

# Research Proposal Summary

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Subject : **Automatic Detection and Extraction of Musical Rhythm**

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## 1 Context

The automatic detection and extraction of musical rhythm is a flourishing research field. This problem might seem at first very simple: most people, even those without any musical knowledge, do not have any difficulty in foot-tapping along with a music track. Nevertheless, the problem of automatic rhythm recognition is very difficult when dealing with a large variety of musical genres. Disposing only of the signal's temporal waveform, the goal is not only to find the beat rate but also to provide the more complex rhythmic structure which appears in a musical composition. Of particular interest is the concept of bar boundary, which can contain two, three, four or more beats.

## 2 Research

The objective of my PhD work is the search for detection and recognition tools to obtain the rhythmic structure of a musical piece. An important part of my first PhD year was devoted to learn the state of the art of automatic rhythm processing. During that time, I learned that one of the key concepts is *beat*. For this reason, most of my work so far has been the development of beat estimation techniques. This subject is very important for a large number of applications such as: musical analysis, automatic rhythm alignment of several musical instruments, cut and paste operations in audio edition, beat driven special effects. In the course my PhD I have proposed some algorithms that share various elements with other tempo estimation systems. One of the originalities of my research is to perform tempo estimation on the harmonic/noise decomposition of the audio signal using noise subspace projections. Then beat detection is carried out on the noise component of the signal. More recently, in an article submitted to ISMIR 2004 we have defined the concept of Spectral Energy Flux as the derivative of the signal frequency content with respect to time. This yields to an efficient musical note onset detector that combined with pitch-estimation techniques to estimate periodicity lead to an effective beat-tracking system.