition, Boura [9] proposes a "Rhetorical method for the critical appraisal of Electroacousic structures". The rhetorical approach tends to derive from the Aristotelian approach to helping an orator communicate better with an audience. A rhetorical structure for understanding music typically involves:

- The Prelude
- The Narration
- The Division
- The Proof
- The Refutation

Rhetoric structure is very apparent in much of the early *Musique Concrete* and *Elektronische Musik* - Boura analyses several pieces from composers such as Pierre Schaeffer, John Cage and Stockhausen. In addition to the aforementioned composers, the author also cites Mutations as a piece that uses a clear rhetoric structure in its composition.

III. Aesthetics

Having been born and raised in France, he was aware of current musical trends happening around him. He did feel influenced by the musical aesthetics present in Paris, of Schaeffer and musique concrete. His reaction to this movement was that it "yielded dull sounds that could only be made lively through manipulations which, to a large extent, ruined the control the composer could have over them" [1].

In an interview with Curtis Roads, Risset, in answering a question about why he as a composer has turned to the

computer responded with an answer about his interests as a composer and sound designer. Risset states that his interest as a composer has been in the timbres of sounds. However, limitations with analog electronic music did not offer enough control to an artist. Working with Max Mathews and the computers at Bell Labs allowed him to explore synthesis deeper and refine his musical aesthetic better. Specifically, computers allowed Risset to tackle four specific problems [4]. One of which is described as :

> ***Suggest an illusory world****, as John Chowning demonstrated so convincingly, by playing directly, so to speak, on perceptual mechanisms, thus unveiling perceptual "primitive".*

Risset's work focuses on the perception of the content, rather than the frequency structure of the content. This can be seen in his work on trumpet and bell timbre, Risset glissandi, and specifically in *Mutations*. Risset aligns with and revives the perceptual argument of Artistoxenus. This argument against Pythagoras states that "the foundations of music are not in number ratios, but in the ear of the listener" [2]. Risset's glissandi "seem to go down in pitch when their frequencies are multiplied by 2 - a striking effect that is contrary to intuition and common sense" [2]. This work was influenced by Roger Shepard, who's time at Bell Labs overlapped with Risset's, and who is known for his creation of the Shepard tones. These tones, despite aurally ascending endlessly, do not actually continue to ascend. Shepard "believed that a gap was needed between tones to achieve the illusion" [1].

When discussing the additive synthesis used to create bell tones, Risset is very specific about mentioning realism. He adds the amplitude modulations to the bell tones (Figure 1c) because "such modulations exist for real bells; they can be ascribed to beats between closely spaced modes because the bell does not have perfectly cylindrical symmetry. Beats in bell-like and gong-like sounds can produce an effect of warmth" [7]. It is this attention to detail that gives the synthesized sound the authenticity and realism Risset was hoping to achieve.

IV. Impact

Mutations was honored at Dartmouth in 1970 and it went on to inspire a laser and film composition by Lilian Schwartz in 1973, which was awarded a "Golden Cine Award".[3]

Mutations is a notable example of illusions of the ear, as credited in the Computer Music Journal [10]. His work on the Shepard-Risset glissandi has continued to be a focal point in many music perception experiments. [11].

Sounds used by Risset in *Mutations* via the Risset's catalog provided some of the earliest realistic instrument libraries. The catalog remains accessible through *Csound* via the Csound book's CD-ROM catalog of instruments[12].

V. Conclusion and Thoughts

Risset was an exemplary composer and inventor. He was able to work at one of the most cutting-edge laboratories in the world and alongside some of the most important computer scientists and composers of that era. His own personal research led to many breakthroughs in timbre synthesis and perception of computer music, both of which can be classified as musical illusions.

In *Mutations*, Risset is able to combine both of these musical illusions in one piece. His acute knowledge of how spectral information of a sound is transformed and how it can be altered was used to the greatest of its ability in the synthesis of the bell tones. He works diligently to transform one sound to the next, using one timbre to extend the harmony. Throughout the piece, many aspects of the music are serialized and highly controlled.

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