About This Issue

Karlheinz Stockhausen's life ended a year ago, but the influence of this giant of 20th-century composition will long persist. *Licht-Bilder,* the third scene of the opera *Sonntag* from his monumental *Licht* cycle, premiered in 2004. When *Licht-Bilder* was performed at the Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe later in 2004, Ludger Brümmer of ZKM interviewed the composer. This issue of *Computer Music Journal* includes a new translation of that interview, which focuses on Stockhausen's approach to electronics, using *Licht-Bilder* as a point of departure for a more general discussion. Stockhausen outlines his vision for future musical development in the parameters of dynamics, timbre, and space. He then answers questions on the role of the composer and on the use of machines, describing the inception of a composition as "hearing something as if in a dream."

The cover of this issue announces "Parametric Piano Synthesis," the subject of the article by Jukka Rauhala and his co-authors. The emulation of traditional musical instruments has long served as a touchstone for sound-synthesis techniques, because those sounds are so familiar that any limitations of a technique tend to leap into focus more quickly than when the technique is applied to creating novel sounds. "Sampling synthesis" solved that problem by simply using audio recordings of the instruments. The utility of sampling synthesis is illustrated by the ubiquitous digital piano, whose effectiveness owes much to the fact that piano notes are discrete and have few control parameters, allowing them to be reproduced using a limited set of recordings. However, there are some advantages to synthesizing the sounds of musical instruments, even the piano, without using recordings. These include drastically lower memory requirements (an important consideration for hand-held devices) and the ability to achieve useful timbral variations by manipulating synthesis parameters in ways that might or might not mimic the physical instruments.

The article by Rauhala et al. presents a physics-based approach to synthesis of the piano. (Sound examples are included on the DVD that accompanies this issue.) Their technique employs a digital waveguide model of the piano string, as well as simulations of beating, sympathetic resonance, and the knock of the hammer strike. The synthesis algorithm permits real-time control of parameters such as inharmonicity and fundamental frequency. This real-time control not only speeds the task of tuning the model for a specific target sound but also encourages the creative exploration of timbres impossible to achieve with real pianos. The authors describe the model's implementation in PWGL, a Lisp-based graphical patching environment for composition and synthesis.

A related environment for computer-aided composition is OpenMusic, which like PWGL has roots in the PatchWorks software developed in the late 1980s and the 1990s. The article by Jean Bresson and Carlos Agon introduces a new object in OpenMusic, called the sheet. A longstanding problem in music representation concerns how to align traditional notation with simultaneously depicted linear-time functions, such as audio waveforms and graphs of MIDI data. Instead of warping the music notation to fit a strictly linear time axis, the sheet object embodies the opposite priority, warping the linear-time objects to align with the non-proportionally spaced symbols in the music notation. The authors also discuss other features of the sheet and general problems of score representation in computer music composition. The objects within the tracks in a sheet can be constructed algorithmically using OpenMusic patches embedded within the score. Objects can be inspected and manipulated using various editors in OpenMusic, and functional relations can be established between them.

The article by Dionysios Politis et al. presents a very different type of software for notating and synthesizing music. The focus here is not on visual programming or on computer-aided contemporary composition, but on assembling and auditioning music in the style of ancient Greece. After an overview of the materials of ancient Greek music and the sources from which scholars understand it, the article presents two pieces of software. One is a simple Flash-based interactive demonstration that introduces novices to the features and speculated sound of the kithara, an ancient stringed instrument. The other is a more complex Windows application for composing music with ancient Greek musical notation and tunings. This second application offers a Csound-synthesized aulos (an ancient woodwind), as well as vocals created using the Synthesis Toolkit (STK). The vocal synthesis employs a text-to-singing interface and historical pronunciation. As presets, the application offers a few

Front cover. A portion of a grand piano. (Image-processed photo by *Computer Music Journal*.)

Back cover. This screen image shows a Csound synthesis patch embedded in an OpenMusic sheet. See the article by Jean Bresson and Carlos Agon for details.

of the approximately 60 ancient melodies or melodic fragments that have survived by virtue of having been notated in stone or on papyrus.

The final article explores the potential of information theory for music analysis. The authors, Elizabeth Margulis and Andrew Beatty, consider some implications of entropy for music cognition and aesthetics. They speculate that entropy might be a valid measure of novelty, surprise, or complexity, and that different musical styles might exhibit higher entropy in different parameters. Then they present their own study of entropy in music. Using David Huron's Humdrum toolkit, they analyzed a database of approximately 270 pieces or movements by Bach, Corelli, Handel, Telemann, Haydn, and Mozart, as well as 33 barbershop quartets. Eight musical parameters were investigated: duration, texture, and six parameters related to pitch. The authors found that entropy in a musical parameter could correspond to some rough aspects of style, and that in some styles much of the entropy occurred in a single parameter. In most parameters, music from the second half of the 18th century tended to have higher entropies than music from the first half.

Max Mathews has been getting some well-deserved attention on the occasions of his 80th birthday, in November 2006, and the 50th anniversary, in 2007, of his introduction of software for synthesizing audio samples—a technology that laid the engineering foundations for the fields of computer music and digital audio. For example, Mr. Mathews gave the keynote speech at the 2006 International Computer Music Conference (ICMC) in New Orleans; and in 2007 a "MaxFest" consisting of concerts and talks was presented at Stanford University and in Mountain View, California. In 2008 and 2009, *Computer Music Journal* is continuing to celebrate Max Mathews's contributions. The DVD accompanying this issue includes videos of his ICMC keynote, other comments of his at the ICMC and at MaxFest, and footage of him performing at MaxFest.

Mr. Mathews also served as the curator for part of this DVD. We had asked him to select some of his favorite computer music, and he chose works by seven composers with whom he has been associated over the years: Jean-Claude Risset, John Chowning, William Schottstaedt, Emmanuel Ghent, Gerald Bennett, Jon Appleton, and Richard Boulanger. Mr. Mathews also appears as a performer on his invention, the Radio Baton. We thank him and the composers for allowing us to include their music on the DVD. In addition, Mimi Garrard graciously provided us with the video of her dance company performing Mr. Ghent's *Phosphones*. The disc also includes sound and video examples related to recent and forthcoming articles in the Journal, including the article on piano synthesis in this issue. Additional material by and about Max Mathews will appear in these pages and on the annual disc in 2009.