FINAL PROJECT – MUMT 621

Project proposal

Applications of the wavelet transform in Music Information Retrieval

Introduction

The wavelet transform is now a well-known signal processing method. It has found numerous applications in the domain of Image processing, where it has been used in successful algorithms for problems like image compression, image denoising, or image reconstruction. In all this cases, it appears to be one of the more efficient methods if one starts with no prior information about our picture.

Furthermore, Neurosciences research in the field of vision showed that there are a probable link between the neural treatment of the image stimuli and the wavelet transform. That theory explained the human ability to extract quickly picture contours.

The principle of the wavelet transform is quite simple. Rather than using filters to split the signal in successive bands, like in the Short-Time Fourier Transform, we now filter the whole signal with different frequency/time-resolution filters. This property draws on the spectrogram information related to steady states (low time resolution) or very variable states (high time resolution).

All this considerations lead us to the question of the applications of this transform in the field of music, and in particular the domain of music information retrieval. The contrast between the extensive use of it in image processing, compared to its few applications in music processing is curious and we would like to look at the different attempts that were made to implement it in music information retrieval problems.

Project

The project divides into 2 main tasks

- an extensive review of the different applications of the wavelet transform in music information retrieval, looking in particular into the ISMIR proceedings
- an attempt to apply this transform on a MIR problem such as:
    - Optical music recognition: the demonstrated ability of the wavelet transform to extract and suppress linear features on images could be used for staff line removal. Different levels of difficulties could be analysed, from the printed score to the hand-written one
    - Transient detection: the wavelet transform is able to extract time with strong signal variations or moments of steady states. This ability could be used in coordination with other algorithm requiring such testing for synchronising events, such as in sound-to-MIDI transcription.
    - wavelet feature extractor: a feature extractor module for the Music Information Retrieval framework jMIR could be developed to add a new kind of features to those already available

Bibliography

Ghias, Asif, Jonathan Logan, David Chamberlin, and Brian C. Smith. 1995. Query by humming: musical information retrieval in an audio database. *Proceedings of the third ACM international conference on Multimedia*: 231–236.

Grimaldi, M., P. Cunningham, and A. Kokaram. 2003. A Wavelet Packet representation of audio signals for music genre classification using different ensemble and feature selection techniques. *Proceedings of the 5th ACM SIGMM international workshop on Multimedia information retrieval*.

Kronland-Maninet, R., I. Morlet, and A. Grossmann. 1987. Analysis of sound patterns through wavelet transforms. *International Journal Pattern Recognition Artificial Intelligence* 1 (2): 97–126.

Lambrou, T., P. Kudumakis, R. Speller, M. Sandler, and A. Linney. 1998. Classification of audio signals using statistical features on time and wavelet transform domains. *Proceedings of the International Conference on Acoustics, Speech and Signal Processing* 6: 3621–4.

Li, G., and A. Khokhar. 2000. Content-based indexing and retrieval of audio data using wavelets. *Proceedings of the International Conference on Multimedia and Expo* 2: 885–8.

Lin, C., S. Chen. T. Truong, and Y. Chang. 2005. Audio classification and categorization based on wavelets and support vector machine. *IEEE Transactions on Speech and Audio Processing* 13 (5): 644–51.

Tzanetakis, G., A. Ermolinskyi, and P. Cook. 2002. Pitch histograms in audio and symbolic Music Information Retrieval. *Proceedings of the International Society for Music Information Retrieval Conference*.

Tzanetakis, G., G. Essl, and P. Cook. 2001. Audio analysis using the discrete wavelet transform. *Proceedings of the Conference in Acoustics and Music Theory Applications*.

Vacher, M., D. Istrate, and J. Serignat. 2004. Sound detection and classification through transient models using wavelet coefficient trees. *Proceedings of the European Signal Processing Conference*.

Woojay, J., M. Changxue, and C. Yan. 2009. An efficient signal-matching approach to melody indexing and search using continuous pitch contours and wavelets. *Proceedings of the International Society for Music Information Retrieval Conference*: 681–686.