# ADEPT: A FRAMEWORK FOR ADAPTIVE DIGITAL AUDIO EFFECTS

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## ABSTRACT

The field of music information retrieval (MIR) has enabled research in 'intelligent' audio processing. Emerging applications of MIR techniques in music production might provide mixing engineers, musicians and composers control over extant effects processing plugins based on the audio content of the recorded music. In adaptive digital effects (ADAFx) processing, mapping functions are used to modulate algorithm parameters via features that are extracted from the input audio signal or signals. We present an audio software plugin that is designed to facilitate feature-parameter mappings within digital audio workstations. We refer to it as the Adaptive Digital Effects Processing Tool (ADEPT).

## 1. BACKGROUND

There are many examples of adaptive effects, such as dynamic range processors, gates, and pitch-correctors that have long been mainstays of music production. Previous research has investigated organizational methods for adaptive digital audio effects [1, 2]. [1] proposed a general taxonomy of adaptive effects, describing auto-adaptive, external-adaptive, feedback-adaptive, and cross-adaptive techniques. [2] went beyond purely signal-level models of content with a comprehensive treatment of 'content-based transformations'. Related research has investigated adaptive processing for automated mixing tasks, for example [3, 4]. [5] and [6] focused on implementing flexible frameworks for user-defined adaptive effects routing using audio plugins as target effects.

## 2. SYSTEM DESIGN AND IMPLEMENTATION

The ADEPT adaptive audio processing software utilizes existing audio plugins and implements feature extraction and a mapping algorithm in order to facilitate ADAFx processing. As a result it can control any processing parameters that are made available as automatable controls within the digital audio workstation (DAW). Developed using JUCE, a C++ framework which enables cross-platform deployment of audio plugins, it communicates with Ableton Live using Open Sound Control [7] and the LiveOSC MIDI Remote Script. ADEPT works with the DAW and existing plugins, providing immediate benefits due to the large variety and quality of available effects processing and synthesis algorithms, and integration with production and performance practices.

Each instance of the ADEPT plugin computes a stream of audio features using Essentia [8], a C++ audio feature extraction library. Audio features from a given source may be mapped to any plugin parameter in the DAW session, including those belonging to plugins residing on other tracks. At present, the feature-parameter mappings are one-to-many; a single feature stream may feed multiple mappings controlling different parameters. The software makes it easy to realize evocative real-time effects (Fig. 1) via feature-driven effects automation (Fig. 2) controlled through the graphical user interface of a software plugin (Fig. 3).

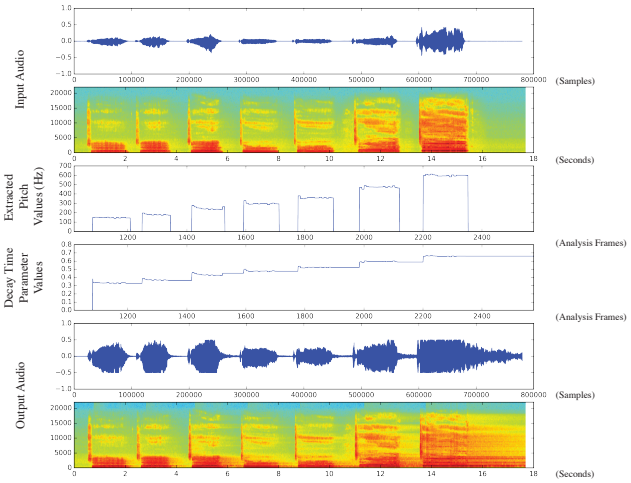


Figure 1: Example time series of audio feature and effect parameter data with mapping from pitch to reverb decay time

## 3. EVALUATION

Two pilot studies were conducted to explore potential evaluation methods and to gain insight into the strengths and weaknesses of the software prototype. Qualitative data was collected regarding the utility of the proposed ADAFx routing framework, the user experience, and the aesthetic quality of the audio effects produced by participants in study. Part I was based on music production tasks to be performed

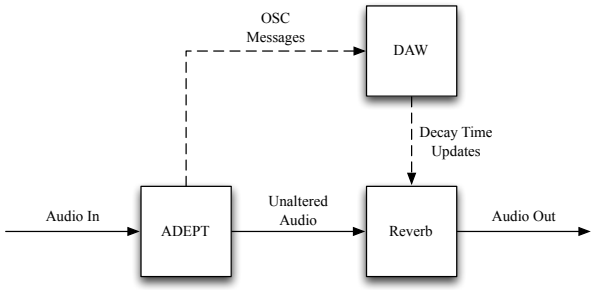


Figure 2: Block diagram of pitch to reverb decay time mapping


Figure 3: View of the ADEPT plugin GUI

with the ADEPT plugin or with conventional methods. In Part II, expert listeners were asked to evaluate the audio output from Part I. Due to the small number of participants we cannot draw strong conclusions, but the results suggest that such a system may be a valuable addition to conventional mixing and performance workflows for effects processing and synthesis.

## 4. CONCLUSION

We developed a conceptual framework for flexible adaptive effects routing in the DAW environment and investigated potential use cases for such a system. A software implementation of this framework was created in the form of an audio plugin, where we explored the utility of a number of audio features and an interface for defining control mappings. Finally, we conducted a small two-part pilot study to evaluate the software's utility and integration with existing workflows.

## 5. REFERENCES

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