The Map of Mozart

Rudolf Mayer, Thomas Lidy, Andreas Rauber
Vienna University of Technology
Department of Software Technology and Interactive Systems
{mayer, lidy, rauber}@ifs.tuwien.ac.at

Abstract

We present a study on using a Mnemonic Self-Organizing Map for clustering a very homogeneous collection of music. In particular, we create a map containing the complete works of Wolfgang Amadeus Mozart. We study and analyze the clustering capabilities of the SOM on this very focused collection. We furthermore present a web-based application for exploring the map and accessing the music it represents.

Keywords: Self-Organizing Map, Clustering, Explorative Search

1. Introduction

The Self-Organizing Map (SOM) [1] has been successfully applied in the field of Information Retrieval in general, and specifically also in the area of Music Information Retrieval, as for example in the SOM-enhanced JukeBox (SOMeJB) [5]. In this paper, we present our work with a specific collection of music, which is characterized by being very homogeneous. We took the 250th anniversary of Wolfgang Amadeus Mozart as motivation to create an intuitive visualization and interface to his complete works.

2. Self-Organizing Maps

The Self-Organizing Map (SOM) [1] and related architectures enjoy considerable popularity for data mining applications. This is due to their ability to generate a topology-preserving mapping from a high-dimensional input space to a lower dimensional output space. The data thus structured and organized enables an easier interpretation of complex inherent structures and correlations in the data. In many applications the output space is constituted by a two-dimensional rectangular or hexagonal grid. This provides a representation which is easy to read and interpret. A number of techniques for visualizing the maps have been suggested to further assist the user in interpreting the maps. In our work, we are specifically using the Smoothed Data Histograms (SDH) [4] for representing the cluster structure.

2.1. PlaySOM and PocketSOMPlayer

SOMs may be used to offer explorative access to music collections. They are used in the PlaySOM and PocketSOM applications [3], where the user can interactively browse and zoom trough the data space, and select playlists on the map on desktop and mobile devices. For our studies, we will use a slightly modified version of this method, namely Mnemonic SOMs.

2.2. Mnemonic SOMs

For memorizing the orientation of a map, i.e. the location of different genres of music on the map, and for explaining to the user where those genre clusters are located on the map, a rectangular map might be sub-optimal. Therefore, in this study we used a modification of the SOM, the so called Mnemonic SOM [2]. This modification is based on using not rectangular maps, but recognizable shapes in the form of countries, geometrical figures, and similar. In our specific case, we use a map based on the silhouette of Mozart's head.

2.3. Rhythm Patterns Features

In order to be able to arrange the pieces of music thematically on the SOM, their content first needs to be represented in the form of a vector of characteristic features. For our experiments, we use a set of features that is based only on the audio content of the music, the Rhythm Patterns (RP) [5]. This feature set includes psycho-acoustic processing and describes the loudness amplitude modulation for a range of modulation frequencies on 24 critical frequency bands. A Rhythm Pattern feature vector consists of 1440 dimensions. Capturing fluctuations on all human audible frequency regions, it is capable not only to discover rhythmics, but also timbral features and thus recognizes different instrumentation in music.

3. Music Collection

The music collection we used in our experiments are the complete works of the composer Wolfgang Amadeus Mozart. This collection contains 2.442 tracks, consisting of different genres such as Operas, Symphonies and Sonatas. The data has been manually classified into 17 different classes. We use this class information to enhance the different visualizations we provide. An overview of these classes and the number of pieces for each class is given in Table 1.

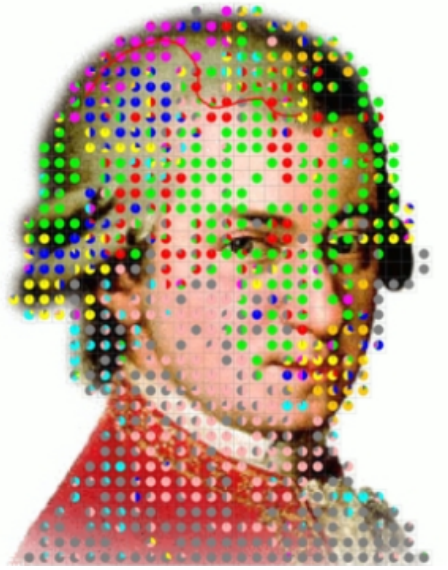

Figure 1. Map of Mozart with class information.

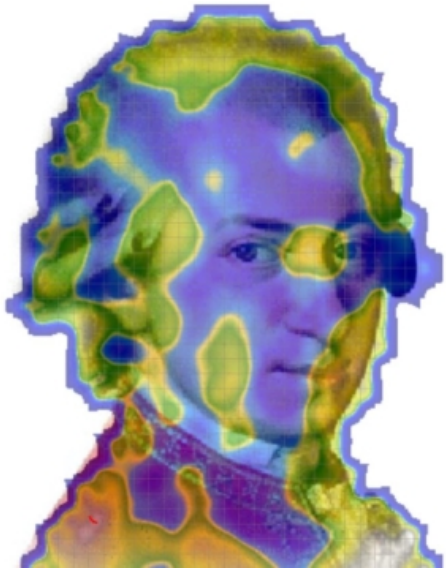

Figure 2. Map of Mozart with image and SDH visualization.

Table 1. Classes of Mozart's Music

Class name	# Pieces
Symphonies	144
String Ensembles	130
Sacred Works	324
Serenades	77
Dances	207
Songs	33
Church Sonatas	17
Horn, Oboe, Clarinet Ensembles	10
Piano Ensembles	30
Concertos	159
Keyboard Works	146
Operas	768
Divertimenti	169
Canons	41
Concert Arias	53
Flute Quartets & Sonatas	27
Violin Sonatas	107

4. Map of Mozart

In our study, we mapped the music collection onto a Mnemonic SOM in the shape of the silhouette of its composer. As visualizations, the user can choose between three different variants: (1) the map with the image of Mozart as background, as depicted in Figure 1; (2) only the shape of Mozart with the SDH visualization; and (3) a combination of both, a semi-transparent SDH on the image, as shown in Figure 2. Additionally, the user can choose to show the distribution of the classes the pieces of music belong to.

To make the PlaySOM application more easily accessible, an HTML version has been created. Even though this version allows less ways of interaction, the user can still easily navigate through all the pieces of music on the map, and select music to listen to. The Map of Mozart can be explored with limited amounts of music available on-line at `http://www.ifs.tuwien.ac.at/mir/mozart`.

One can find, for example, the string ensembles in the region of Mozart's right ear, while the dances are arranged left-above of the string ensembles in the region of the back of the head. Almost all operas composed by Mozart are located in the lower part of the map. The operas are further divided into different regions, for example recitatives, located in the region of Mozart's neck. A cluster of piano music can be found on the top edge containing piano sonatas and piano concerts. It becomes apparent that the clustering abilities of the SOM and the features extracted by the Rhythm Pattern algorithm are still working on an as homogeneous dataset as this specific music collection by Mozart. Moreover, the Mnemonic Map of Mozart offers attractive and eye-catching visualizations to the user, and a playful alternative to the Köchel-Verzeichnis for exploring Mozart's music.

References

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