Research Proposal: Practical Algorithmic Co-composition

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1 Case for Support

1.1 Overview

Machine learning is a field of study that has been growing at an extraordinary rate since its inception. It has been applied in a wide variety of areas, and is rapidly becoming the key technique in any task that involves the use of large amounts of data. One area in which machine learning still struggles to face real world application however is in the creation and refinement of art.

Although a reasonable volume of research has been committed to producing "creative" artificial intelligence for the creation of art, there is currently very little to show for it in terms of practical applications. One of the key reasons for this is that, as in many extremely hard problems that depend on experience and intuition, machines are still far from outperforming skilled humans in the general case. This is to be expected as the technology is still emerging and somewhat immature, but the currently available technology may still be suitable to start producing real world results when focused on the right task.

The research being put forward by this proposal is directed towards an artificial intelligence capable of performing a large subset of the skills used in song composition. The particular skills possessed by the AI will be such that instead of writing original compositions independently, it will perform interactive composition with a human composer. By doing so the AI is able to perform a significant share of the work during composition without being required to single-handedly tackle the full creative scope of the task. This approach addresses many of the shortcomings of current musical AI in the context of a practical implementation.

The key challenges that will be tackled by this research project can be summarised as:

- Identification of the specific tasks in which AI is sufficiently powerful to assist skilled human composers, and in which automation is expected to have the most positive impact in the creative process.
- Determining a set of machine learning algorithms that are capable of performing these tasks in such a way that the material they produce is useful to composers.

Success in both of these areas would cleanly pave the way to practical musical AI. This would be a groundbreaking step forward within the field, as to date applied musical AI has served purely experimental or demonstrative purposes. Involving an AI directly in the real-world creative process of composition would provide enormous benefits to the field, in terms of useful research data, economic incentive, and public interest.

1.2 Background

The use of technology in music composition has grown greatly in recent years. With the advent of software synthesizers, DAWs, and the MIDI format, the PC has become a powerful professional tool for composing and editing music. The impact that this has had on the music industry has been extraordinary, with much more power being put in the hands of independent and amateur producers; combined with the platform for promotion and distribution provided by the internet this has resulted in a large number

Algorithmic composition as a field has captured the interest of many researchers, but currently remains highly impractical. There are many limitations to the currently used algorithms, and while partial successes have been made there is no current real-world use case for these systems. Instead the goal of the existing body of work is focused on achieving a complete algorithmic composer of equal ability to a human composer. Although a great deal of progress has been made towards this goal however it may not be the most direct route to an algorithmic composer that serves a practical purpose.

The most cutting-edge algorithmic composition systems currently are used to produce music of various styles. One of the most successful and well-known of these is Iamus, a supercomputer running software based on the Melomics system [**diaz2011composing**].

The earliest attempts at algorithmic composition were not knowledge-based, but rule-based. Musical experts would encode sets of compositional rules and constraints into code, which would then generate scores that followed these rules. Implementations of this method have been able to produce some interesting and occasionally powerful results. However, they are noted to be very "brittle", meaning that they tend to perform very poorly outside of certain cases. Performance improves slightly in specific subtasks, such as harmonization, but so far no suitable results have been produced.

Machine learning was introduced to composition during its earliest days, with the use of simple models such as Markov chains trained on small numbers of songs to generate rhythm [4]. These attempts tended to produce very low quality or simple output. The reasons for this include lack of processing power, lack of data sources, and the use of fairly unsophisticated methods.

More advanced approaches began to emerge decades based on the use of neural networks trained on a set of melodies to generate new melodies [5]. These methods still performed quite poorly in practise, but demonstrated more versatility and produced better subjective results than earlier attempts. Since then many more modern adaptations have been made to previous methods, such as using evolutionary search or learning rules from data. However, the results given by AI in pure composition are still quite poor according to subjective evaluation.

With this inadequacy of AI in its current state, most research is focused on specific subtasks of composition. These include tasks such as harmonization for specific genres or styles [3], measuring distance or 'similarity' between musical objects [2], and generation of chord progressions [1]. The current AI landscape is not sufficient to create a whole original composition, as there are many gaps and imperfections in the work accomplished so far.

Continuation as a goal of algorithmic composition has been previously attempted with a few specific methods.

1.3 Objectives

The general aim of this research is to determine the most effective method of current AI as applied to the task of algorithmic co-composition and evaluate its quality. This is given by the following set of specific objectives:

- Identify the set of related tasks in co-composition for which automation is likely to cause the most positive impact and current AI is not incapable of performing to some degree
- Survey current methods for algorithmic composition that target these areas and are interactive or may be adapted to work interactively, and identify those that demonstrate the greatest proficiency in these areas

- Experimentally evaluate the overall efficacy of these methods applied collectively through both objective and subjective analysis

1.4 Workpackages

2 Budget

3 Justification For Resources

4 Impact Statement

The primary impact of this research is to create a prototype of a new form of tool for composers that may increase productivity significantly, bestowing major advantages to the music industry. In order to achieve this it is necessary to develop this research in close contact with industry professionals, so that we may work directly towards the requirements of potential users of this technology. Specifically we will be working with various musical artists to achieve a

5 Workplan

References

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