# About This Issue

This issue's first article describes "bach," a free library for the widely used Max music software. (Its name is a recursive acronym for "BACH: Automated Composer's Helper.") The authors explain that with bach they aimed to narrow the gap between symbolic music processing, as typified by music notation software and specialized computer-aided composition environments, and signal processing, as typified by sound-synthesis languages and digital audio tools. bach focuses on real-time manipulation of symbolic musical data. Moving beyond simple display, editing, and playback of notated music, bach provides over 200 modules for processing the note data. At the same time, its integration into Max gives the user access to digital signal processing, MIDI, visual data, and hardware interfaces. The authors designed bach to serve as a potential foundation for other libraries for interactive computer-aided composition. They describe one library already implemented, called "cage," which is intended for higher-level manipulation of symbolic musical data and for solving typical compositional problems. (One application of the bach and cage libraries will be discussed in the Fall 2015 issue of *Computer Music Journal*.)

The next two articles are based on research that won Best Paper awards at the New Interfaces for Musical Expression (NIME) conference in 2013 and 2014, respectively. The first of these, by Andrew McPherson, describes how he has augmented traditional musical keyboards by sensing the continuous motion of the keys themselves or of the performer's fingers. After analyzing aspects of continuous motion in keyboard technique, the article presents a historical survey of acoustical and electronic keyboard instruments whose keys have provided continuous control. These date back to Leonardo da Vinci's *viola organista* design. Later examples include the baroque clavichord, the early 20th-century Telharmonium and Ondes Martenot, and some late 20th-century synthesizers, e.g., the Yamaha CS80. Today, continuous-control keyboards show up in instruments such as McPherson's own magnetic resonator piano (described in *CMJ* 36:4, Winter 2012). The article then reports on his optical keyboard scanner, which is the device that was described in the NIME 2013 paper. This scanner fills the void left by the discontinuation of the Moog PianoBar (see *CMJ* 29:1, p. 108) while adding new capabilities such as polyphonic aftertouch. Another of the author's inventions, TouchKeys, consists of capacitive overlays that can be attached to the key tops of any keyboard, making each key a continuous, multi-touch controller.

Luke Dahl's article similarly concerns capturing a performer's motions, but in this case the performer is not playing a physical instrument but instead is "air drumming," i.e., playing an imaginary percussion instrument. The performer's in-air gestures can be detected in order to trigger synthesized percussion sounds. Interfaces that rely on gestures in the air, such as the theremin, work well for controlling continuous, sustained sounds, but percussive sounds pose problems of timing: At exactly which instant during an air drummer's gesture should the sound be triggered? To answer this question, the author conducted a set of experiments in which air drummers played along with a recording while their gestures were recorded by motion-capture cameras. The captured data were then analyzed to determine which movement features best corresponded to the moment of the percussive attack. The most useful feature was found to be the sharp peak in magnitude acceleration that occurs at the instant that the hand starts to decelerate. This research result can be expected to improve the timing of sound synthesis triggered by air drumming.

In the next article, Lance Putnam explores a signal-processing technique for creating new sorts of echo effects. The textbook echo effect is produced by delaying an audio signal, reducing the amplitude of the delayed signal, and adding it to the input signal in a feedback loop. The amplitudes of the resulting echoes follow an exponentially decaying curve. Putnam's new digital technique, which he terms a "waved echo," relies on complex numbers to represent all aspects of the signal path, including the audio data as well as coefficients and other variables. Instead of a single delay feedback, there is a set of $n$ parallel signal paths, with the signal

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*Front cover*. A figure from the article on the bach software, depicting Andrea Agostini's music for the film *Wunder der Schöpfung.* The ostensible notes in the score actually contain numerical data, breakpoint functions, and textual instructions that control a complex sound-synthesis system synchronized to video playback.

*Back cover*. Figures from the article by Giraud et al. The top illustration contains the opening measures of the second fugue from Book 1 of the *Well-Tempered Clavier*, manually annotated to point out various fugal elements. The bottom illustration shows the corresponding automated analysis of the entire fugue.

in each path being fed back and finally summed with the others. The amplitudes of the resulting echoes now follow the shape of a curve that is the sum of $n$ damped complex sinusoids. The real and imaginary parts of the complex audio output can be tapped independently, and interesting spatial trajectories can be created by mapping the real component to the left channel of a stereo signal and the imaginary component to the right channel, or vice versa. The author describes various effects that can be produced using waved echoes, as well as a variety of transformations that can be applied. Sound examples are available online at MIT Press's Web site.

The final article, by Mathieu Giraud and colleagues, presents a system for automated musical analysis of fugues, given a symbolic representation of the musical input in which the polyphony is separated into individual voices. The authors' algorithms detect the canonical parts of a fugue: subject, countersubject, etc., as well as features such as harmonic sequences, pedal tones, and cadences. As a corpus to analyze, the authors chose the 24 fugues in Book 1 of J. S. Bach's *Well-Tempered Clavier* and the first twelve fugues in Shostakovich's *Twenty-Four Preludes and Fugues*, op. 87. The authors compare the results of their automated analyses with "ground truth" data that includes musicologists' manual analyses of the same works.

In this issue's Reviews section, Andrew Lambert and Florian Krebs report on a conference in Abu Dhabi that examined rhythm in a cross-cultural and interdisciplinary context. Perspectives particularly relevant to computer music included those of music information retrieval, psychology, and computer-assisted composition and performance. Next, former *CMJ* editor Curtis Roads reviews the English translation of a French book on the late composer Luc Ferrari. Our current reviews editor, Ross Feller, then shares his thoughts on Neil Leonard's CD *For Kounellis*, which was inspired by a large sculpture consisting of upside-down church bells.

Concluding the issue, the Products of Interest section announces recently released audio and MIDI hardware, a good number of software plug-ins, and other software such as the new version of Max.