Visual Design Tool Interfaces for AM-FM Image Modeling

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Abstract: In this paper, we describe our integration of an existing AM-FM image modeling code base with the Ptolemy and Khoros environments. Khoros is an environment for rapid prototyping and algorithm development, and Ptolemy is a software infrastructure upon which specialized design environments can be built. The Ptolemy implementation demonstrates the ability to parallelize the AM-FM modeling algorithms, and would be useful in designing a real-time, embedded implementation of the algorithm. The interface to Khoros is designed for ease-of-use, so that it can be used to rapidly develop the AM-FM modeling algorithms themselves or applications which might benefit from AM-FM analysis.

1. Introduction

An AM-FM (Amplitude and Frequency Modulation) image representation is similar to the Fourier frequency domain representation in that a set of coefficients is found to model the signal. However, instead of scalar weightings of linear phase sinusoids, AM-FM representations allow *spatially varying* weightings of complex exponentials with *spatially varying* phase. Joe Havlicek wrote his Ph.D. thesis on this subject, and he developed libraries written in C to perform the computation of AM-FM representations. Our aim was to implement this algorithm in Khoros and Ptolemy. Khoros is an environment for rapid prototyping and algorithm development, and Ptolemy is a software infrastructure upon which specialized design environments can be built. Therefore, Khoros could be used to develop the algorithm or applications of the algorithm, and Ptolemy could be used to find real-time or embedded system implementation.

2. Overview of Multi-component AM-FM Image Modeling

In order to describe the project fully, it is necessary to discuss AM-FM modeling techniques in detail sufficient to explain the algorithms that we implemented. The goal of multi-component AM-FM image modeling is to represent an image as a sum of amplitude and frequency modulated complex exponentials which we will call AM-FM *components* of the image. So we model an image $\mathrm{t}(\mathbf{x})$, where $\mathbf{x}$ is a two dimensional vector indicating spatial location, according to

$$\mathrm{t}(\mathbf{x}) = \mathrm{Re}\left\{\sum_{n=1}^{N} \mathrm{a}_n(\mathbf{x}) \cdot \exp\left(j\varphi_n(\mathbf{x})\right)\right\}$$