Brain Computer Music Interfacing Demo

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Research Objective:

Development of Brain-Computer Music Interfacing (BCMI) technology to connect the brain directly with musical devices such as personal stereos, automated pianos and electronic musical instruments.

We hope to make the results of our research available to people with physical difficulties, who are unable to play music using standard musical devices. The entertainment industry may also benefit from this technology (e.g., games, etc.), but this is not our primary objective at the moment.

The objective of these slides is clarify what the proof of concept system shown in the demo movie is actually doing.
Achievement to date:

A system that composes different musical pieces and plays them with expression on an automated piano using information extracted from the electroencephalogram (EEG) of a subject.

There is no magic and there is no cheating either.
We are not interested in science fiction. Rather, we are interested in developing systems that work in reality.

Let’s clarify this: pigs don’t fly!

Our system does not...

• … play a tune that you think in your head or “mind’s ear”. This is impossible with current technology.

• … allow you to play the keys of the piano by explicitly thinking about playing them.
What the system actually does:

It composes and plays the music based on the information found in the brainwaves.

• It analyses the brainwaves

• Then it activates compositional rules to generate specific types of music according to the results of the analysis

• Finally, it composes the music and plays it on the piano, in “real-time”
(Very) Brief Introduction to Brain-Computer Interfacing (BCI)

1. Brain signals are analysed to extract particular features
2. These features are translated into commands to operate a device
3. User and system must adapt to each other (feedback)

Our system analyses the ongoing spectrum of the EEG in order to:

(a) infer the spectral band of its most prominent frequencies (FFT)
(b) measure the complexity of the signal (Hjorth analysis)
The frequency band is used to control a generative system that **composes** the music.

The signal complexity is used to control the **interpretation** of the music, in this case its tempo. The more complex the signal, the faster the music.
The generative system composes sequences of short sections of music using **musical grammars**. In the demo movie, each section is generated by a rule selected from two sets of grammatical rules to generate music in two different musical styles: Eric Satie and Beethoven.
If the most prominent frequencies are in the lower band of the EEG spectrum (< 12 Hz) than the system generates music in the style of Eric Satie.

If the most prominent frequencies are in the higher band of the EEG spectrum (> 13 Hz) than it generates music in the style of Beethoven.

The subject in the movie has learned how to switch from one style to the other; is it not difficult to learn this (e.g., by closing his eyes and relaxing he could command the system to generate music in the style of Eric Satie.)