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Summary of the research proposal

Introduction

My name is Pau Arumi, I got the degree in computer science engineering for *Facultat d'Informatica de Barcelona* (FIB), of *Universitat Politecnica de Catalunya* (UPC) in 2002. In the final years, I took the specialization branch on algorithms, AI and software engineering.

Besides being interested in computer science, I have also a strong interest in music (composition and productin). That is why I approached the Music Technology Group (MTG) of the IUA-UPF in 2001 and did my Master Thesis there.

My research interest might be set on two orthogonal axis. First, the software engineering field, with emphasis in good object-oriented design techniques, and agile development methodologies. And secondly, the domain of sound and music; more specifically, in the computational models that are suitable for this domain.

I've been working on CLAM (*C++ Library for Audio and Music*, developed in the MTG) almost from its beginning and I'm very involved and motivated in its development. I think the framework has already proved useful. Still, it faces some difficult issues that would greatly benefit of a serious research. Thereof, this is the context in which I'd like to do my research. Being CLAM the main testbed for testing concepts and design principles (and also a beneficiary of its outputs)

The subject of research in more detail : Actor-oriented models of computation for the sound and music domain

Basically, data-flow or actor-oriented contrasts with (and complements) object-oriented design by emphasizing concurrency and communication between components. The components have a well defined interface that restricts how an actor interacts with its environment. Central to actor-oriented is the fact that actors interact by sending messages through channels they are connected to.

Not the only, but probably the best, example of research effort in this field is the Ptolemy-II project from *Berkeley University*. With focus on embedded systems, Ptolemy-II experiments and explores in depth a number of models of computation. Related to this project, very relevant scientific articles and PhD. thesis (and open source software, as well) have been published. And although it doesn't fall into the domain which I'm personally interested (sound and music), it provides an important foundation base.

Audio and music processing, has been proved a suitable domain for actor-oriented modeling -- indeed, there is a big number of projects that takes this approach; CLAM, for instance. But, at the

same time, is also an specially difficult domain. Difficulties arise specially when we want our model to be very flexible and expressive.

Although some other frameworks are going into that direction --*Marsyas* (*Princeton University*) and OSW (*Berkeley University*) for instance-- there are still some types of applications that need more expressiveness than the provided by these frameworks.

Some examples of that kind of expressiveness difficult to deal with, are:

a) signal processing happening both in the low and the high level, for example: transformations of low-level signal (i.e. audio) driven by high level (musical-features)

b) extract high level descriptions from audio in a flexible way

c) real time and streaming processing with low back-to-back latency

d) time restrictions: real time precessing with a variety of "times": time imposed by hardware devices clocks, virtual times (sheet music tempo), different execution rates in different actors, etc

I find difficult to predict which will be the exactly my research line in the future years of my PhD. It is likely that, it will incorporate some related areas which I'm also interested. For example:

- Design pattern languages (related to our actor-oriented models)
- Fast application prototyping
- Object oriented framework design and evolution
- Agile methodologies for frameworks development.
- Agile methodologies in conjunction with open-source.