

# Warm Chorus - Demo

Aku Rouhe, Niklas Sallinen  
Aalto University School of Electrical Engineering  
Department of Signal Processing and Acoustics

niklas.sallinen@aalto.fi

## Abstract

*The Abstract*

**Keywords** — Keyword 1, keyword 2

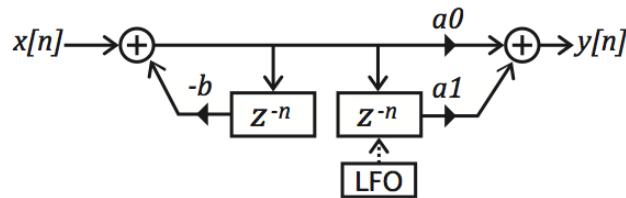
## 1 Introduction

## 2 Theory

### 2.1 Generic Chorus

Generic chorus algorithm is based on simple idea that copies the original sound and then delay different copies with different delays and the slightly detune them. The very basic chorus is just parallel delay lines wich are modulated with low-frequency oscillator (LFO) to get some detuning.

Industry standard chorus is is slightly different and even more simple but better sounding. It consist of one feedback delay line and one feedforward delay line whose are modulated with LFO as in the case of basic chorus. Block diagram of the industry standard chorus is shwn in the figure 1



**Figure 1:** Block diagram of industry standard chorus. [1]

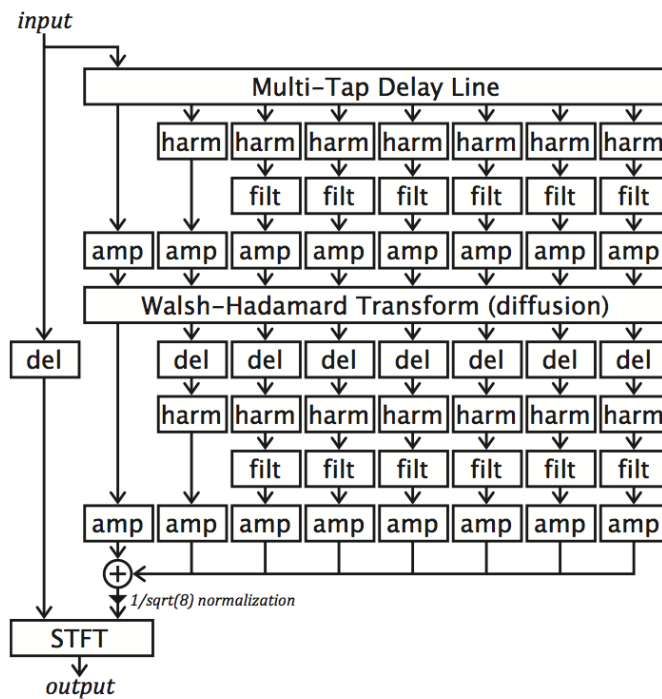
Usually in chorus applications the parameters that can be adusted are not real life related. Usual parameters are for example modulation depth, modulation speed and feedback gain.

## 2.2 Orchestral Section Model

Orchestral section model is based on real orchestra section and it takes account placement and playing skills of players. Meaning that the different players play different amount out of tune and usually the worst players are placed in the back of the section. [1]

This is completely new way of thinking about chorus as its interest are based on physical modeling rather than computational tricks. As the current chorus has parameters as modulation depth and modulation speed orchestral section model has more real life parameters. Dudas' warm chorus algorithm is mainly based on such a model [1].

## 3 Implementation

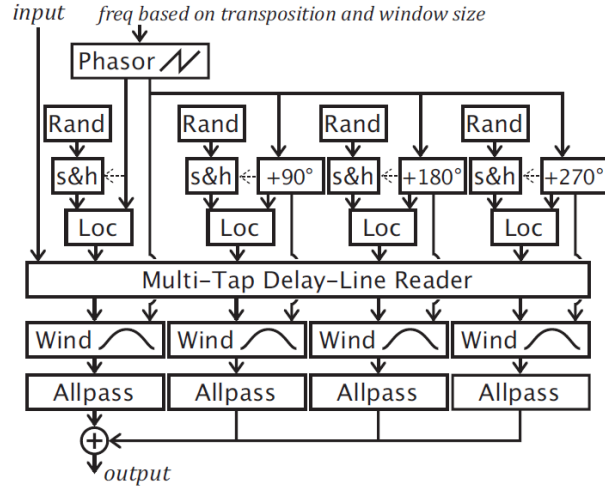


**Figure 2:** Block diagram of the warm chorus algorithm. [1]

### 3.1 Harmonizer

Harmonizer is structure which detunes input signal slightly to get different "players" play slightly out of tune as in the real orchestra section. The block diagram of the harmonizer is shown in figure 3

In harmonizer structure there are four channels which are windowed with four sinusoidal windows that are 90 degrees more out of phase than previous. To decrease the beating effect that is present in the current chorus there is added some random variance to the detuning of the sound. That means that each window is slightly differently out of tune. That is as



**Figure 3:** Chorus Harmonizer Block Diagram. [1]

well related to the real world as the players usually do not play whole music piece in same detuning. [1]

The detuning is made with multi-tap delay-line which is modulated with phasor signal which is basic sawtooth wave form. After that each channel is windowed by using Hanning window and after that it is allpass filtered. The windows are triggered with phasor signal and it as well triggers the randomization for each window. After allpass filtering all the channels are summed together. [1]

## 4 Results

## **5 Conclusions**

Conclusions text.

## References

- [1] Warm Chorus...