

Concert at CCRMA , march 10, 2020
Speaking in mute silence.

Vilbjørg Broch , Computer generated immersive audio and voice.

I am at CCRMA as a visiting scholar, and will stay till the end of march.

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The concert is officially canceled due to the Covid-19 virus. Instead of program notes this is a bit of detailed information, it is mostly meant to share with people related to CCRMA. It is rather technical, so if you do not work with audio dsp on a daily basis, then please do not feel intimidated. The news about canceling public events at CCRMA came only last week, so I have not really planned this to be a stream-able concert. All works are encoded for ambisonics. A few include acoustic voice in the space. Many thanks to CCRMA for hosting me and to the staff for helping me realizing this.

All works are new. The general connecting idea for these works is to explore the projection of higher dimensional geometric and algebraic structures onto 3D for spatialization. In this way large systems of FDNs are created, time-varying to various degrees since the structures are rotating in the higher dimensions and then projected. All spatialization and synthesis is realized as large PD objects and the ambisonics encoding happens directly within the objects (5th order). As well as various filtering. I write all math functions myself, I guess that is something I really like to do. Something which is especially useful also for this project is Clifford algebra, which enable rotations and hyperplane reflections in any dimension. Almost infinitely more work could be done to continue to develop the basic ideas in this project: straight forwards lies refined filtering and also very much looking at the scattering functions within the systems, this I have practically not yet explored. I know many people at CCRMA know much about these things so the idea with sharing some technical information on the pieces is very much to inspire for conversation.

There will be 5 pieces, everything is live generated:

Efflux

Computer generated immersive audio. 11 min.

The spatialization is done using the 6D hypercube. I looked a lot at these structures, the basis of Euclidean space, generating the standard lattice. I have mapped to the 8cube inclusive. Understanding how all subspaces are connected. But with my current ideas for implementation it is too computationally intensive to go higher than the 6cube. Something fun about the hypercubes , or measure polytopes as the great 20th century geometer Coxeter named them, is that in dimension n the number of vertices is 2^n while the sum of all subspaces is 3^n . In 3D these numbers are 8 and 27, in 8D they are 256 and 6561. This has very much been the thread to find the way through the structures, but the story is a bit long.

The overall time-structures of the piece is a non-period order series generated as substitution series using matrices iteratively.

Deep Black Unlearning

Computer generated immersive audio and voice. 13 min.

The text fragments are from C.G. Jung's 'Psychology and Alchemy'

In the alchemical work - the opus - the transmutation of the metal and that of the mind are not separate processes. There is some reference to the necessary state of 'Nigredo' which one will have to pass through.

The synthesis is done with the 'Quasicrystal Phase Function' Quasicrystals have been with me since 2013, when I by chance ran into polish mathematician Mark Grundland who was working at Cambridge, UK at that time. Quasicrystals are characterized by nonperiodic order, rotational symmetry but no translational symmetry. Mathematical quasicrystals can be generated by projecting sections of lattices onto irrational subspaces. In chemistry they were first seen in the 1980ties in alloys of metals and revolutionized crystallography. The function I am using here is from the complex plane to the real numbers. It ends up being a 10fold sum of complex exponentials of very specific ratios. I do not think anyone would have guessed that without taking the trip around studying the symmetries of the Coxeter groups.

The spatialization structure is abstract, using finite fields – number theory – to connect 56 nodes in space.

7 Sphere Karma

Computer generated immersive audio. 6 min.

Practically everything in this piece is generated using the 8D algebra the octonions. Multiplication of 2 unit length octonions will keep you on the 7 sphere. The octonions have been with me for some 3 years by now, and it will probably take several lifetimes to exhaust their finesses. Finally here the octonions get to swirl a bit in full 3D. Good old phase modulation but everything controlled by orbits from 8D. Time structures are generated from octonion multiplication over finite fields.

The dreamer is at a social gathering. On leaving she puts on a stranger's hat instead of her own.

Improvisation. Voice and computer. 5 min.

The spatialization is done with the 5cube, but using projective geometry and homogeneous coordinates.

Syntropy 7 times 8

Computer generated immersive audio. 14 min.

The composition can in some ways be called 'spectral' . The spatialization is again an abstract graph system. The synthesis is wave-table oscillation from quite large wave-tables, so that the reading window can be gradually moved and hence vary the spectrum of the tone a little bit. The waveforms for the tables are generated using a family of polynomials and iterating over finite fields. I am using the Spread polynomials discovered by mathematician N.J. Wildberger relatively recently. (The logistic equation lies as the second degree) I have used this in many different ways during the later years. When computing over finite fields it is possible to vary complexity by varying the size of the field , e.g. the prime number. In this way noise of different periods and complexities can be created. From the same prime and initial value a different series can be created with a different degree polynomial.
