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Sonifying Chemical Evolution

First Life - imagining the chemical origins of life

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ABSTRACT

This presentation discusses the creation of *FIRST LIFE*, a 75-minute mixed media performance for string quartet, live audio processing, live motion capture video, and audience participation utilizing stochastic models of chemical data provided by Martha Grover's Research Group at the School of Chemical and Biomolecular Engineering at Georgia Institute of Technology.

INTRODUCTION

This composition created auditory models of many of the elemental and environmental conditions present in early Earth thus providing a new way to imagine the salient biochemical morphologies at play in the origins of evolution. One of the goals was to create both an artistically sensitive realization of the scientific data and to provide an educational opportunity for audience participants to engage with the fundamental principles and challenges of this multinational research project into the origins of life.

Data values drawn from self-organizing chemical compounds were assigned to the sonic properties of frequency, amplitude, duration, timbre, tempo, string instrument physical properties, and spatial location. The stochastic processes also contain Hidden Markov Models that embed a degree of probabilistic input from both the computer-generated processing and from the Vega String Quartet.

Audio-visual programs used in the composition of the work were Kyma, Max, and Isadora. The live motion capture video system uses two Microsoft Kinect and is a further development of a system created in 2008 for my chamber opera, *Ophelia's Gaze.*

CHEMICAL BACKGROUND

The Martha Grover biochemical team at Georgia Tech designed a computer model to explore the very earliest stages of the chemical evolution of life. One of the big themes to emerge from the model is that to end up with the diverse stuff of life, information-carrying polymers must strike a balance between stability and instability.

COMPOSITIONAL PROCEDURES

PHASE 1: Collecting data: monomers, polymers, oligomers, peptides, amino acids; RCSB PDB Protein Data Bank

PHASE 2: Visualization: PyMOL molecular visualization

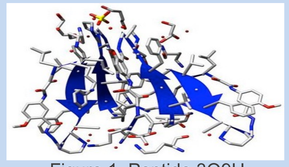

Figure 1. Peptide 3Q9H

PHASE 3: Data-driven composition: MaxMSP with IRCAM FTM objects, Open Sound Control, stochastic processes

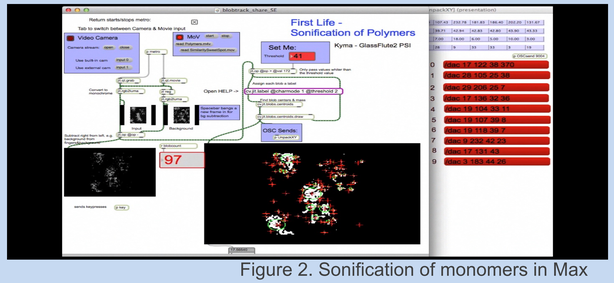

Figure 2. Sonification of monomers in Max

PHASE 4: Performer interaction / MaxMSP & Vega Quartet

Pitch classes mapped to polymer chains

0 2 4 7 9	C D E G A	0 2 5 7 9	C D F G A
0 2 6 7 10	C D F# G Bb	1 2 5 8 9	C# D F G# A
2 3 4 7 8	D Eb E G Ab	10 1 2 3 4	B C# D Eb E
3 4 5 6 11	Eb E F F# B	6 7 8 9 10	F# G Ab A Bb

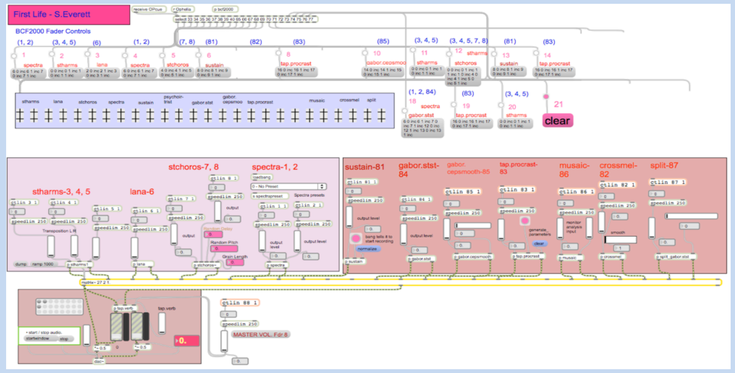

Figure 3. Max patch for live electronics

PHASE 5: Audio parameter matching: physical modeling, Kyma

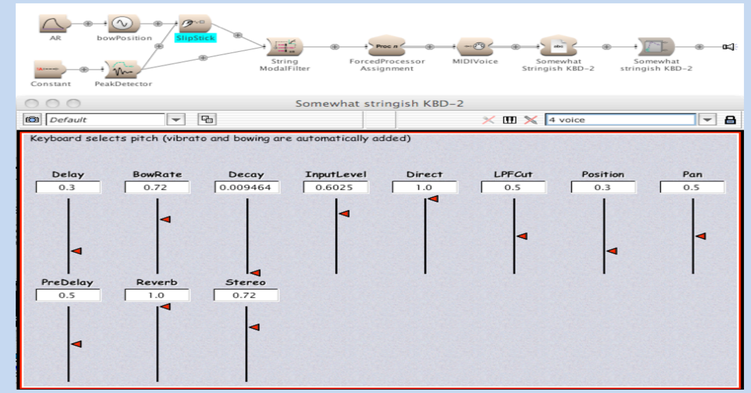

Figure 4. Physical string modeling of data in Kyma

PHASE 6: Performer-audience gesture capture and interaction:

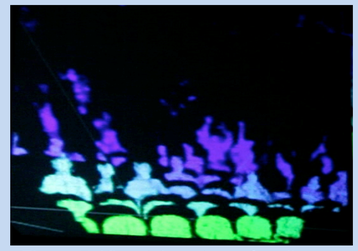

Figure 5. Kinect 1 capture of audience

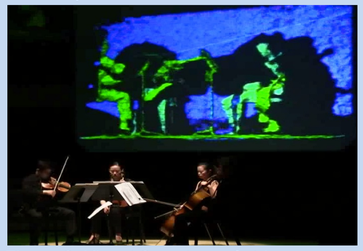

Figure 6. Kinect 2 capture of string quartet

ACKNOWLEDGEMENTS

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