10 July 2005

Music Discover

Progress Report of Arie Livshin, IRCAM

Tâche 2. Reconnaissance des instruments de musique et indexation

In my multi-instrumental recognition system, I separate a multi-instrumental sound mixture into the different notes and then use a classifier trained on solos to recognize the instrument playing each of these notes.

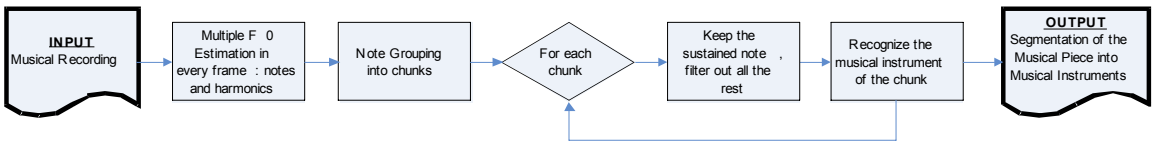

Diagram 1. The instrument recognition system for multi-instrumental, polyphonic music

I begin by using a multiple-f0 detection process by Chunghsin Yeh of IRCAM (Yeh, Röbel and Rodet 2005) to get an estimation of the fundamental frequencies and corresponding harmonics of the notes in every time frame of the musical piece. Next, consecutive time frames containing the same quantized pitch are grouped together into "chunks". Thus, each chunk of frames contains one note which is sustained throughout the chunk and is presumably performed by a single instrument, and some other notes playing along with it.

Next, the sustained note and its corresponding harmonics are retained while the rest of the spectrum is filtered out using a phase vocoder.

The filtered chunks are each classified by my real-time solo recognition process. The classifications of the chunks form an instrument mapping ("segmentation") of the musical piece (we exemplified this process on duos in Livshin and Rodet 2004b).

The recognition system is being constantly updated and new pattern recognition techniques are being integrated and evaluated. Different instrument-specific feature descriptors are developed and tested at the solo recognition stage.

Note that the filtering phase of this process is very relevant to '**Tache 3 - Séparation de sources**'. Unlike the work of LTCI which concentrates on source separation of drum sequences, my program performs source reduction/separation on mixtures of sounds of harmonic instruments, e.g. authentic classical-music performances.

Livshin, A., Rodet, X. (2004b). *Indexing Continuous Recordings*, Proc. 7'th international conference on Digital Audio Effects (DAFx 2004), pp. 222-227, Naples, Italy.

Yeh, C., Röbel, A., Rodet, X. (2005). *Multiple fundamental frequency estimation of polyphonic music signals,*, Proc. IEEE, International Conference on Acoustics, Speech and Signal Processing (ICASSP'05), Philadelphia, USA.

Website

I have created a web-site for the MusicDiscover project in cooperation with Chunghsin Yeh of IRCAM. The site is divided into a public section which describes the project for

the general public and a private section accessible with a password, which contains the private documents and various files used by the project participants.
URL: http://recherche.ircam.fr/equipes/analyse-synthese/musicdiscover

Bases de données

A solo-recognition evaluation database ("musical phrases") was created in cooperation with Slim Essid of LTCI.
The lack of a common evaluation database for musical instrument recognition is an old problem which was never properly addressed. Our database finally offers a common testing bed for researchers who wish to compare their different techniques and algorithms for performing instrument recognition on solo musical phrases.

The database contains a total of 68 solos of 16 musical instruments – bassoon, cello, clarinet, double bass, French horn, oboe, saxophone, trombone, trumpet, tuba, viola, violin.
In order to avoid copyright issues, each solo piece is a 30-seconds extraction from the original musical piece, from which all silent parts were removed.

Demo programs

I understand that there are plans to create a demo program for the MusicDiscover project which will demonstrate its various aspects. I have created a friendly graphical program for instrument recognition in solos in real-time which we could use for this purpose. Another very similar program of mine demonstrates instrument recognition and segmentation in duets, although not in real-time.
These programs were used successfully in different presentations and demonstrations although screenshots have not been published.

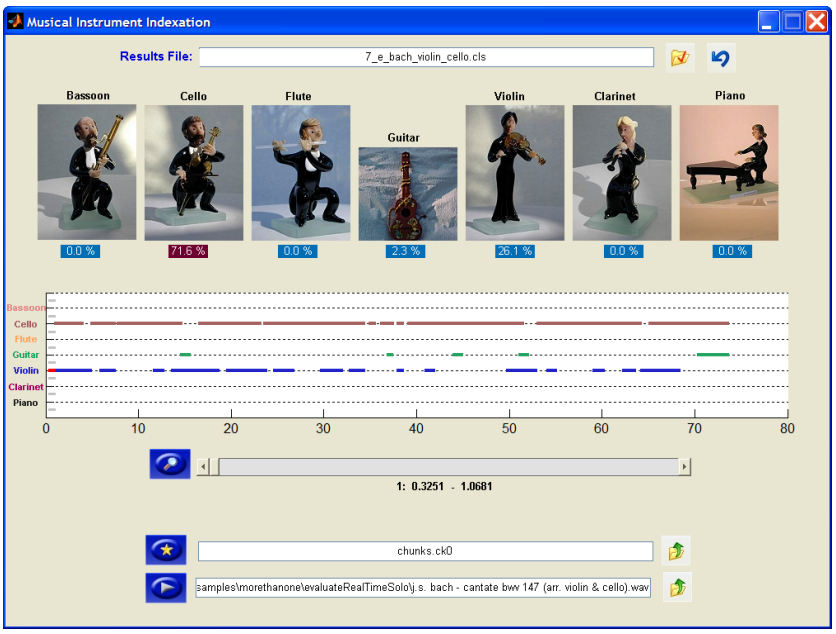

Diagram 2. An example screenshot of the duo instrument recognition program